RARE AND THREATENED VEGETATION OF THE CALIFORNIA NORTH COASTAL BASIN:

A Regional Inventory

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Produced
by

Legacy-The Landscape Connection
1999

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Acknowledgements

This document has been greatly enhanced by the input, insight, and support of many people. Vegetation ecologists John Sawyer and Todd Keeler-Wolf, both of whom have contributed greatly to the general understanding and conservation of California vegetation, graciously offered their time and expertise regarding various aspects of this project. Special thanks also go out to Allen Cooperrider and Gordon Leppig for reviewing early drafts of the document and providing constructive criticisms and helpful suggestions to improve it. Curtice Jacoby provided technical assistance investigating various digital data-bases for this project. Max Sugihara and Karen Youngblood helped with maps. The cover art was crafted by my father, Garry Green. I also thank Jennifer Bloeser, my wife, for her help in overcoming technical challenges associated with the project and her overall loving support.

This project was made possible by funding from the Foundation for Deep Ecology.

Introduction

Regional Conservation

An ecological **region** is a part of the earth characterized by distinctive physical and biological features. Regions reflect unique natural histories and encompass important landscape-level processes that drive biological diversity. In a cultural sense, human inhabitants relate to and depend upon the ecological landscapes in which they reside. This woven fabric of physical, biological, and cultural features underscores the necessity of regional approaches to maintaining native biodiversity. Conservation efforts currently being organized within the California North Coastal Basin (CNCB) stem from this basic premise.

Legacy-The Landscape Connection (Legacy-TLC), a non-profit organization based in Arcata, California, formed in 1992 with the goal of "providing information that helps citizens protect and restore the ecological integrity" of the Klamath Ecoregion. The group has initiated efforts to identify, map and assess significant ecological elements within the CNCB, and is developing a biodiversity database to storehouse that information. It is hoped that this data-base will facilitate informed decisions concerning biological resources of the region, and additionally, provide a basis for developing long-term biodiversity conservation strategies.

Vegetation of the California North Coastal Basin

One of the many striking biological features of the CNCB is its floristic diversity. This diversity is reflected in the abundance of rare plants and unique plant assemblages that characterize the region. The CNCB encompasses most of the world's coastal redwood forest, including old-growth stands that rank among the highest in the world in terms of total biomass. The region includes other relict conifer forests that were once more widespread in North America. Several endemic native grass communities occupy the coastal terraces, prairies, and sand dunes that characterize the regional landscape. Freshwater stream, pond, and marsh habitats of the region are inhabited by rare riparian vegetation. Coastal salt and brackish marshes contain assemblages of plants which have been largely eliminated from other areas in the state. In terms of its vegetation, the California North Coastal Basin is clearly of global significance. The region is also integral to the rich natural heritage of a state known worldwide for its tremendous floristic diversity.

Inventory Purpose and Objectives

The purpose of this document is to provide information that will help citizens and resource managers identify, protect and restore rare and threatened vegetation in the California North Coastal Basin. It addresses floristic diversity primarily at the series-level, but contains information that will be useful in both broader and finer-scale approaches to conservation. The primary project objectives are to: 1) identify series of the CNCB that are uncommon, rare and threatened on a statewide and/or global scale, 2) identify habitats and community types associated with high numbers of uncommon, rare, and threatened series within the region, 3) recommend strategies for identifying and protecting rare and threatened vegetation, and 4) present this information in a format that is useful to citizens, scientists, educators, and others interested in the rare and unique vegetation of the region.

How this Document is Organized

This document is roughly divided into several parts. The first part (pp. 1-8) introduces the California North Coastal Basin, outlines the methods used to conduct this inventory, and explains how to interpret Inventory tables. The second part (pp. 9-16) lists rare, threatened, and uncommon series of the CNCB, classifies each according to its level of rarity, provides important background information on each type, and identifies habitat/community types associated with high numbers of listed series. Inventory findings are summarized, recommendations made, and literature cited in the third part (pp.17-19). Lastly, the Appendix includes an hierarchical framework for understanding the relationships between rare vegetation types and borrows from *A Manual of California Vegetation* (Sawyer and Keeler-Wolf 1995) to provide detailed series descriptions and to discuss the conservation of California vegetation.

Sources of Information

This document synthesizes information about California's vegetation as it pertains to the state's North Coastal Basin. It draws heavily from several sources focusing on California vegetation and flora, especially *A Manual of California Vegetation* (Sawyer and Keeler-Wolf 1995). Other sources include the unpublished *Preliminary Descriptions of the Terrestrial Natural Communities of California* (Holland 1986), the unpublished *List of California's terrestrial natural communities recognized by the California Natural Diversity Data Base* California Natural Diversity Data Base 1997), *The Jepson Manual* (Hickman 1993), *The Distribution of Forest Trees in California* (Griffin & Critchfield 1972) and *The Terrestrial Vegetation of California*(Barbour & Major1977).

The California North Coastal Basin

The California North Coastal Basin (see Figure 1 on page 3) is a hydrologic region of extreme northwest California. It is comprised of all westward draining watersheds of the northern Coast Ranges between Bodega Bay and Redwood Creek, and is here defined to include coastal marine terraces extending northward to Oregon. Major watersheds include Humboldt and Bodega bays, the Russian, Eel and Mad rivers.

Geologically, the CNCB landscape is dominated by the Northern Coast Ranges, which are formed by the uplifted Franciscan Formation and comprised of highly erodible sedimentary rocks. The highest mountains within the region (South Fork Mountain and the Yolla Bolly's) extend to between 5,000 and 7,000 ft. in elevation and may be covered in snow for many months during the year. Sand dunes, marine terraces, coastal bluffs, and estuaries are prominent features of the coastal lowlands.

