

Redwood National and State Parks Coastal Inventory Protocol and 1st Annual Report (January 2006)

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Introduction

Redwood National and State Parks are located along the North West coast of California's Pacific Ocean, from Orick to Crescent City, encompassing 37 miles of coastline. The parks coastline is diverse in its overall geology and landscape, leading to an equally diverse numbers of habitats. These different habitats lead to a wide range of ecological communities with a large number of species.

The park, contracted through a cooperative agreement with Humboldt State University scientists, has decided to fund an examination of the habitat and diversity of intertidal animals along the parks coastline, through a coastal inventory project beginning in the summer of 2005 and running through the completion of this inventory, in January of 2007. The results of this study will be integrated into a database that includes GIS information.

Field data collection followed a protocol that came from the melding of two different protocols, both from similar projects: (1) the first project done for Glacier Bay National Park, and (2) the other for Point Reyes National Seashore. During low tide windows throughout the summer of 2005 a research team walked the coast delineating segments based on geomorphologic features and collecting data on physical and biological attributes. Data collected included photos and GIS points for each segment as well as many biological and physical observations (see methods for details), and specimens.

At this point over a hundred segments have been sampled and over 300 pictures taken. The sampling will continue this summer (2006) when the summer negative low tide season begins (May 15th, 2006). Throughout 2006 the data will be used to compile a Microsoft Access database, offering a user-friendly tool to examine the parks' coastal biotic and physical diversity. This will allow park biologists to look at trends in species diversity, locate bio-diversity hotspots and unique habitats, collect baseline information on the species found along the parks' coast, and build a current specimen collection.

Study Area

The study area for this project encompasses the coastline of Redwood National and State Parks in Northern California, which extends from Crescent City to Orick, CA. The coastline surveyed during the summer 2005 season consisted of the highlighted areas on the map below, with each survey covering 20-100 m of shoreline. Remaining coastline will be surveyed during the upcoming summer field season (May-Aug 2006), and two off-shore pinnacles (yet to be determined) will also be examined.

Methods and Field Data Collection Protocols

Segment Delineation and Geomorphology

The coastline was broken down into segments from 20-100 m. The length of a segment was determined by the substrate recorder, and one other intern. A pedometer was used to measure distance. Delineation for a segment change was driven by changes in either substrate structure (using the Wentworth Scale) or beach slope, measured with an inclinometer. Rules for determination are as follows:

Segment Breaks and Substrate Guidelines:

- 1) Segments are a minimum of 20 m in length, except for special segments. (e.g. going around headlands)
- 2) Change in primary substrate type results in change of segment number.
- 3) Change in secondary substrate by a single step if it is $\geq$ pebbles results in change in segment number.

- 4) Change in Slope:
 - a) by three degrees if slope is between 0-5,
 - b) by at least five degrees if slope is between 6-15.
- 5) Modifiers consist of patches of a specific substrate type as outlined by the Wentworth Scale. In order to be a modifier, patches can be no greater than 33%. If over 33%, the substrate would be considered secondary.
- 6) Perpendicular length no greater than 100 m.

Definitions

Modifiers – Patches of a specific substrate type as outlined by the Wentworth Scale that falls within 1%-33% of the total segment.

Primary substrate – The most abundant substrate within a given segment.

Secondary Substrate – The second most abundant substrate within a given segment.

Special Segments – Consist of Pocket Beaches, around heads, or very long homogenous stretches of sandy beach (e.g. Klamath Spit).

Typical vs. Complex Beach – A typical beach has a well defined slope and/or substrate. Complex beaches are uncommon, usually rocky and have a continuously changing slope with no clear geomorphological pattern.

Wentworth Scale – A linear size scale used to define grain sizes in sediments and sedimentary rocks.

