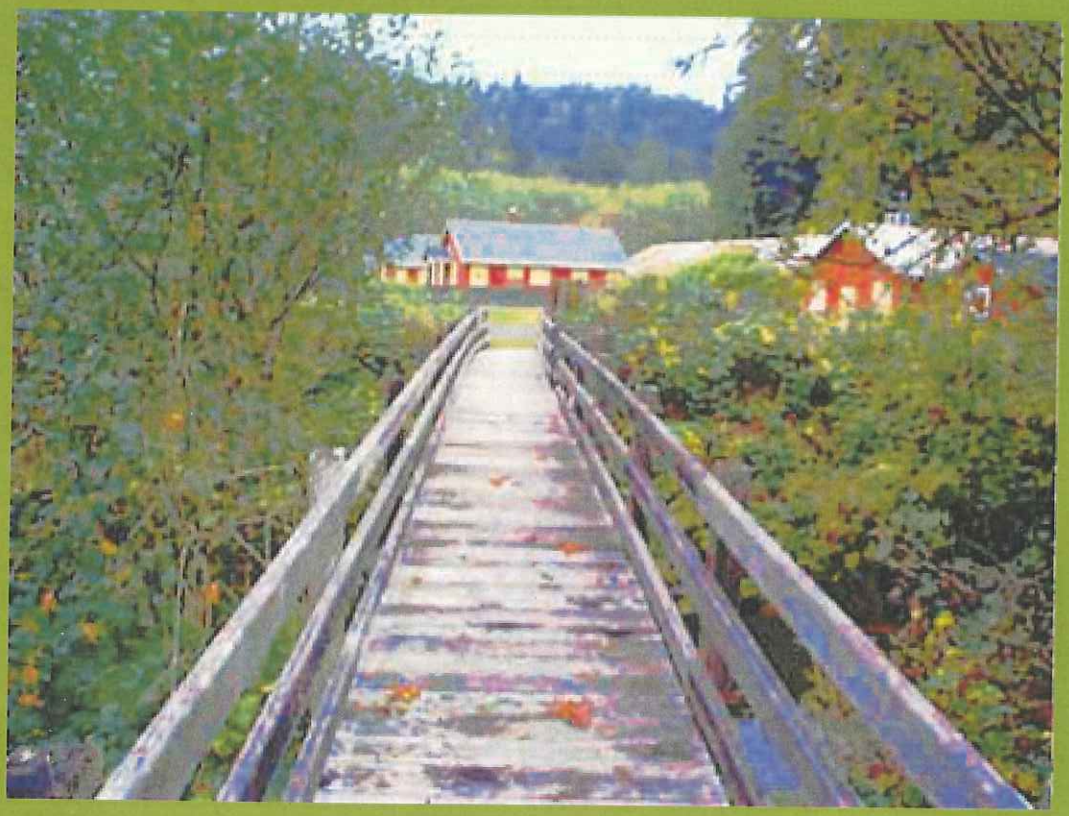
Redwood Creek National Watershed Center's Region of Focus



Report by

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1 Problem Definition

1.1 Problem Statement

Redwood Creek National Watershed Center (RCNWC) needs to define their watershed region of focus in order to provide service and information to those interested in watershed-based management, education, and research.

1.2 Background

Mission Statement of the Center

"The Redwood Creek National Watershed Center seeks to create opportunities for people to experience the beauty of the redwood ecosystem and learn about it while taking part in watershed scientific and practical field programs, thus connecting people with the natural world and responsible actions to sustain it."

Adopted 2/99

Redwood Creek National Watershed Center, in partnerships with Redwood National State Parks (RNSP), the Yurok tribe, the former logging community of Orick and Humboldt State University (HSU), is developing a center to serve all those interested in watershed-based management, from scientists actively engaged in watershed research to tourists who want to learn about the wondrous redwood forest ecosystem. The watershed center will be located in the former Prairie Creek Fish Hatchery, which is listed on the National Register of Historic Places. RCNWC is working with RNSP to restore the former Prairie Creek Fish Hatchery as the location for the watershed center. The hatchery was closed in 1993 due to concern over water quality, the desire to protect natural salmonoid stock, and lack of funding. At the time of the closure, Humboldt State University professors and students began discussing the possibility of turning the hatchery into an interpretive center, field research station, or "Salmonoid Institute" (RCNWC Business Plan, 2002). Gradually these ideas evolved into the development of the RCNWC.

Presently the RCNWC has an advisory committee with members from over 70 organizations working in the fields of watershed education, restoration and management. While there is a plethora of watershed groups in Northern California, there are few watershed centers with a regional focus. While they have a close connection to coastal temperate rainforests, RCNWC does not affiliate themselves exclusively to one particular watershed, and they aim to function as an "umbrella" for their advisory committee and other watershed groups, providing support and enhancement for these groups, rather than creating more competition in watershed training and education fields (RCNWC Business Plan, 2002). RCNWC and its Advisory Committee have identified five key components to the center: research, training, education, interpretation, and coordination.

1.3 Context

During the summer of 2001, RCNWC Project Director Paula Yoon and Assemblymember Virginia Strom-Martin began developing a concept to establish legislation for three coastal watershed centers - RCNWC, Pogonip Watershed Resource Center in Santa Cruz, and South Coast Watershed Resource Center in Santa Barbara affiliated with local universities (HSU, USCS, and UCSB). Legislation would provide much-needed administrative and educational funds for these centers. These regionally located centers would serve as a crucial point for the study of watersheds and watershed-based management within their given coastal regions. The research capacities of local universities could provide regional centers with the best available science in watershed management techniques. Furthermore, these centers could serve as a clearinghouse of watershed information made available on the web and in hard copies at university libraries within their regional areas (RCNWC Draft Concept Paper, 2001).