The maritime climate of the CNCB is Mediterranean and typified by cool wet winters and mild dry summers. Over seventy percent of the seasonal rain occurs between November and March. Summer precipitation in the form of fog is an important phenomenon in coastal areas.

The California North Coastal Basin falls within the California Floristic Province, but is also considered part of the Pacific Northwest coastal temperate rain forest region extending northward into Alaska. Broadly defined habitat/community types of the CNCB include redwood and associated coastal forests, mixed evergreen forests, oak woodlands, chaparral, coastal prairies, north coastal scrub, beach and dune vegetation, coastal salt marsh, closed-cone pine and cypress forests, and montane and subalpine vegetation (Barbour and Major 1977).

Figure 1: The California North Coastal Basin[1]

[1] Coastal marine terraces extending from Redwood Creek to the Oregon border are not included on this map, but are covered by this inventory.

Vegetation Classification

Vegetation Classes

Vegetation consists of "all the plants in an area and the way they are arranged" (Sawyer and Keeler-Wolf 1995), and it is defined by *structural* and *floristic* elements. **Structure** refers to the physical arrangement of the plants that form vegetation. **Flora** refers to all the plant species comprising vegetation. Many current mapping and landscape classification efforts specific to the CNCB emphasize structural elements of vegetation. New approaches to landscape classification are clearly needed to better resolve floristic diversity in regional assessments.

If the goal is to protect unique vegetation, one might rightly ask, where do we begin? A preliminary but important step is to recognize a standard definition for the critical units of diversity we are striving to protect. The California Native Plant Society has recently developed a floristically driven system of classification that defines the *series*, and at a finer scale the *association*, as the fundamental units of vegetation. Both the scientific credibility and utility of the CNPS system are underscored by the fact that the U.S. Forest Service, Bureau of Land Management, Biological Resources Division of U.S.G.S., U.S. Fish and Wildlife Service, and the California Biodiversity Council have all accepted the CNPS classification as the new standard for the state (Keeler-Wolf and Barbour1997). Furthermore, the CNPS classification relates to practical conservation needs in California and to a national standard classification of vegetation being implemented by The Nature Conservancy (TNC) and numerous federal agencies.

The Series

A *series* is a unit of vegetation named after the plant species (or genus) that is dominant in the layer with the greatest amount of cover (Sawyer and Keeler-Wolf 1995). The dominant *layer* consists of **trees** in forests and woodlands, **shrubs** in chaparral and scrub communities, and **herbaceous** plants in grasslands and other non-woody communities.

The series (and at a finer scale the *association*) is a fundamental unit in the California Native Plant Society's vegetation classification system. The quantitative basis that underlies the series concept is an important and practical feature that enables people to objectively identify (or discredit) vegetation as being unique and worthy of protection. By creating a standard language based on meaningful floristic units, the CNPS classification facilitates collaborative efforts to identify and preserve unique vegetation, as well as to provide protection under environmental laws.

Each series is comprised of one or more floristic a*ssociations*; fine-scale units of vegetation based on groups of species that commonly co-occur. Associations are typically defined to include characteristic understory species as well as overstory dominants. While associations constitute meaningful units of floristic diversity at a fine-scale, their use in regional conservation planning is often limited by financial, political and pragmatic constraints.

The Sub-series:
It is important to note that while the series concept provides a standard definition for the critical unit of concern, the units themselves encompass varying levels of diversity. The Redwood series, for example, represents a forest type that exhibits far more floristic and ecological variation than, say, the California bay series. However, this variation is not always reflected in the diversity of associations which comprise a particular series. One problem with the CNPS classification is that

it currently lacks a mechanism for treating cases in which important elements of diversity neither fit formal series definitions, nor are adequately encompassed or expressed at the association-level.

In order to resolve such important differences, this inventory recognizes vegetation *sub-series* (literally, "below the series-level") that constitute important elements of diversity somewhere between the series and association-levels. The purpose of recognizing the sub-series as a vegetation class is not to create yet another set of criteria for defining vegetation units, but rather to acknowledge important ecological variation and place it within the hierarchy of the existing CNPS classification.

Sub-series level vegetation types can reflect variation in overstory composition, geographic location, habitat specificity, ecological function, stage of development, history (land-use or otherwise), or some combination of all the above. The treatment of sub-series in this document is not exhaustive; rather, I include only distinct types which have been recognized by others (Holland 1986;), are implied by the range of plot-based descriptions (Sawyer and Keeler-Wolf 1995; California Natural Diversity Data Base 1997), or comprise a particular stage of forest development that is rare. Further work is needed to adequately describe variation at the sub-series level.

This document considers only two important kinds of sub-series; *ecotypes* and *phases*. An **ecotype** is a sub-series that occupies a specific habitat, or which is typically found under a certain set of environmental conditions. For the purposes of this document, ecotype is defined broadly to include geographic variation in the distribution of a series. Ecotypes can be distinct with respect to overstory species composition, and may reflect unique adaptive potential. Examples include the alluvial Redwood, north coast Black cottonwood, and coastal Tufted hairgrass sub-series. A **phase** is a specific stage of vegetation development, usually characterizing forest stands or woodlands, that exhibits distinct structural, functional, or temporal dimensions. Examples include the old-growth Redwood and non-successional Red alder sub-series. Additionally, this document considers one *super-series*--a complex of series that typically mix at a fine spatial scale, or which are otherwise difficult to distinguish from one another (i.e. Northern coastal scrub, and various willow series, respectively).