Bedrock = Continuous rock

Boulder ≥ Head size (>256 mm)

Cobble = Pool ball to head size (64-256 mm)

Pebble = Pea to pool ball size (4-64 mm)

Granule = BB to pea size (2-4 mm)

Coarse Sand = pinhead to bb (1-2mm)

Fine Sand $\leq$ pinhead (should feel like salt or sugar)

GPS Measurements

For each segment, 2-4 GPS points were recorded. A specific point was first given a complete segment ID number followed by the number 01, 02, 03 or 04. If four points were taken for a segment, 01 would lie half way along the perpendicular transect line on the northern most edge (also the start point) of that given transect. Point 02 would then lie opposite to that on the southern boundary.) and point 04 would lie along the middle of the transect as close to the waterline as possible, 03 would be taken along the middle transect farthest from the water. When safety was a concern, only the north and south end boundary points were measured. This was the case when surf was heavy and breaking onshore, or if surf was breaking onto large boulders in narrow segments.

Photographs

Digital photographs were taken for each transect to record landscape morphology and type. Approximately 1-4 digital photos were taken per transect. Fewer photographs were taken when homogenous 100 m segments were being inventoried. For each segment photos were also taken of biota if a) a species could not be identified on site or b) of interesting tide pool formations, algae, and other observed wildlife occurred.

Biota Inventory

For each segment two surveyors conducted a biota inventory of the intertidal zone that included algae, invertebrates, fish, and other observable wildlife. Taxa were recorded on a standardized, check list style data sheet. Unknown genera were photographed and, when necessary, collected and later identified at the Telonicher Marine Lab. For each taxonomic group observed during a survey it was noted whether it was rare, present or common. A given species was considered rare if 1-5 were identified per a given segment, present if 6-25 were identified, and common if 26- ∞ were identified. Survey duration for each segment was between 4-10 min. The maximum survey time was dependent on how difficult it was to navigate the terrain of that segment (e.g. tide pools or very rocky segments were harder to walk along than sandy beach segments).

Segment Identification Numbers

Segments were labeled with a four part identification number related to the year, field leader, site locality/orientation, and segment number. The first part consisted of the last two digits of the year (e.g. 2005 = 05). The next part contained the field leaders initials (KC=Kalei Colridge), followed by an abbreviation for the site locality surveyed. For example: Enderts Beach = EN followed by an N or an S to represent North or South of the entry point, FS = Footsteps Rock, SR= Split Rock, etc. The last number was the specific segment number within that site. An example of a complete ID number for the 5th segment surveyed at False Klamath moving south from the start point would be 05KCFKS05.

Hydrological Information

Streams and cliff seeps were recorded for each segment when present. Features noted were: width, depth, clarity, high gradient (Yes or No), and perennial flow (or assumed perennial flow, also Yes or No). Clarity fell into the categories of clear (C), discolored (D), turbid (T), or no water (N).

Human Objects/Impacts

Notes were made of any human object observed within a segment, or any clear impacts made upon the site by humans.

Additional Information

This consisted of a check box table to note the presence or absence of commonly observed biotic, geologic and miscellaneous items seen on the coast. See data sheet for specific categories.

Narrative

For each segment a narrative was made. This was an opportunity to note details of a segment that were not taken into consideration in the data sheets as well as other miscellaneous observations.

Upland Vegetation

Upland vegetation was recorded for each site. The data was represented by the percent coverage of the general vegetation types found on the coastline within the park, for each site. The categories can be found on the second page of the protocol sheet under “Upland Vegetation”.

Transects

The two biota surveyors were also responsible for recording the location of specific information about the beach with regard to the perpendicular transect line running the middle length of the segment. A third surveyor was responsible for conducting pedometer measurements and walked the transect line with the two biota surveyors and recorded the meter distance for the upper and lower beach (if present) as well as the demarcations (if present) for browse zones, barnacle bands, muscle bands, algae, halophytic area, true terrestrial areas, berms, and wrack line. Not all of these features were always present, and they were only recorded if they consisted of clearly demarcated areas. The biota surveyors also recorded the photograph numbers for each section or segment.

Database

All data will be entered into a Microsoft Access database so that all recorded segment information will be linked together-but none of this has been done yet.