Unfortunately, in the fall of 2001 it was announced that there would be no new funding for projects in 2002 due to the state budget crisis, so the development of this pilot project was put on hold. Senator Wesley Chesbro offered his support to continue developing the

proposal for 2003; however, in light of the current $21 billion deficit in the state budget, it does not seem likely the governor will be allocating funds for any new projects any time in the near future. However, during this interim period it is important for RCNWC to continue developing this concept of regionally located watershed centers affiliated with local universities. Specifically, the center needs to clarify the geographic parameters of their regional area of focus.

The question "how does the Center define the term 'region'?" has been raised in several advisory committee meetings. Advisory Committee members who conduct biological and ecological research were concerned RCNWC would define the term politically or too narrowly (i.e. just within Redwood Creek watershed or Humboldt County) and therefore exclude geographic areas of interest to their research. Traditionally, regions have been defined based upon arbitrary geopolitical boundaries. The Center recognizes the need to define 'region' in terms of watershed and ecological boundaries, rather than county or state line boundaries. Other groups dedicated to the art of advancing watershed science and education are beginning to recognize that same need. The Watershed Management Council held a group of California Watershed Management Forums in 1999 and 2000 at UC Davis. One of the highlights of these forums was the recognition that "the State must think in terms of watershed boundaries instead of political ones to address its natural resource issues" (WMC, California Watershed Management Forums, *Final Report*, 2000). The concept of "watershed democracy" has been used in New Zealand since 1991 when the country re-organized their political structure to follow watershed boundaries.

This report will explore viable alternatives for defining RCNWC's region of focus. The chosen alternative will identify the geographic parameters of RCNWC's region of focus. "Region of focus" refers to the geographic area in which RCNWC will collaborate with and provide services for watershed groups, educators, researchers, and managers. The Center will serve as an "information hub" for watershed groups, researchers, and managers that are collecting data and developing watershed management techniques within their defined region. RCNWC will also collaborate with state and federal agencies to ensure the methodology developed by local watershed groups fuse with state

and federal methodologies to provide a local link to the development of resource management policies at all levels.

1.4 Objectives

Defining RCNWC's region of focus shall –

- Minimize overlap with other regional watershed centers.

- Minimize overlap with other regionally located universities that conduct watershed management research.

- Be based in good watershed and eco/bio system based science, not arbitrary lines of political jurisdiction.

- Include ecologically sound boundaries that encompass the range of flora and fauna species of particular biological interest, such as coastal redwood, Chinook and coho salmon, and steelhead trout.

- Accurately represent the geographic location of RCNWC Advisory Committee members.

2 Alternatives Deliberation

2.1 Introduction

The following alternatives explore viable options for defining RCNWC's region of focus. These alternatives were developed after a brainstorming session appended at the end of this document (Appendix A). Additionally, decision criteria derived from the report's objectives were developed. The sums of each alternative's criteria score were then compared to determine the strengths and weaknesses of each alternative.

2.2 Criteria

What about a criteria of data availability?

These criteria were developed to evaluate and compare alternative options for defining RCNWC's region of focus.

Minimal Overlap with other Regional Watershed Centers: This criterion determines the proximity of RCNWC's region to other regional watershed centers. Each alternative will be ranked using the following scale:

1- 50 miles or less from RCNWC's region.
2- 50-250 miles from RCNWC's region.
3- more than 250 miles from RCNWC's region.

Minimal Overlap with other Universities: This criterion determines the proximity of RCNWC's region to universities (aside from HSU) that conduct watershed-based management research or provide watershed training and education. Each alternative will be ranked using the following scale:

1- 50 miles or less from RCNWC's region.
2- 50-250 miles from RCNWC's region.
3- more than 250 miles from RCNWC's region.

Diversity of Species: It is important for the Center's region of focus to cover a diversity of flora and fauna species of particular biological interest in order to attract scientists and researchers to use the Center's facilities. This criterion measures diversity of species in a

regional area. Each alternative will be compared and its species diversity ranked in comparison using the following scale:

1- Low Diversity
2- Moderate Diversity
3- High Diversity

How are these determined?

Watershed and Eco/Bio Science Based: This criterion measures how closely the defined regional boundaries follow natural boundaries (drainages, species distribution) as opposed to arbitrary political boundaries (roads, county lines, etc).

Population Density: The North Coast area is unique to California due to its relatively low population density. This criterion measures the population density within a particular regional boundary. Each alternative will be ranked according to the following scale:

1- 100 to 399 + people per square mile
2- 50 to 99 people per square mile
3- Less than 49 people per square mile

This information is from the 1990 Census; population data collected in the 2000 Census will not be available until May 2003.

Accurately Represent AC Members: One of the Center's primary goals is to serve the needs of its advisory committee members. The chosen alternative must cover an area geographically large enough to include most, if not all, AC members. Each alternative will be ranked according to the following scale:

1- AC members poorly represented
2- AC members well represented
3- AC members highly represented

what distinguishes each?

2.3 Alternatives

The following options are considered to be viable alternatives for defining RCNWC's regional area of focus. The final decision may include one or any combination thereof the listed alternatives.