Holland Communities

Prior to CNPS's series-level classification system, Robert Holland's unpublished classification of terrestrial natural communities of California provided a basis for The Nature Conservancy (TNC), California Fish and Game, and other agency efforts to protect and manage rare vegetation throughout the state. The fundamental units of Holland's classification, "natural communities", are anecdotally defined in terms of habitat, geography, elevation, physiognomy and/or vegetation. Examples of Holland community types that occur in the CNCB are Alluvial Redwood Forest, Northern Riparian Scrub, Coastal Terrace Prairie, Northern Coastal Salt Marsh, North Coast Black Cottonwood Riparian Forest, Northern Interior Cypress, and Active Dunes.

The primary shortcomings of the Holland classification are: 1) the lack of uniform criteria in distinguishing the "community" as a fundamental unit, 2) overlapping community descriptions, and 3) uneven resolution with regard to the scale of vegetation that defines each community (Keeler-Wolf 1993, cited in Sawyer and Keeler-Wolf 1995). Additionally, Holland's system lacks the quantitative basis that is necessary to scientifically define vegetation and justify its protection under environmental laws.

Regardless of its shortcomings, Holland's system provides a useful and intuitive model for identifying and interpreting patterns of diversity across the landscape. One advantage of the system is that it differentiates among similar but geographically distinct subtypes. Also, to the extent that citizens, agencies, and lawmakers find it more compelling to deal with a few large units rather than many local variants that must be defined on arguably technical grounds, the Holland system has pragmatic value to conservation. The need for a more standardized system, provided by the California Native Plant Society, should not prevent us from assimilating useful aspects of the Holland classification into conservation planning at the landscape scale.

Identifying Rare and Threatened Vegetation of the CNCB

Overview of Methods

The purpose of this inventory is to identify and characterize rare and threatened vegetation of the CNCB at the series and sub-series levels. The specific focus is on vegetation that is rare and threatened on a global and/or statewide scale. In order to do this in a systematic and defensible manner, I relied heavily upon rare and threatened "status ranks" originally developed for Holland community types. Each series was selected or rejected as rare and threatened based on status ranks of associated Holland communities and relationships between the two classifications.

Heritage Program Status Ranks

Nature Conservancy (TNC) Heritage Program status ranks for global rarity, state rarity, and threat, originally developed for Holland's terrestrial natural communities (Holland 1986) and later used by California's Natural Diversity Data Base, are shown below:

Global ranks
G1: Fewer than 6 viable occurrences worldwide and/or 2,000 acres
G2: 6-20 viable occurrences worldwide and/or 2,000-10,000 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 worldwide abundance

State ranks
S1: Fewer than 6 viable occurrences statewide and/or 2,000 acres
S2: 6-20 viable occurrences statewide and/or 2,000-10,000 acres
S3: 21-100 viable occurrences statewide 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 ranks
0.1: Very threatened
0.2: Threatened
0.3: No current threats known

Cross-walking Status Ranks

Heritage Program status ranks generally do not translate directly to the CNPS series-level classification. For example, the Hooker willow series is a component of three different Holland communities (Freshwater Swamp, Red Alder Riparian Forest and North Coast Riparian Scrub), each with a unique set of status ranks. Assessing series rarity and threat in such cases required the reconciliation of unequal status ranks. In other cases (i.e. Beach pine and Pygmy cypress forests), the two systems correspond very closely and status ranks were easily adapted to the series-level.

Selection Criteria

For the purposes of this inventory, series and sub-series were identified as rare and threatened based on their relationship to Holland types for which rarity and threat status ranks have already been developed. Holland communities with a global rarity ranking of G1 or G2 and a threat ranking of 0.1 or 0.2 are considered globally rare and threatened. Holland communities with a state rarity ranking of S1 or S2 and a threat ranking of 0.1 or 0.2 are considered rare and threatened in California. As discussed earlier, applying status ranks at the series level was not always a straightforward process, and in many cases it was necessary to consider supplemental information regarding rarity and threat.

Several cases arose in which a series or sub-series did not meet the strict selection criteria described above, but exhibited other evidence of rarity. In some cases, available information was simply insufficient to make a clear determination of rarity, although evidence points in that direction. A few listed series or sub-series are not officially recognized at this time (Sawyer and Keeler-Wolf 1995), but the author finds reason to believe that they will be recognized in the future. Still other types did not meet selection criteria but are considered rare and worthy of special consideration by the Natural Heritage Division of California Fish and Game (based on global/state rarity ranks of G3/S3 or less; California Natural Diversity Data Base 1997). All such series and sub-series are lumped together in Table 3, identified as “uncommon, rare, or threatened”, and qualified with a need for further research and consideration in conservation planning.

Rarity

It is worth mentioning that there are many different kinds (or causes) of rarity. For example, the Pygmy cypress series is restricted in range by the distribution of unique soils along a short section of the Mendocino coast. Old-growth redwood forests, on the other hand, have been greatly reduced in extent by commercial logging during the last 150 years. Sitka spruce forests are rare in California but more widespread to the north, where more suitable conditions prevail. While the Pygmy cypress series, the old-growth Redwood sub-series, and the Sitka spruce series are all considered rare in this document, both the scale of rarity and the factors driving it are different in each case. Understanding the factors that underlie rarity is important in developing conservation strategies based on patterns of native biodiversity.

Inventory Tables

Information tables are used to organize the results of the rare and threatened vegetation inventory. Table columns relate the series or sub-series name, form, and associated habitats, community types, and physical conditions.

