REDWOOD NATIONAL AND STATE PARKS
GEOLOGIC RESOURCES MANAGEMENT ISSUES
SCOPING SUMMARY

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Executive Summary

A Geologic Resources Evaluation scoping meeting for Redwood National and State Parks was as held in Ashland, Oregon, March 2-3, 2004. The scoping meeting participants identified the following as the most significant geologic resources management issues.

1. Sediment transport and other fluvial processes have played a significant role in the management of the park. Legislation in 1978 expanding the park mandated erosion and sedimentation studies.

2. Continuing seismic activity and the potential for tsunamis is of major concern.

3. Coastal and marine issues, including offshore sediment budget, potential oil spills, and visitor use (rock climbing and social trails) are of concern.

Introduction

The National Park Service held a Geologic Resources Evaluation scoping meeting for Redwoods National and State Parks (REDW) in Ashland, Oregon, Tuesday afternoon, March 2 and Wednesday morning March 3, 2004. The purpose of the meeting was to discuss the status of geologic mapping in the park, the associated bibliography, and the geologic issues in the park. The products to be derived from the scoping meeting are: (1) Digitized geologic maps covering REDW; (2) An updated and verified bibliography; (3) Scoping summary (this report); and (4) A Geologic Resources Evaluation Report which brings together all of these products.

Redwoods National Park was established October 2, 1968. It was designated a World Heritage Site September 5, 1980, and a Biosphere Reserve June 30, 1983. Redwoods National Park joined three California state parks as one cooperative management unit of the National Park Service and California Department of Parks and Recreation. The state parks are: Prairie Creek Redwoods State Park, Del Norte Coast Redwoods State Park, and Jedediah Smith Redwoods State Park. In May 1994, Redwoods National Park became Redwoods National and State Parks, containing 45% of all the old-growth redwood forest in California. The total area of REDW is 112,613 acres.

REDW is covered by 13 topographic quadrangle maps. From north to south they are: Crescent City, Hiouchi, Sister Rocks, Childs Hill, Requa, Fern Canyon, Ah Pah Ridge, Orick, Holter Ridge, Rodgers Peak, Bald Hills, French Camp, and Panther Creek. In addition, there are 54 other quads of interest around the park, mostly east and south. Two geologic maps at the 1:62,500 scale cover the southern third and northern about one-fifth of the park: OF-81-496, Geologic Map of the Redwood Creek Drainage Basin, Humboldt County, California; and, Geology and Ground-water Features of the Smith River Plain, Del Norte County, California, respectively. Also, the park is on the Weed Sheet of the Geologic Map of California, scale 1:250,000.

Physiography

Redwoods National and State Parks lies in the Coast Range Physiographic Province which stretches from the Santa Inez River and the Transverse Ranges in Southern California north into Alaska. In California, the Coast Range can be divided into the southern California Coast Range, west of the San Andres fault, and the northern California Coast Range, east of the San Andres fault. It is the latter that is of interest here and more specifically from the town of Trinidad, CA north to the Oregon border (41º to 42º north latitude). Discussions below in refers only to this segment of the Coast Range.

The province is characterized by many elongate valleys and ranges that are roughly parallel to the Pacific coast. Drainages are structurally controlled and generally to the northwest. Principle drainages are the Klamath River, Smith River, Redwood Creek and Prairie Creek. Although elevations in the Coast Range are generally between 2,000 feet and 4,000 feet, the relief can be considerable. The highest point in the park is Schoolhouse Peak at 3092 feet. Rodgers Peak is 2745 feet elevation and elevations of over 1000 feet occur less than a quarter mile from the coast.

Geologic History and Stratigraphy

Most of REDW is underlain by rocks of the Franciscan Formation (also called a Group, Series, assemblage, or complex). The Franciscan is composed of greywacke, shale, altered volcanic rocks, chert, some limestones and metamorphic rocks including greenstone (altered submarine volcanics), glaucophane schist, chlorite schist and serpentinized peridotite. The Franciscan Formation is over 50,000 feet thick and no top or bottom has been recognized. The age of the Franciscan extends from Upper Jurassic to Upper Cretaceous (Bailey, *et. al*, 1964). Much of the Franciscan assemblage consists of rock that has been sheared and lifted from the ocean floor as a result of the plate action along the Cascadia subduction zone.

The Franciscan has been subdivided into various units according to lithology, mineralogy, and degree of metamorphism. In the Redwood Creek area southeast of Orick, CA, the Franciscan is divided into four named units (from oldest to youngest): Redwood Creek schist, Snow Camp Mountain unit (west of Redwood Creek), Coyote Creek unit, and Lacks Creek unit (both east of Redwood Creek). There are other unnamed units including the metamorphosed sandstone and mudstone of the Grogan Fault Zone and sandstone and mudstone units above the Lacks Creek unit (Hardin, *et al*, 1981).