Alternative 1: Redwood Creek and Mad River Watersheds

Under this alternative, the Center's regional area of focus will be limited to the Redwood Creek and Mad River watersheds. These watersheds comprise 721,435 acres and contain 1,408 miles of naturally occurring waterways (CARA website, 2002). These watersheds are home to a wide diversity of species, including stands of ancient redwoods, the largest herd of Roosevelt Elk in North America, Coho and Chinook salmon, steelhead trout, spotted owl and marbled murrelet. Humboldt State University is the only regionally located university in the area that conducts watershed management research. There are no regional watershed centers within the vicinity and no existing watershed groups focusing exclusively on the management of the Redwood Creek and Mad River watersheds. The population densities in these watersheds do not exceed 49 people per square mile.

Limiting RCNWC's region of focus to these two watersheds would be manageable and support the Center's mission of creating "opportunities for people to experience the beauty of the redwood ecosystem." However, it would exclude a large portion of RCNWC advisory committee members who live and conduct watershed research outside these two watersheds. It would also exclude the Trinity, Klamath and Gualala Rivers, all of which have some of the largest remaining populations of endangered or threatened salmonid populations in the state.

Alternative 2: Upriver/Downriver

Under this alternative, the Center's regional area of focus will include the Redwood Creek watershed and Mad River basin, and extend to include the watersheds immediately up and down stream. Immediately upstream is the Smith River, which extends into Southern Oregon. Downstream lays the Lower Klamath and the Lower Eel. Southern

Oregon University, which is approximately 165 to the northeast, conducts some watershed research, though primarily in the Rogue River basin. The range of species diversity is similar to alternative one. There are no known regional watershed centers in the vicinity. The population densities in these watersheds do not exceed 49 people per square mile.

This alternative would encompass a greater range of critical salmonid habitat and include more RCNWC advisory committee members than alternative one, though a good portion of the remaining redwood forests and threatened salmon habitat in California subsist further to the south in Mendocino County.

Alternative 3: North Coast Bioregion

Under this alternative, the boundaries of the Center's regional area of focus would be defined based upon bioregion delineations established by Hartwell H. Welsh, Jr., a scientist with the USDA Forest Service (see Appendix B). According to Welsh, bioregions are defined by physiographic and climatic limits that define the natural communities of organisms in space and time through interactions with the physiological and behavioral capabilities of these organisms" (Welsh, 1994). He uses the natural distribution of plant species to define the bioregions because plants are "less vagile than animals." The North Coast bioregion extends east of the Pacific Ocean to the Klamath bioregion, delineated by "the transition from redwood forest and mixed evergreen forest with rhododendron into mixed evergreen forest with chinquapin" (Welsh, 1994). This bioregion delineation excludes eastern portions of the Redwood Creek watershed. It is bound to the North by southern Oregon. All of Mendocino County, coastal drainages such as the Russian and the Gualala, and portions of Napa and Sonoma County that drain directly toward the San Francisco Bay are included in this bioregion. South of Sonoma County to the southern boundary of the redwood forests in Monterey County, all rivers that drain directly into the Pacific Ocean is included. This alternative encompasses a vast diversity of species including the red-legged frog, California slender salamander, red-shouldered hawk, and marbled murrelet.

This alternative is not ideal because it would exclude eastern portions of the Redwood Creek watershed and Yurok tribal land, thus poorly representing crucial members of the RCNWC advisory committee. The population density in the San Francisco Bay area far exceeds 100 people per square mile, and the watershed issues faced in this urban population differ greatly from the watershed issues faced in rural areas heavily dependent upon a resource extraction based economy. Moreover, UC Berkeley offers a comprehensive watershed management program and conducts watershed research. Further to the south, CSU Monterey has recently established a water institute and conducts their own watershed research. The Pogonip Watershed Resource Center, a partner in the 3- coastal regional watershed centers concept, falls within this region.

what about Sonoma State

Alternative 4: North Coast Hydrologic Region

This alternative follows the natural drainage patterns of the North Coast, as mapped by the California Resources Agency (See Appendix C). This hydrologic region extends from the upper Klamath in the northeast to Bodega Bay in the southwest. Rivers in this hydrologic region include the Eel, Russian, Trinity, Smith, Mad, and Redwood Creek. This region includes a vast array of wildlife species similar to those listed in alternatives 1, 3, and 4. It includes a huge range of old growth Redwood trees, Douglas fir, many types of oak (Tan, Canyon Live, Black, Oregon), Pacific Madrone and California Bay. This regional area also represents the majority of advisory committee members. Aside from HSU, the nearest universities conducting watershed research (UC Berkeley and Southern Oregon University in Ashland) are more than 60 miles away. The population density does not exceed 99 people per square mile. The only political boundary this alternative adheres to is the Northern California/Oregon border, which divides the Chetco, Smith and Rogue River watersheds. A highly beneficial aspect to this alternative is that it follows natural drainage patterns, which is the most logical means of defining a region for a watershed center.

Table 2.1 A decision matrix displaying scores for the four alternatives.