Series or sub-series:
This column lists series and sub-series that meet the rare and threatened criteria discussed earlier. The series name indicates the dominant species or genus in the overstory as measured by cover. Bold-faced parentheses are used to denote sub-series status. The scientific name for the dominant species is italicized and included in parenthesis below each series name.

Form:
This column denotes the physiognomic form (tree, shrub or herbaceous) of the dominant overstory layer and the species or genus for which the series is named.

Community Types/Habitats:
This column lists important community types, habitats, and physical conditions associated with the series.

Rare Habitats and Community Types

Series can grouped together into larger classes based on the habitat they occupy and/or the broad-scale vegetation pattern they partly or wholly comprise. For instance, various willow and alder series occur in *freshwater emergent wetland* habitat, and comprise what is easily identified as *riparian* vegetation. Many habitats and broad community types are easier to identify (remotely *and* on the ground) and map than series-level vegetation. This is especially true at a large spatial scale and when dealing with species that are difficult to identify (i.e. willows, grasses, etc.). Understanding the relationship between broad habitat/community types and rare and threatened series increases our capacity to include elements of floristic diversity in landscape-level assessments and conservation strategies.

The relationship between community/habitat type and rare vegetation is illustrated in Table 4 on page 19. Four-fifths (80%) of the rare and threatened series listed in this inventory are predominantly included in one or more of eight broadly defined but easily recognized habitats or community types. Efforts to locate and map rare and threatened vegetation, both on the ground and from the air, can be effectively guided by this knowledge.

Figure 2. Summary reference list of series and sub-series included in this document. Sub-series are denoted by parentheses, and all types are included in Tables 1-3 on the following pages.

Beach pine series
Black cottonwood (north coast)
Bishop pine
Bulrush
Bulrush-cattail (brackish)
California bay
California oatgrass
Ditchgrass
Douglas-fir—Ponderosa pine (old-growth)
Douglas-fir—tanoak (old-growth)
Fen habitat
Foothill needlegrass
Grand fir
Hooker willow
Idaho fescue
McNab cypress
Mixed willow
Mountain alder
Native dunegrass
Northern coastal bluff scrub[1]
Northern coastal scrub (northern elements)[2]
One-sided bluegrass
Pacific reedgrass
Pacific willow
Pickleweed
Pondweeds with floating leaves
Pondweeds with submerged leaves
Purple needlegrass
Pygmy cypress
Red alder (non-successional)
Redwood (alluvial)
Redwood (old-growth)
Red fescue
Rush
Saltgrass (coastal)
Sand verbena—beach bursage
Sargent cypress
Sitka alder
Sitka spruce
Sitka willow
Tufted hairgrass (coastal)
Valley oak
Western hemlock
Western hemlock (old-growth)

[1] Holland natural community type (Holland 1986).

[2] This type is a subset of the Holland (1986) natural community type.

Table 1: Globally rare and threatened series and sub-series of the California North Coastal Basin.[1]

Series or sub-series	Form	Community types; Habitats
Bishop pine (*Pinus muricata*)	tree	Closed-cone pine forest; coastal terraces, headlands
California oatgrass (*Danthonia californica*)	herb.	Coastal prairie; Wetlands, coastal uplands of all types
Foothill needlegrass (*Stipa lepida)*	herb.	Oak woodlands, Montane forests; uplands, including ultramafics
McNab cypress (*Cupressus macnabiana*)	tree	Closed-cone cypress forest; slopes, ridges, ultramafics (in part)
Native dunegrass (*Leymus mollis*)	herb.	Beach and dune; foredunes, river mouths
Northern coastal bluff scrub[2] (Holland community type)	shrub/ herb	Northern coastal scrub; rocky, exposed bluffs and headland terraces.
Pacific reedgrass (*Calamagrostis nutkaensis*)	herb.	Coastal prairies; coastal bluffs, terraces, wetlands
Pygmy cypress (*Cupressus goveniana ssp. pygmaea*)	tree	Closed-cone cypress forest; maritime terraces in Mendocino Co.
Sargent cypress (*Cupressus sargentii*)	tree	Closed-cone cypress forest; Ultramafics stream benches, slopes, ridges
Valley oak (*Quercus lobata*)	tree	Oak woodland; valley bottoms, gentle slopes
Redwood[3] **(alluvial**[4]**)** (*Sequoia sempervirons*)	tree	Coastal forests; raised stream benches and terraces
Redwood[3] **(old-growth**[5]**)** (*Sequoia sempervirons*)	tree	Coastal forests; slopes, raised stream benches

[1] Rarity assessments are based on The Nature Conservancy Heritage Program status ranks, using a global rarity rank of G2 or G1, and a threat ranking of .2 or .1, as minimum selection criteria.

[2] Northern coastal bluff scrub (Holland community type):
Holland's (1986) Northern Coastal Bluff Scrub has not been adequately treated at the series-level. Sawyer and Keeler-Wolf (1995) apparently intended for the Dune lupine-goldenbush series to include this type (Miles and Goudey 1997), but did not define the series accordingly. Barbour and Major (1977) provide a community description that corresponds closely to Holland's (1986); this document recognizes the type described by these treatments.

[3] A comprehensive treatment of redwood forests is due to be published by Save the Redwoods League (Noss 1998). That book should include a more thorough examination of ecological and floristic diversity within the Redwood series.