The Redwood Creek schist consists of two major rock types: metasedimentary rocks consisting of light-colored, fine-grained schist and phyllite, and metavolcanic rocks which include massive greenstone and fine-grained, foliated metavolcanics (Cashman, *et. al*., 1986). The Snow Camp Mountain unit consists of bedded graywacke and mélange (a mixture of various sized particles and various rock types). The Coyote Creek is an incoherent unit consisting of mudstone with some sandstone and blocks of greenstone and chert (Harden, *et al*, 1981).The Lacks Creek unit is a turbidite deposit consisting of mostly coherent sandstone with interbedded mudstone and sandstone. The sandstone may be massive forming steep slope and prominent ridges.

Coastal plain sediments are present to the north of Redwood Creek designated either the Prairie Creek Formation or the Gold Bluffs Formation. These are unconsolidated to weakly consolidated sand, silts,

and gravels. The oldest sediments contain fragments of Pliocene plant fossils (Harden, *et al*, 1981). Youngest deposits are stream terrace alluvium, landslide deposits, and modern floodplain and overbank deposits.

Significant Geologic Resource Management Issues in Redwood National and State Parks

1. Fluvial processes

The Redwood National Park Act as amended in 1978 gave the Secretary of the Interior the authority to reduce the impacts of upstream sedimentation and to rehabilitate areas that have been subject to timber harvesting in the past. Due to the nature of Franciscan rocks, the steepness of many slopes, the amount of precipitation, and the exposure of soil and bedrock from intensive logging, stream erosion and sedimentation has had and continues to have a profound impact on the park. The lower 40% of Redwood Creek is within REDW and the upper 60% is on private land that has been logged. Redwood Creek has been listed in the Clean Water Act as sediment and temperature impaired.

Monitoring continues on creeks within REDW, including changes in pool and riffle distribution, pebble counts, facies mapping of streambed deposits, and measurements of discharge and turbidity. It may be difficult to determine the exact source of turbidity and sedimentation, but the primary sources are the logging roads both inside and outside the park. The park is surveying roads on private lands and park staff have provide input to Timber Harvest Plans in an attempt to minimize sediment erosion.

2. Seismic Activity

The Redwoods area is seismically very active with frequent earthquakes of magnitude 6 or greater. Much of the activity is related to the Cascade Subduction Zone. Earthquakes of magnitude 9 have occurred on an approximately 500-year interval, triggering landslides and tsunamis which could destroy many park facilities. As revealed by sediment cores, large magnitude earthquakes have resulted in large tsunamis (such as around 1700). The oral history of the Native Americans in the area also tell of significant tsunami events.

3. Shoreline Issues

Much of the park extends along the Pacific shoreline and the park boundary extends out one-quarter mile from the shoreline. Therefore, there is a need to study sediment input and transport along the shoreline. The increase in sedimentation from sediment-choked streams has a great impact on the morphology of the shoreline as sediment is deposited at some areas and erosion accelerates at others. There is a great need for studies of the shoreline position and movement using aerial photography, LIDAR, radar, and ground surveys.

Increasing shipping and oil tanker traffic is also an issue. In an area known for frequent and intense winter storms, the potential for ships being damaged and sinking and releasing their cargo of oil or other hazardous substances is high.

Rock climbing and social trails created by visitors to coastal features is increasing and creating the potential for injury. There may be a need for a climbing management plan to evaluate the problems and dangers of climbing.

4. Other Issues

Aeolian Processes: Coastal sand dunes, although small and localized, are an important resource of the park and habitat for both native and exotic species. The invasion by European bunch grass has stabilized dunes making them less mobile and consequently less suitable habitat for the snowy plover. No vehicular traffic is allowed on the dunes. The use of recreational vehicles on Freshwater Spit has been discontinued; however, some surface restoration from prior use may be needed. Windblown dust from China may have impacts that are not yet known such as the introduction of foreign material, exotic species, and pathogens.

Estuaries: Levees on Redwood Creek have straighten the mouth of the creek so that rather than meandering, the creek shoots straight out. The result is a loss of estuarine habitat and the species that depend on that environment. There has been estuary monitoring on the Klamath River by the U.S. Forest Service and by the Yurok Indian Tribe. Also, the USGS has collected water quality data in some of the estuaries.

Wetlands: Wetlands in REDW are small and many are artificial, having been created by prior surface disturbance. Small wetlands are created by seasonal seeps that are important to elk habitat. Wetlands are located at Dolason Ranch and Prairie Creek Meadows, where the Western lily, a T&E species, may be found. The park needs a wetlands inventory. The Klamath Network wetlands inventory is scheduled for FY'06.