	Center Overlap	University Overlap	Species Diversity	Eco/Sci Based	Represents AC	Population Density	Total
Alter. 1	3	2	2	Yes	2	3	12
Alter. 2	3	2	3	Yes	3	3	14
Alter. 3	1	1	2	Yes	1	1	6
Alter. 4	2	2	3	Yes	3	2	12

2.4 *Final Decision Justification*

During the final decision-making process, it was decided that "watershed eco/sci based" and "represents AC members" criteria should be given the highest priority. Good natural resource management begins by defining regions based on natural systems, such as species distribution or hydrologic boundaries, rather than arbitrary county or state lines of political convenience. It is essential the chosen alternative encompass the majority of the RCNWC advisory committee members because since its inception, the Center's development has reflected the needs of its advisory committee members.

Though it includes a large range of species diversity and accurately represents the majority of the AC members, alternative 3 was immediately rejected because it excludes eastern portions of the Redwood Creek watershed and Yurok tribal land. Moreover, it overlaps with other universities conducting watershed research and/or training, watershed centers, and includes urban watersheds. Alternative 1 was also rejected because it excludes advisory committee members who live and/or conduct research in southern Humboldt and Mendocino Counties. Alternative 2 received the highest score, but it was rejected on the same grounds as alternative 1.

Alternative 4, which received the second highest over-all score, was slightly modified to create Alternative 5 (See Appendix D), which will be fully detailed in the Preferred Alternative Implementation section of this report. Defining the RCNWC's region of focus based upon the natural drainage patterns of the North Coast seemed the most logical choice, since the Center's focus is on watersheds. Alternative 5 will include three watersheds that cross into southern Oregon – the Smith, Chetco, and Rogue River watersheds. It will exclude the upper Klamath because the climate and geography of that area is high desert, which deviates greatly from the RCNWC's coastal temperate rainforest focus.

3 Implementation Plan

3.1 Implementation Plan Context

After identifying the chosen alternative, the author of this report chose to investigate how different government agencies and NGO's working on natural resource issues delineate hydrologic boundaries and define watershed terminology. This section begins with a general description of the preferred alternative and some of its unique factors.

3.2 Preferred Alternative Implementation

3.21 Description of Preferred Alternative

The preferred alternative includes the following rivers and their tributaries: Winchuck, Smith, Redwood Creek, Lower Klamath, Trinity, Eel, Russian and southern portions of the Rogue. These rivers are critical habitat for almost all of the remaining Coho and Steelhead populations in California; together, the Trinity and Klamath rivers support the second largest Chinook population in the state (*California Rivers Report,* 2002). The Smith and the Salmon Rivers are two of the only three rivers in California that are not dammed. The Trinity, Smith, Van Duzen, Klamath, Eel, Scott and Salmon Rivers all have segments that have state/and or federal scenic river status (*California Rivers Report,* 2002). The greatest threats to rivers in this region include dams, logging, water diversion and in stream gravel mining. Nearly all of the rivers in this region are listed under the Clean Water Act as impaired due to high sediment content.

Counties in this California portion of this region are Humboldt, Del Norte, Trinity, Mendocino, and northwestern portions of Siskiyou, Lake, and Sonoma. Counties in Oregon include southern portions of Curry, Josephine and Jackson. The region is bound to the north by the Winchuck and Rogue watersheds and to the south by Bodega Bay in Sonoma County.

Particular species of interest in this region include northern spotted owl, marbled murrelet, California red-legged frog, California wolverine, Bald eagle, western snowy plover, Chinook and Coho Salmon, Steelhead Trout, and tidewater goby.

Does this species have significant tests to watersheds?

This region accurately represents the majority of advisory committee members. There are a few members further south in Santa Cruz and Santa Barbara and a few in Northern Oregon, though these areas are clearly outside the scope of RCNWC's preferred region of focus. Since the Center's inception, Humboldt State University faculty and students have been supportive of their efforts. Nearly a third of the advisory committee members are Humboldt professors or staff.

3.32 Hydrologic Terminology

The USGS delineates hydrologic units in the United States into four divisions: region, subregion, accounting unit, and cataloguing unit. These units are based on surface hydrologic features. The U.S. is divided into 21 regions; California is region 18 and Oregon falls under region 17. There are 222 subregions nationwide; California is divided into seven subregions (See Appendix E). The chosen alternative is considered a 'subregion' under USGS terminology, though slightly modified from the North Coast/Klamath subregion identified by the USGS and used by the Trust For Public Land in their *California Rivers Report*. However, this subregion delineation differs slightly from the delineation used by the CA Resources Agency, which divides the state into ten subregions (See Appendix F). The third hydrologic unit further divides subregions into accounting units. The fourth level of classification is the cataloguing unit, an eight digit unit which is used by the EPA in their "Surf Your Watershed" website. Their use of the term "watershed" is a bit misleading, since cataloguing units generally refer to a basin and subbasin. For instance, Redwood Creek and the Mad River are in the same USGS cataloguing unit and therefore considered to be the same watershed by the EPA, despite the fact the two rivers have different headwaters and drain into the ocean miles apart. See Appendix G for an excellent glossary of watershed terminology complied by Bruce M. McCammon of the USDA- Forest Service, Pacific Northwest Region.

4 Monitoring and Evaluation

4.1 Monitoring and Evaluation Context

Because the RCNWC is a project in development, it is difficult to access at this point how well the defined region of focus will represent future users of the Center's facilities and services. It is suggested that when the Center is up and running that they develop a method to document what geographic regions their patrons are coming from. For instance, the Center could have all visitors sign in and write down where they live. Additionally, the Center could develop surveys for visitors to the Center to fill out. There could be different surveys designed for different user groups, i.e. one for researchers, one for ecotourists, one for schoolteachers, etc. Utilizing these simple methods will allow the Center to monitor how well their defined region of focus represents their user groups.