[4] Redwood (alluvial) sub-series:
Holland (1986) recognized Alluvial Redwood as a distinct type, and other ecologists differentiate pure redwood alluvial stands from upland stands in which redwood shares the canopy with other conifers and broadleaf tree species (Sawyer and Keeler-Wolf 1995). This

document recognizes alluvial redwood as a distinct ecotype that is unique in overstory species composition.

[5] Redwood (old-growth) sub-series:
The old-growth phase of forest development is structurally and functionally distinct from younger stages and worthy of sub-series status. While old-growth redwood covers more than 10,000 acres (a limiting criteria for this document), there are probably less than "6 viable occurrences" (also a limiting criteria) where forests are extensive enough to accommodate historical disturbance regimes. Furthermore, old-growth redwood can be considered rare from the standpoint of historical extent, as it now (by almost all accounts) covers less than 10% of its pre-European range.

Table 2: Series and sub-series of the California North Coastal Basin that are rare and threatened on a statewide scale[1].

Series	Form	Community Types; Habitats
Beach pine (*Pinus contorta ssp. contorta*)	tree	Beach and dune; stabilized sand dunes, coastal terraces, headlands
Black cottonwood (north coast)[2] (*Populus balsamifera ssp. trichocarpa*)	tree	Riparian forest; streamsides, floodplains
Bulrush (*Scirpus* species)	herb.	Wetlands; saltwater, brackish, and freshwater water bodies
Douglas-fir-Ponderosa pine (old-growth)[3] (*Pseudotsuga menziesii/Pinus ponderosa*)	tree	Montane forests; raised stream benches, terraces, slopes
Fen habitat	habitat	Wetlands; freshwater, local wet areas with peat
Grand fir (*Abies grandis*)	tree	Coastal forests; slopes, maritime terraces
Hooker willow (*Salix hookeriana*)	tree	Riparian forests, Wetlands; freshwater
Mountain alder (*Alnus incana ssp. tenuifolia*)	tree	Riparian forest, Wetlands; montane streams, ponds, etc.
Pickleweed (*Salicornia* species)	herb.	Coastal salt marsh; saltwater, brackish estuaries
Sand verbena - beach bursage (*Abronia spp. - Ambrosia chamissonis*)	herb.	Beach and dunes; sand dunes, river mouths
Sitka alder (*Alnus viridis*)	tree	Riparian forest, Wetlands; montane streams, ponds, etc.
Sitka spruce (*Picea sitchensis*)	tree	Coastal forests, Wetlands, seaward slopes near ocean, stabilized sand dunes, wet areas
Sitka willow (*Salix sitchensis*)	tree	Riparian forest, Wetlands; freshwater
Tufted hairgrass (coastal)[4] (*Deschampsia caespitosa*)	herb.	Coastal terrace prairie; estuary margins, coastal terraces and bluffs
Western hemlock (old-growth)[5] (*Tsuga heterophylla*)	tree	Coastal forests; slopes, raised stream benches and terraces

[1] Rarity assessments are based on The Nature Conservancy Heritage Program status ranks, using a state rarity rank of S2 or S1, and a threat ranking of .2 or .1, as minimum selection criteria.

[2] Black cottonwood (north coast) sub-series:
Holland (1986) recognized a North Coast Black Cottonwood Riparian Forest type that is distinct from montane cottonwood stands. Sawyer and Keeler-Wolf (1995) acknowledge this distinction, but don't treat it at the series level.

[3] Douglas-fir - Ponderosa pine (old-growth) sub-series:
The Douglas-fir/Ponderosa pine series is typically included in a broad Mixed conifer type, but is primarily restricted to mountains in the northern half of the state. The series is considered "rare and worthy of consideration" by the California Natural Diversity Data Base (1997). Warbington and Beardsly (1996) found no old-growth ponderosa pine forest on national forest land in northern California, and ponderosa pine was only 2% important (as measured by relative density of trees greater than 30 inches d.b.h.) in old-growth Pacific Douglas-fir stands. Evidence clearly suggests that the old-growth phase of this type is rare in California.

[4] Tufted hairgrass (coastal) sub-series:
The Tufted hairgrass series includes stands found in coastal terrace prairies along the northern and central coasts of California, as well as those found in montane, subalpine, and alpine meadows throughout the state. The only coastal association described in the CNDDB (1997) is considered rare. Strong habitat incongruities between montane and coastal stands support a distinction between coastal and montane ecotypes, the former of which is far less common.

[5] Western hemlock (old-growth) sub-series:
The Western hemlock series is considered rare and worthy of consideration by the California Natural Diversity Data Base (1997), and the old-growth phase is scarce in California. Western hemlock stands reach their southern terminus in the CNCB, but are common in coastal forests further north. Old-growth stands have been greatly reduced in extent during the last 150 years.

Table 3: Uncommon, rare, or threatened series and sub-series of the California North Coastal Basin[1].