Groundwater: Little is known about the groundwater at REDW. Groundwater studies were done on a well at the Mill Creek campground. Well drawdown maybe impacting Coho in the creek. There is a study by the State of California at Prairie Creek campground to evaluate the water quality related to septic systems. Petroleum-based chemicals have been detected in Lagoon Creek Pond. The source is not known, but may be groundwater related.

Hazards: Geological hazards have a very high priority with the park and most are associated with fluvial processes and seismic activity discussed above. Landslides are natural occurrences on steep slopes underlain by Franciscan rocks, but logging and road construction have accelerated the downhill movement of slope material. This has also increased sedimentation in stream and the potential for rockfalls. The channelization of streams allows large slugs of sediment to move rapidly (and more destructively) downstream.

Large dormant and paleo-landslides are being mapped, but the smaller features associated with specific surface disturbances are also of great concern. Erosional and landslide hazards on Redwood Creek were mapped by Steve Coleman in 1973. A 1978 coastal landslide map is available. At present there are no facilities located on or near active landslides. Campgrounds are located on floodplains which may be at increased risk from flooding and mudflows. In 1997, storm events triggered about 400 landslides, taking out roads and culverts. Most event occur during the winter when there is lower visitation.

Road restoration has been a major undertaking at the park. This effort has restored many of the old logging roads and reduced landslide activity in those areas. However, most roads open to visitor traffic are gravel and subject to erosion. The adequacy of culverts used to channel water and debris should be continually monitored.

Paleontological resources: Although the paleontological resources are not extensive, their occurrence has helped with the dating of the Franciscan Formation. Petrified wood, carbonized wood, and ammonites have been found at Gold Beach. Diatomaceous cherts and pollen have also been found in the fossil record. Pollen are helpful indicators of paleoclimate and have been dated to about 6,000+ years.

Mining: Little mining has been done in the area of the park. Sand and gravel mining has occurred outside the park. Nickel and cadmium mining operations are being proposed north of the park.

Serpentine soils: Serpentine is a naturally occurring mineral in Franciscan rocks and soils. The concern of serpentine is the potential to contain asbestiform crystals which are carcinogenic. Although a trail goes through one serpentine-bearing unit, there appears to be no serious concern about the soils; however, some high levels of asbestos have been detected in water samples. Serpentine soils in wetlands provide habitat for the rare plant Dalintonia. This should be studied more closely as part of a wetlands inventory.

Minerals: Other than the occurrence of serpentine, one of the minerals unique to the park is orickite. Orickite, named after the town of Orick, CA, is a yellow hexagonal, copper-bearing mineral with the same basic formula as chalcopyrite, but with added water: $CuFeS_2 \cdot nH_2O$.

Interpretation: The General Management Plan (GMP) for REDW identifies geology as an interpretative theme. At present floods and tsunamis are the focus of interpretation. A graduate student currently developing a interpretive manual for the park. There is a need to develop a road guide to the park that includes geology and soils for visitors who do not leave their vehicles. The Geoscientist-in-the-Park Program through the Geologic Resources Division can provide a geologist who could help develop an interpretative program.

Unique Features: REDW staff identified the following as unique geologic features in the park:

1. Gold Bluff
2. Josephine Ophiolite
3. Sea stacks

Scoping Meeting Participants

Tim Connors	Geologist	NPS, Geologic Resources Division
Sid Covington	Geologist	NPS, Geologic Resources Division
Anne Poole	Geologist	NPS, Geologic Resources Division
Pete Biggam	Soil Scientist	NPS, Natural Resources Information Div.
Joe Seney	Soil Scientist	USDA, Natural Resources Conservation Service
Chris Currens	Aquatic Biologist	USGS, Biological Resources Division
Marsha Davis	Geologist	NPS, Columbia Cascades Support Office
Vicki Osaki	Geologist	NPS. Redwoods National and State Parks
Mary Madej	Geologist	USGS, Geologic Division
Daniel Sarr	Network Coordinator	NPS, Klamath Network
Bob Truitt	Data Manager	NPS, Klamath Network
Hanna Waterstat	Data Miner	NPS, Klamath Network