5 Conclusion

5.1 Conclusion Context

In order for the RCNWC to implement their defined region of focus, it is suggested they use the watershed terminology established by Bruce P. McCammon found in Appendix G. Using this standardized terminology will allow them to communicate with state and federal agencies more effectively. It is also suggested they invite a staff member of the North Coast Regional Water Quality Control Board to join their advisory committee. RCNWC could play a key role in the continued development of the NCRWQC's comprehensive "Watershed Assessment Program."

6 References

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Brainstorm Appendix A - Brainstorm

look at Map of rivers & their drainages (tributaries) Smith, Klamath, Trinity, Mad, Eel, Russian.
bound by redwood distribution to the north

South of Eugene -
Southern Ore College (Medford) - see if they study watersheds

Southern boundary - Mendocino/Sonoma county line - where does the Russian drain into the ocean?.

look at EPA "Surf your watershed" pick out watersheds on the N. Ca & S. Oregon Coast to be in our region -

who is taking care of watersheds to the East?.

range of steelhead, chinook, coho? (historical v. best remaining habitat?)

CERES website - has nice hydrological maps.

What do we want the scale of our watershed to be?

Redwood Creek → 1 watershed
North Coast

have different layers of scale to define our watershed?

SB watershed center is bound by the Santa Inez Mountains . . . how about us?

What resources are important to the North Coast? (follow logic of New Zealand)

Rural / ~~small~~ population

our watersheds are also forest watersheds

Appendix B - California Bioregions

Hartwell H. Welsh, Jr © (1994)

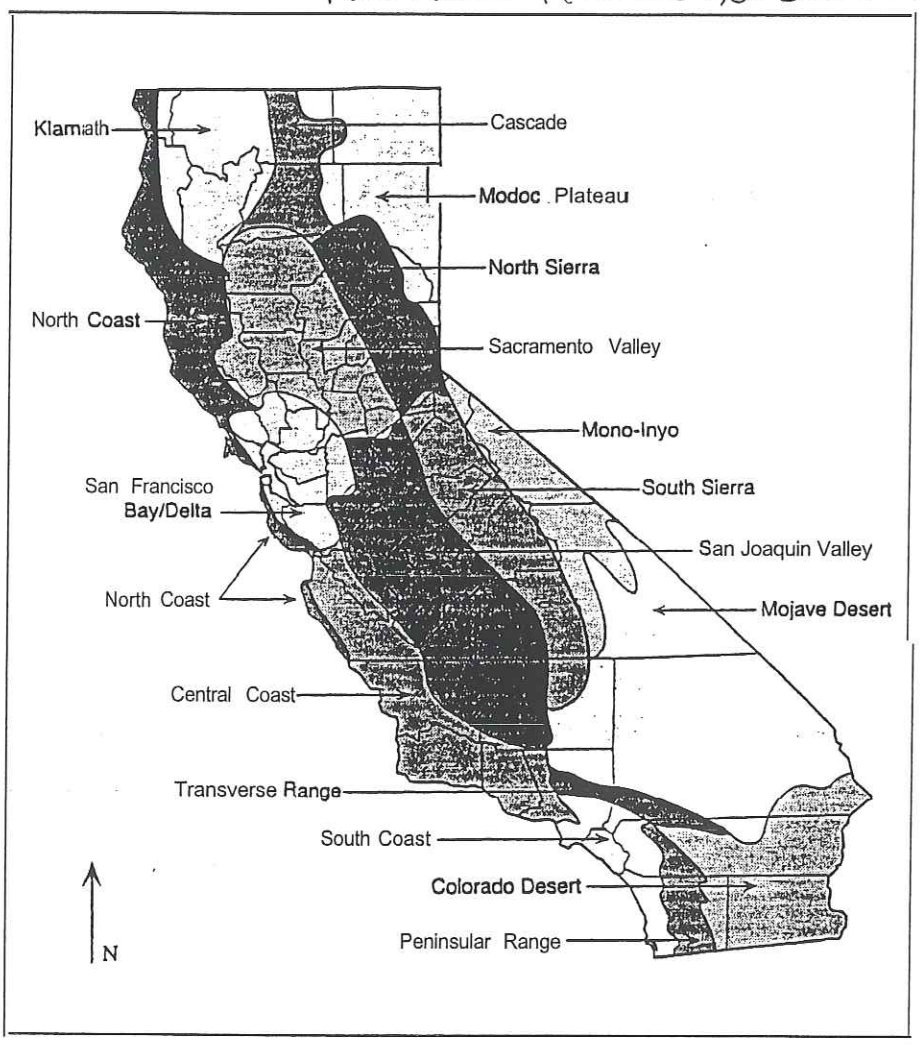


Figure 6. Approximate boundaries of the sixteen proposed bioregions of California. Fine lines are county boundaries.