Series	Form	Community Types; Habitats
Bulrush – cattail (brackish)[2] (*Scirpus* species – *Typha* species)	herb.	Wetlands; estuaries, brackish water
California bay (*Umbellularia californica*)	tree	Mixed evergreen forest, Riparian forest; streamsides, uplands
Ditch-grass (*Ruppia* species)	herb.	Coastal salt marsh; brackish water (plant submerged)
Douglas-fir – tanoak (old-growth)[3] (*Pseudotsuga – Lithocarpus*)	tree	Mixed evergreen forest; uplands, raised stream benches
Idaho fescue (*Festuca idahoensis*)	herb.	Coastal prairie, Montane forests; upland slopes and ridges, ultramafics
Mixed willow (*Salix* species)	tree	Riparian forest, Wetlands; freshwater
Northern coastal scrub (northern elements)[4]	shrub	Coastal bluffs and hillsides; rocky, thin soils on exposed sites
One-sided bluegrass (*Poa secunda*)	herb.	Montane forests; all topographic locations
Pacific willow (*Salix lucida ssp. lasiandra*)	tree	Riparian forest, Wetlands; freshwater
Pondweeds with floating leaves (*Potamogeton* species)	herb.	Wetlands; freshwater
Pondweeds with submerged leaves (*Potamogeton* species)	herb.	Wetlands; freshwater
Purple needlegrass (*Stipa pulchra*)	herb.	Coastal prairie (Bald Hills prairie); uplands, all topographic locations
Red alder (non-successional)[5] (*Alnus rubra*)	tree	Riparian forest; wet areas, alluvial sites
Red fescue[6] (*Festuca rubra*)	herb	Beach and dunes; stabilized sand dunes, coastal terraces
Rush[7] (*Juncus* species)	herb.	Wetlands; dune hollows meadow margins, bottomlands
Saltgrass (coastal)[8] (*Distichlis spicata*)	herb.	Coastal salt marsh; salt and brackish marshes near bays and river mouths
Western hemlock (*Tsuga heterophylla*)	tree	Coastal forests; slopes, raised stream benches and terraces

[1] All types are considered rare and worthy of special consideration by the California Natural Diversity Data Base (CNDDB; 1997), which is based on a Heritage Program status rank of G3/S3 or less (Keeler-Wolf, pers. comm.). Exceptions include the Douglas-fir—tanoak (old growth) sub-series, the Rush and Red fescue series (see below), and the Northern coastal scrub (northern elements) super-series. The justification for including each of those types in this inventory is given below.

[2]Bulrush – cattail (brackish) sub-series:
The CNDDB recognizes a rare brackish type for the Bulrush-cattail series, which is otherwise more common in freshwater habitats throughout the state. Historical and continued loss and degradation of native wetland habitats have reduced the extent of this ecotype.

[3]Douglas-fir – tanoak (old-growth) sub-series:
Characterized by a two-tiered canopy, the Douglas-fir - tanoak series is not to be confused with other Douglas-fir series which are dominated by a single canopy layer. Warbington and Beardsley (1996) estimated that there is over 100,000 acres of pristine Douglas-fir—tanoak forest on national forest land in northern California. However, intact old-growth of this type covers only a small proportion of its original range with the CNCB.

[4]Northern coastal scrub (northern element) super-series:
This super-series, a subset of the Holland (1986) community type after which it is named, resists classification at the series-level. The type is comprised of several characteristic shrub species that mix in a fine scale mosaic, and thus may has both floristic geographic dimensions. Characteristic dominants include Salal (*Gaultheria shallon*), Salmonberry (*Rubus spectabilis*), Thimbleberry (*Rubus parvifolium*), Silk tassel (*Garry eliptica*), and Black-huckleberry (*Vaccinium ovatum*). Northern elements can be distinguished from the *Baccharus* phase that characterizes northern coastal scrub south of Mendocino County, as described by Barbour and Major (1977). However, the Coyote brush series may be mixed among other shrub species characterizing this northern type. Belsher recently identified a Salmonberry – thimbleberry ("Bramble and thicket") series based on field-data (Belsher, pers. comm.). That study did not support a Salal—black-huckleberry series, as currently recognized by the CNDDB (1997). This document lists only the larger super-series complex so as not to exclude important elements which have not been clearly resolved at the series level.

[5]Red alder (non-successional) sub-series:
Red alder is common on frequently disturbed sites throughout the region, but is typically successional to conifer forest types in the absence of disturbance. The phase indicated here refers to self-replacing stands that are reported to occur on certain sites that remain wet year-round (Sawyer, pers. comm.). Research is needed to confirm this.

[6]Red fescue series:
Neither this series nor the Rush series (see below) have been formally recognized (as of November 1997) by the Natural Heritage Division of CF&G or the *Manual of California Vegetation* (Sawyer and Keeler-Wolf 1995), presumably due to a lack of available data on the types. Highly isolated stands of Red fescue occur on coastal marine terraces and stabilized sand dunes in Del Norte County.

[7]Rush series:
Areas dominated by rush occur on coastal lowlands and in sand dune hollows.

[8]Saltgrass (coastal) sub-series:
This series is closely associated with the rare Pickleweed series in coastal salt marshes, but is more widely distributed as a component of alkali marshes in other parts of the state. The coastal sub-series recognized here corresponds to associations that are rare (California Natural Diversity Data Base 1997; Sawyer and Keeler-Wolf 1995). Rampant conversion of coastal salt marsh habitat to other uses in the past century has significantly reduced the presence of this series in the region.

Table 4: Habitats and community types[1] of the California North Coastal Basin that include high numbers of rare, threatened, or uncommon series and sub-series.