References

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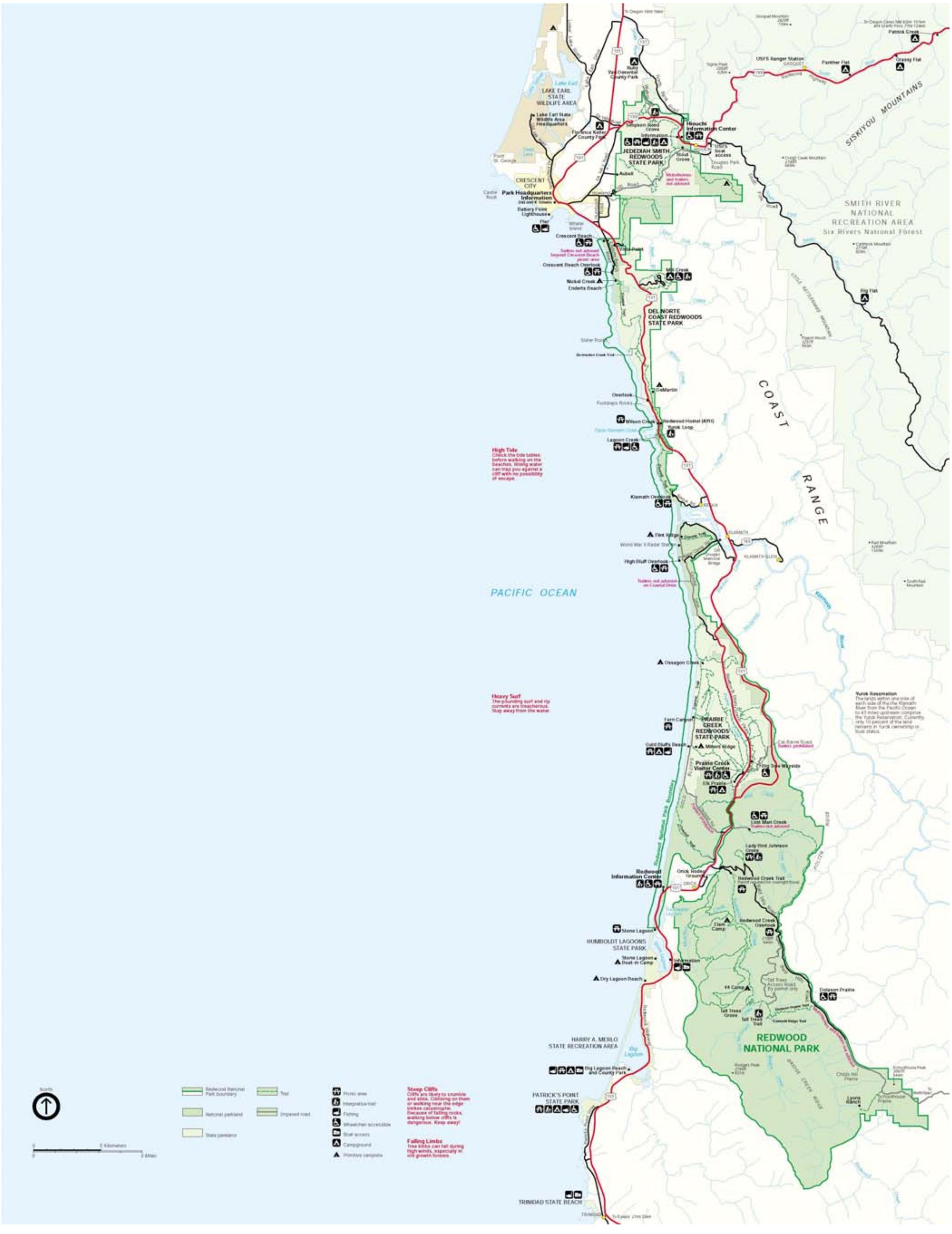

High Tide
Check the tide tables before walking on the beaches. Rising water can trap you against a cliff with no possibility of escape.
PACIFIC OCEAN
Heavy Surf
The pounding surf and rip currents are treacherous. Stay away from the water.
LAKE EARL STATE WILDLIFE AREA
CRESCENT CITY
Park Headquarters Information
Hiouchi Information Center
JEDEDIAH SMITH REDWOODS STATE PARK
SISKIYOU MOUNTAINS
SMITH RIVER NATIONAL RECREATION AREA
Six Rivers National Forest
DEL NORTE COAST REDWOODS STATE PARK
COAST RANGE
PRAIRIE CREEK REDWOODS STATE PARK
Prairie Creek Visitor Center
Redwood Information Center
HUMBOLDT LAGOONS STATE PARK
HARRY A. MERLO STATE RECREATION AREA
PATRICK'S POINT STATE PARK
TRINIDAD STATE BEACH
REDWOOD NATIONAL PARK
North
Redwood National Park boundary
National parkland
State parkland
Trail
Unpaved road
Picnic area
Interpretive trail
Fishing
Wheelchair accessible
Boat access
Campground
Primitive campsite
Steep Cliffs
Cliffs are likely to crumble and slide. Climbing on them or walking near the edge invites catastrophe. Because of falling rocks, walking below cliffs is dangerous. Keep away!
Falling Limbs
Tree limbs can fall during high winds, especially in old growth forests.