Appendix C - North Coast Hydrologic Region

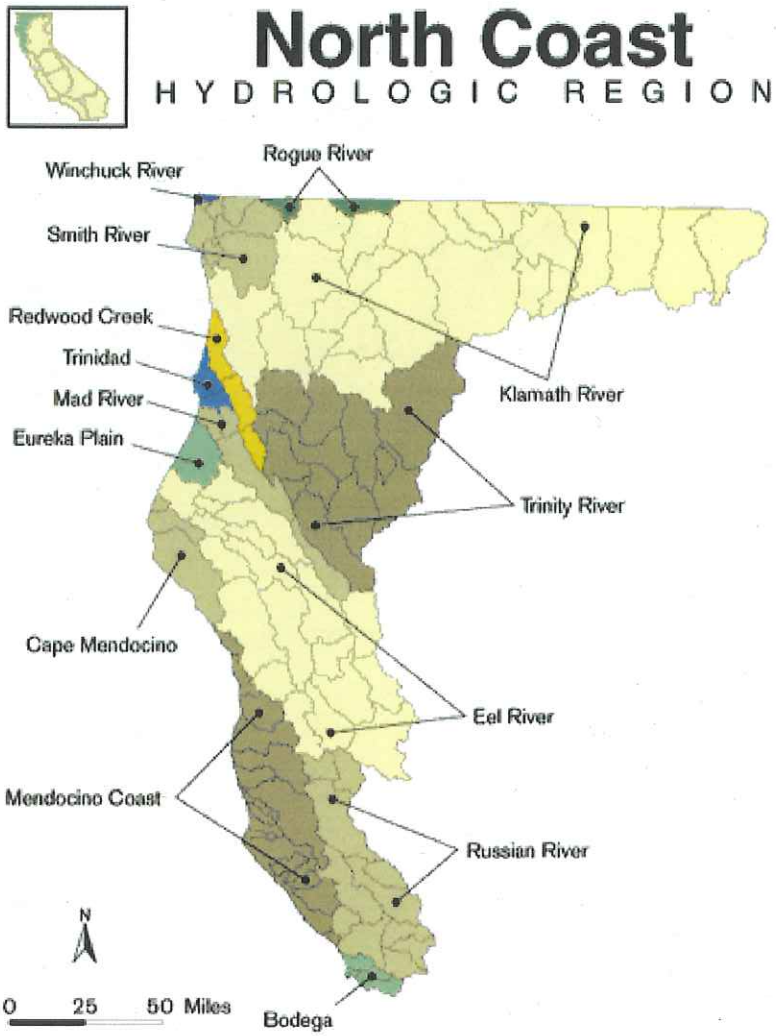
CALIFORNIA WATERSHED Information Technical System
A Project of CERES

Geographic Information by Hydrologic Region

PLEASE SELECT A HYDROLOGIC AREA

Bodega
Cape Mendocino
Eel River
Eureka Plain
Klamath River
Mad River
Mendocino Coast
Redwood Creek
Rogue River
Russian River
Smith River
Trinidad
Trinity River
Winchuck River

About the regions



Graphics: California Environmental Resources Evaluation System (CERES).
Source: Named Hydrologic Units: State Water Resources Control Board, 1988.

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This file last modified on: Monday, June 8, 1998.
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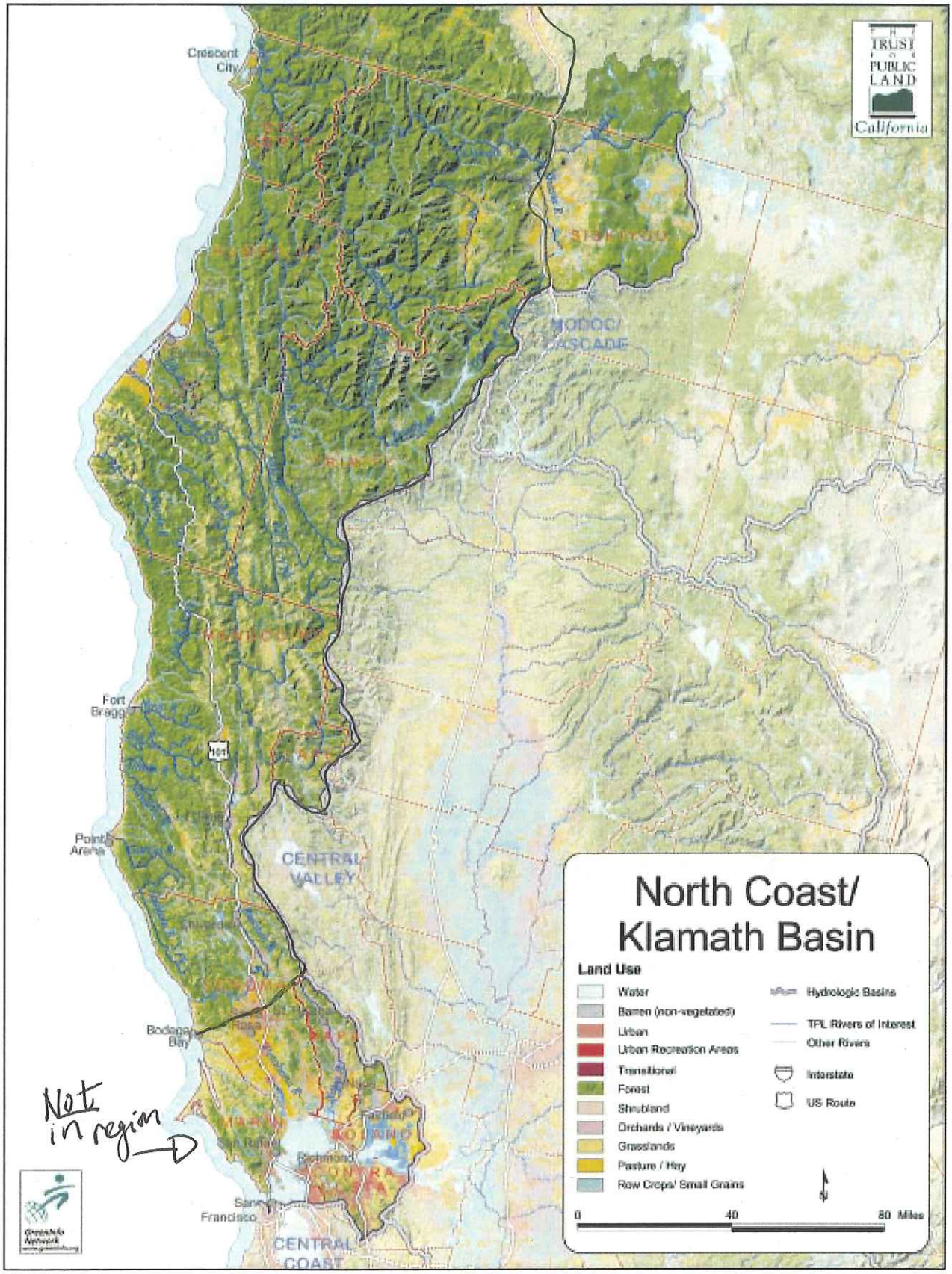
Appendix D – RCNWC's Region