Habitat/Community Type	Type based on:	Series
Beach and dunes	(TVC)[2]	Native dunegrass, Red fescue Sand verbena/beach bursage Beach pine, Sitka spruce, Rush
Coastal salt marsh	(TVC)	Bulrush, Bulrush-Cattail (brackish), Pickleweed, Saltgrass (coastal)
Coastal prairie	(TVC)	California oatgrass Pacific reedgrass, Idaho fescue, Purple needlegrass, Tufted hairgrass (coastal)
Riparian forest	Hydrology, Structure	Black cottonwood (north coast) Hooker willow, Mixed willow Pacific willow Red alder (non-successional) Sitka willow, Sitka spruce Mountain alder, Sitka alder Pacific willow
Ultramafic/ultrabasic parent material (includes serpentines)	Geology	Foothill needlegrass, Idaho fescue Sargent cypress, McNab cypress
Closed-cone pine and cypress Forest	(TVC)	McNab cypress, Pygmy cypress Sargent cypress Bishop pine, Beach pine
Old-growth conifer forest	Development Structure Age	Redwood, Western hemlock Douglas-fir/ponderosa pine Douglas-fir – tanoak, Grand fir
Wetlands	Hydrology	Bulrush, Ditch-grass, Fen habitat, Pondweeds with floating leaves Pondweeds with submerged leaves Rush

[1] Habitat/Community types based on either the *Terrestrial Vegetation of California* (Barbour and Major 1977), or on generic habitat/vegetation classes.

[2] *Terrestrial Vegetation of California* (Barbour and Major 1977).

Conclusions and Recommendations

Inventory Findings

The diverse and unique vegetation of the California North Coastal Basin reflects a mixing of elements from northern (Pacific Northwest) and southern (California) floristic provinces. A distinct climactic, geologic, and biogeographic history underlies characteristic patterns of diversity. The CNCB tightly encompasses an area noted as a center of endemism and refugia for relictual species (Raven and Axelrod 1978; pg. 57-58). This unusual flora is manifest in the various and unique types of vegetation that characterize the region.

Methods employed by this inventory have identified forty-four rare and threatened vegetation types at the series and sub-series levels. Twelve of these are globally rare and threatened. Fifteen are rare and threatened in California. Seventeen additional series have been identified as uncommon and possibly rare in the state, and require further consideration in conservation planning. Four-fifths (80%) of the series listed in this inventory are predominantly included in one (or more) of eight broadly defined habitat/community types, a factor which should be considered in efforts to locate, map, and protect rare types across the regional landscape.

Conservation emphasis should initially be placed on rare and threatened types. An integrated effort that combines local knowledge with scientific expertise and technology is well-suited to the task of assessing and protecting rare vegetation across the region. The tendency for the CNCB's rare and threatened series to be concentrated in particular community/habitat types suggests that landscape-level assessment techniques, particularly the use of remotely sensed data, can be effectively synthesized with regional efforts to locate, map, and protect rare and threatened series on the ground.

Recommendations

There are four basic steps that can be taken to systematically protect rare and threatened vegetation at or below the series-level within the North Coastal Basin. They are to: 1) identify rare vegetation types and prioritize them for conservation, 2) develop geographically referenced data-sets and map the distribution of rare types throughout the region, 3) conduct a risk assessment to determine which types are most threatened, and 4) implement site-specific conservation measures to reduce threat, increase protection, and in some cases restore the integrity of rare vegetation.

Step 1:
This document identifies rare vegetation at the series and sub-series levels, and defines the scale of rarity (i.e. global or statwide). Still, more work is needed to lay the groundwork for a comprehensive approach to conservation, including: 1) further clarification regarding the rarity status of some types, especially those included in Table 3, 2) further delineation of rare vegetation at the sub-series level, 3) assessing factors that underlie rarity for each type (i.e. rare as a result of endemism, land-use history, or because the region is at the southern end of its range), and 4) determining when and where it is appropriate to address rare vegetation at the association-level. This need not preclude efforts to begin addressing vegetation types that are clearly rare and threatened.

Step 2:
Two possible approaches can be recommended for mapping the distribution of rare types throughout the CNCB. The first is to map vegetation of the entire region at the series, sub-series, and association-level with no initial focus on rare types. This sort of comprehensive effort would provide a high-resolution data-set for assessing the distribution of vegetation and habitat at various spatial scales, and provide a more empirical context for specifically addressing rare types. An approach that synthesizes the use of remotely sensed data, extensive field-sampling methods, and computer-aided classifications to identify and map vegetation at and below the series-level has been successfully employed in other portions of the state (Keeler-Wolf 1997). However, the potential for a similar approach in the CNCB is constrained by financial considerations and by limited access to private property, which comprises nearly two-thirds of the regional land-base. These two obstacles will have to be overcome before comprehensive mapping efforts that rely heavily on field sampling can be intitiated.

A second and more direct approach is to restrict mapping efforts solely to rare and threatened vegetation. This approach has the advantage of narrowly focusing available resources on the specific series and sub-series of concern. A disadvantage of this approach is the initial reliance upon existing distribution information (often scarce or lacking entirely), local knowledge, and field recognizance as a guide to locating rare series across the expanse of the region. Spectral signatures characterizing known stands of a particular rare type may in some cases be used to identify similar stands in other locations. Regardless of the technical challenges, developing geographically referenced data-sets to depict the distribution of rare types throughout the CNCB is a fundamental step towards protecting those types on a regional scale.

Step 3:
Assessing the risk of degradation or loss for each rare type is an important step in prioritizing conservation activities in the region. The GAP Analysis recently completed in California provides a useful model for assessing risk to biological resources. The basic procedure is to overlay geographic data-sets depicting the distribution patterns of biological resources with those depicting land ownership and management profiles (Davis et al. 1995). That project employed a minimum mapping unit of 1 hectare, an area too large to assess highly localized vegetation types or widespread types that occur in small patches. Most rare series and sub-series of the CNCB fit this description. Still, the basic GAP Analysis methodology could be used to conduct a fine-scale assessment of rare types by employing revised techniques at the appropriate scale. Such a project would provide a basis for developing site-specific conservation strategies that initially target those types most at risk.