Appendix E


Major Rivers
and
Hydrologic Basins
of California
THE TRUST FOR PUBLIC LAND
California
This map uses EPA watershed boundaries to delineate the full extent of the river systems of California. (U.S. side only)
NORTH COAST/ KLAMATH
MODOC / CASCADE
CENTRAL
EASTSIDE/ GREAT BASIN
VALLEY
CENTRAL COAST
DESERT
SOUTH
COAST
Land Use
Water
Barren (non-vegetated)
Urban
Urban Recreation Areas
Transitional
Forest
Shrubland
Orchards / Vineyards
Grasslands
Pasture / Hay
Row Crops/ Small Grains
Hydrologic Basins
TPL Rivers of Interest
Other Rivers
Interstate
US Route
Data Source:
Land Use
U.S. EPA National
Land Cover Data, 1999
0
50
100
150
200 Miles
Greenlink Network

CALIFORNIA WATERSHED Information Technical System
A Project of CERES

Watershed Information by Hydrologic Region

Please Select a Watershed Region

North Coast
San Francisco Bay
Central Coast
South Coast

Sacramento River
San Joaquin River
Tulare Lake
North Lahontan

South Lahontan
Colorado River
About the regions

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Recommended Watershed Terminology

Bruce P. McCammon
USDA-Forest Service, Pacific Northwest Region

When we were married, my spouse and I, like so many others, were presented with a set of mixing bowls. This is a great set of bowls that takes little room on a shelf because they all nest nicely inside each other. The problem with these bowls occurs when one of us asks the other to "hand me a bowl, please." We can quickly determine if the need is for the "biggest" or the "smallest" bowl but selecting among the others usually requires pointing and head shaking. We have no standard terminology for the range of bowls in our set. Much the same problem exists with respect to watersheds. Using the bowl method, we can often communicate with each other adequately by simply referencing "bowl" or "watershed." Often, however, it is necessary to be more specific about the size or scale of nested "containers" in order to communicate effectively. The terminology used to reference "watersheds" is not standardized and often creates a miscommunication when people do not share the same sense of scale for a given watershed term. My goal is to offer a suggestion for watershed terminology that, in my experience, helps to communicate the relative size of watersheds.

Technically, a watershed is the divide separating one drainage area from another (Chow, 1964). The term "watershed" is commonly used to refer to an area; specifically, the area in which all surface waters flow to a common point. A great deal of confusion and misunderstanding is created by the inconsistent use of terms to describe the relative size of watersheds-basin, watershed, drainage, catchment. Use of the term "watershed" to describe the area drained by the Columbia River as well as the area drained by the Deschutes River is technically correct - it just does not provide insight to the fact that the Deschutes is one small tributary to the Columbia River. More confusion is introduced by referencing adjectives such as fifth-field watershed or fifth-order watershed. One way to minimize the confusion is to use a consistent set of terms that is based on established systems for subdividing large watersheds into smaller ones. The preferred terms presented here - Region, Subregion, River Basin, Subbasin, Watershed, Subwatershed, Drainage, and Site - are consistent with the common interpretation of relative watershed size.

REGION

The USGS recognizes 21 major geographic Regions (Figure 1), 18 of which are located within the continental United States (Seaber, et al., 1987). They assign the first two digits of an eight digit numeric code to the Region. The Great Basin (16), the Pacific Northwest (17), and the California Region (18) are most relevant to Federal agencies in Washington, Oregon, and California.

Example: Pacific Northwest Region
17 - - - -

SUBREGION

The USGS further subdivides these Regions into Subregions (Figure 2). Nationally, there are 222 Subregions; 18 of these lie within the States of Washington and Oregon and northern California. A subregion includes the area drained by a river system, a reach of a river and its tributaries to that reach, a closed basin, or a group of streams forming a coastal drainage area. The numeric code for each of the subregions is composed of four digits; two digits each for Region and Subregion.

Example: Willamette Subregion
17 09 - -

RIVER BASIN

The USGS divides Subregions into yet smaller areas, resulting in what is commonly referred to as River Basins (Figure 3). There are 24 river basins completely or partially within the States of Washington, Oregon and the northern portion of California. Like the Subregion, a River Basin is composed of a river system (e.g., Willamette River), a reach of a stream and its tributaries to that reach (e.g., Middle Snake-Powder), a closed basin (e.g., Oregon Closed Basins), or a group of streams composing a coastal drainage area (e.g., Northern California Coastal). The numeric code for each River Basin is six digits long and is referred to as "third field" watersheds.

Example: Willamette River Basin
17 09 00 -

The USGS hierarchy of Hydrologic Units refers to this level of subdivision as Accounting Units (Seaber, et. al., 1987). This nomenclature is very uncommon and confusing to the public and managers. The term Accounting Unit is best avoided.

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SUBBASIN

The smallest subdivision in the USGS hierarchy is the Subbasin (Figure 4). There are 207 Subbasins within the River Basins in Washington, Oregon, and northern California. Subbasins are geographic areas representing part or all of a surface drainage area, a combination of drainage areas, or a distinct hydrologic feature (Seaber, et al., 1987). Almost all of the subbasins are larger than 700 square miles in size. Subbasins in Washington, Oregon, and northern California range from 34 to 4100 square miles with an average of 1143 square miles. The numeric code for the subbasins is eight digits long and is composed of four two-digit fields. Subbasins are equivalent to "fourth field watersheds."

Example: Middle Fork Willamette Subbasin
17 09 00 01

The USGS refers to the Subbasin level of the hierarchy as Cataloging Units. Like Accounting Unit, the term Cataloging Unit has no common use or meaning and should be avoided.

WATERSHED

The USGS hierarchy does not continue subdividing or provide terms for areas smaller than the Subbasin. There is some resistance to labeling the next level within the terminology hierarchy with the term, but the next logical subdivision is the Watershed. If we continue with the coding scheme used by the USGS, Watershed would be the fifth two-digit field. Currently, there is no universally accepted delineation of watersheds in the states of Washington, Oregon, and California
(Editor's Note: California now has the "CALWATER" watershed system, brought to fruit by WMC Prez Clay Brandow. It will likely be widely accepted soon).

SUBWATERSHED

Within any watershed, there are logical stratifications or subdivisions that help orient people, especially analysts, based on geography or a distinctive feature or use. Typically, references like "Lick Creek" or "Upper Crow Creek" are used to identify major tributary areas within a watershed. Similarly, a specific use, such as a diversion for a municipal water supply, may be used to identify a geographic area. Specific features, like a collection of springs within the same geographic area, may be referred to and would logically help orient a person to a Subwatershed area within a bigger watershed.

DRAINAGE

Generally, within a Subwatershed, there are logical stratifications based on the development of the stream channel network. Identifying smaller drainage areas is particularly helpful for organizing and presenting analysis of physical processes within the larger Subwatershed.

SITE

The smallest hierarchical delineation is the Site. This level is not based on hydrography, but represents an area that is appropriate to an existing or proposed use. Examples would be: allotment X, administrative site Y, or campground Z.

Terms to avoid

Terms to avoid when referring to different levels or sizes of watersheds include:

- "x" Field (i.e., fifth field)
- "y" Order
- Stream Class

Field

The term "field" is not recommended for three reasons:
(1) very few people are aware of the USGS national standard hydrologic unit hierarchy,
(2) the term "field" does not convey a visual image of size,
(3) there is no universally accepted system to subdivide below the USGS's Subbasin level (fourth field).

Stream Order

The term "order" is commonly used to refer to the relative size of a specific watershed. While this is technically appropriate for a specific watershed, the term causes problems when we try to use the term to compare or equate, even on a relative scale, the size of different watersheds. An explanation is in order (pardon the pun). Stream order refers to a systematic process for describing the degree of branching of a stream network within a watershed (Strahler, 1952).

The order of any stream segment is determined by starting at the headwaters and labeling each unbranched tributary as order one. Where two order one streams come together, an order 2 stream is created. Similarly, when two second order streams merge, a third order stream is created. The junction of any two streams of equal order results in a stream of the next higher order. Stream density and branching patterns are determined by many factors including geology, soils, relief, and precipitation. Two watersheds of the same size can have very different stream densities.

A consistent relationship between stream order and watershed size does not exist...particularly at the Region or Subregion scale.

Determining stream order is a function of map scale and the delineating process used. Different depictions and, therefore, stream orders, will be derived if different scale maps are used. Similarly, if one analyst uses only the "blue lines" on the quads and another analyst extends the stream network based on contour crenulations, very

different stream orders will result.

A universally accepted procedure for delineation of tributaries for the determination of stream density or stream order does not exist.

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Stream Class

Stream class refers to the relative value of a stream based on the need for protection of beneficial uses. Class I streams typically represent streams that are very important for water supply, fisheries, or recreation values. Other stream classes denote streams of lesser value or streams that are intermittent or ephemeral. Stream class generally represents a sense of values that may be totally independent of watershed size.

Conclusions

The term "watershed" refers to areas of land from which surface waters flow. Unfortunately, the term is used without consistent size discrimination. Some existing terminology, such as Accounting Unit, does not connote any relationship land areas. Use of adjectives and terminology associated with geomorphic or social or biologic value criteria often confuse people who are trying to sort out the relative sizes of watersheds within an area. Use of a common terminology to describe the nested and relative sizes of successively smaller areas would help to minimize the confusion that exists today. The terms Region, Subregion, River Basin, Subbasin, Watershed, Subwatershed, Drainage, and Site are recommended.

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