Step 4:
Once the priority list of rare vegetation types is complete, their distributions known, and risks assessed, tangible conservation practices must be implemented on a site-specific basis. This will undoubtedly constitute the biggest challenge of all, especially where private lands are involved. The purpose of this document is not to elaborate on the various and difficult social issues related to the protection of native landscapes. It can be said, however, that many obstacles may be overcome with the combined support of local inhabitants and outside interests mutually concerned with the diminishing integrity of native landscapes. Cooperation from small-landowners and incentives provided by regional land trusts could facilitate protection across significant areas that are privately owned. Resources from various private organizations and state and federal agencies could be attracted by solid conservation plans. Additionally, there are a number of organizations, programs, and agencies to support ecological restoration where needed.

In conclusion, conserving the unique vegetation of the California North Coastal Basin requires a broadening of the context in which plant communities are viewed. Scientific efforts to characterize diversity within the physical landscape must be balanced by an understanding of the cultural forces that shape vegetation. Basic literacy regarding inherent and functional qualities of native landscapes, and the effect of social forces upon them, is sorely needed at all levels. The importance of incorporating such principles into mainstream education programs cannot be overstressed. Furthermore, strong legal mechanisms for protecting rare vegetation are not currently in place, but are necessary to preserve a disappearing heritage. Lastly, understanding and awareness are the cornerstones of hope for the conservation movement, and only increased human appreciation for the innate qualities of native landscapes will enable plant communities to perpetuate their own unfolding legacy.

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PERSONAL COMMUNICATIONS

Belsher, Jim. 1998. Graduate student of Botany, Department of Biological Sciences, Humboldt State University, Arcata, California.

Keeler-Wolf, Todd. 1998. Vegetation ecologist for the Natural Heritage Division of the California Department of Fish and Game, Sacramento, California.

Sawyer, John O. 1998. Professor of Botany, Department of Biological Sciences, Humboldt State University, Arcata, California.

Hierarchical framework of vegetation types, community types, and series; only rare community types and series of the CNCB are shown.

Example:
Vegetation Type (based on: Barbour and Major, 1977)

Holland Community (based on: Holland, 1986)
Series (based on: Sawyer and Keeler-Wolf 1995)

Beach and Dune

Northern Foredunes
Northern Foredune Grassland
Native dunegrass series
Active Coastal Dunes
Sand verbena – beach bursage series
Northern Dune Scrub

Others: Beach pine series, Sitka spruce series, Rush series, Hooker willow series, Pacific willow series, Red fescue series.

Coastal Salt Marsh

Northern Coastal Salt Marsh
Pickleweed series
Saltgrass (coastal) sub-series
Coastal Brackish Marsh
Bulrush series
Bulrush – cattail (brackish) sub-series
Ditch-grass series

Coastal Prairie

Bald Hills Prairie
Idaho fescue series
Foothill needlegrass series
Purple needlegrass series
California oatgrass series
Coastal Terrace Prairie
Tufted hairgrass (coastal) series
Pacific reedgrass series
California oatgrass series
Serpentine Bunchgrass
Idaho fescue series
Foothill needlegrass series
Purple needlegrass series
One-sided bluegrass series

Chaparral

Mixed serpentine chaparral
Fine-scale: Sargent cypress series, McNab cypress series

Others (fine-scale): Foothill needlegrass series, Purple needlegrass series, McNab cypress series

Closed-cone Pine and Cypress Forest

Northern Interior Cypress Forest
McNab cypress series
Sargent cypress series
Mendocino Pygmy Cypress Forest
Pygmy cypress series
Bishop pine series
Northern Bishop Pine Forest
Bishop pine series
Beach Pine Forest
Beach pine series

Mixed Evergreen Forest

California Bay Forest
California bay series

Others: Douglas-fir – Ponderosa pine (old-growth) sub-series

Montane and Subalpine Forests

Douglas-fir – Ponderosa pine (old-growth) sub-series
See also: **Montane Riparian Scrub** under "**Riparian Forests"**
Serpentine Bunchgrass under "**Coastal Prairies**"

Northern Coastal Scrub

Northern Coastal Bluff Scrub
Northern (Franciscan) Coastal Scrub
Northern coastal scrub (northern) sub-series

Oak Woodland

Valley Oak Woodland
Valley oak series

Fine-scale: Foothill needlegrass series, Purple needlegrass series, California oatgrass, series, Idaho fescue series

Redwood and associated Coastal Forests

Sitka Spruce – Grand Fir Forest
Sitka spruce series
Grand fir series
Northern Alluvial Redwood Forest
Redwood (alluvial) sub-series
Douglas-fir – Western Hemlock Forest/Western Hemlock Forest
Western hemlock series
Western hemlock (old-growth) sub-series
Others: Redwood (old-growth) series

Riparian Forests

Freshwater Swamp
Sitka spruce series
Willow super-series (Pacific willow, Hooker willow, Sitka willow, Mixed willow)
Red alder (non-successional) sub-series
Red Alder Riparian Forest
Red alder (non-successional) sub-series
Montane Riparian Scrub
Sitka alder series
Mountain alder series
North Coast Riparian Scrub
Willow superseries (Pacific willow, Hooker willow, Sitka willow, Mixed willow)
North Coast Black Cottonwood Riparian Forest
Black cottonwood (north coast) sub-series

Wetlands

Sphagnum bog
Fen
Ledum Swamp
Fen habitat (all the above)

Coast and Valley Freshwater Marsh
Bulrush series
Bulrush – cattail (brackish) sub-series
Pondweeds with floating leaves series
Pondweeds with submerged leaves series
Ditch-grass series
Rush series