Results

Biota surveyed during the summer 2005 field season were catalogued in a Microsoft Excel spreadsheet for each site locality. The biota table (see below) lists each site locality and the number of segments (s) per site and the correlating taxa found per number of segments per site. Upon completion of this project the park will receive a compilation of all data in a database format that can allow for the cross examination of the information collected.

Preliminary findings show a wide variety of marine invertebrates and algae along the coastline. An average of 15 algal taxa and 23 invertebrate taxa were found per site with the most depauperate sites appearing to consist of habitat dominated by a sandy beach substratum. Changes in substrate seem to drive changes in the types and abundances of species, as well as their location along the coastline, which is most likely due to changes in wave exposure due to location. At the time of completion of this project, the RNSP will be able to examine these trends using the database provided. This database will also include the results for slope, upland vegetation, photographs for each site, and the rest of the information outlined in the methods section.

A collection of some marine invertebrates and algae have been cataloged. At the conclusion of next summer's field season, this collection will be completed and handed over to the park as part of the results of the on-going project. All specimens will be identified at least to genus, if not species, and will include site locality information.

Table - Biota, Summer 2005

Biota Inventory	(s=13)	COH (s=1)	COS (s=1)	COHPB (s=1)	ESP (s=2)	EN (s=6)	ES (s=11)	FSRN (s=5)	FSRS (s=11)	KLM (s=2)	FR (s=14)	TB (s=6)	SR (s=11)	WCP (s=1)	WC (s=3)	FK (s=7)
Algae:																
<i>Constantinia</i> sp.							2									
<i>Constantinia simplex</i>															1	
Micro algae											1	1				
Unid. alga												1	1			
<i>Acrosiphonia</i> sp.																1
<i>Cladophora</i> sp.	2	1	1	1			1	5	4		8	5	8			1
<i>Codium fragile</i>									1							
<i>Codium setchilli</i>									1							
<i>Ulva</i> sp.	1	1	1	1		6	7	3	7		3		3	1	4	6
Unid. green alga "feathery"									2							
af. <i>Cystoseira</i> sp.															2	
<i>Alaria marginata</i>			1	1	2	6	6	1	8					1	4	3
<i>Analipus</i> sp.							2	1	1						1	
<i>Cystoseira osmondasia</i>															1	
<i>Cystoseira</i> sp.									2	1			1			
<i>Desmarestia</i> sp.		1							1							
<i>Egregia</i> sp.	1		1	1	2	6	6	1			2		1	1	2	7
<i>Fucus</i> sp.	1					1	2		4					1	3	7
<i>Hedophyllum</i> sp.									4						3	7

<i>Laminaria sp.</i>		1	1	1	2	4	9	2	9					1	2	4
<i>Nerocystis sp.</i>												1				1
<i>Pelvetiopsis sp.</i>	1	1	1				3	5	8		1				5	7
<i>Postelsia sp.</i>					2			4	4	1				1		
<i>Pterogophora sp.</i>																1
<i>Ralphsia sp.</i>												2				1
Diatoms (Berkealia)							1									
<i>af. Prionitis sp.</i>									1		1					
<i>Anfeliopsis sp.</i>	2	1		1		4	1									2
<i>Callithamnion sp.</i>							1									
<i>Ceramium sp.</i>									1							
Coralline - articulate	1	1	1	1		4	7	5	10					1	3	4
Coralline - crustose	1	1	1	1	1	6	7	3	10					1	5	7
<i>Endocladia sp.</i>		1	1		2	2	5	5	11			2		1	3	6
<i>Erythrophyllum sp.</i>																1
<i>Gigartina sp.</i>			1				1									
<i>Mastocarpus sp.</i>	2	1	1	1		5	7	5	11		1	1	5	1	5	6
<i>Mazzaella sp.</i>	1	1	1	1	2	5	6	2	8		1	3	9		3	7
<i>Microcladia sp.</i>	1	1		1	1	1	2	2	2							2
<i>Neorhodomela sp.</i>					1		2	3	9					1	4	7
<i>Odonthalia sp.</i>						1	5	1				1			1	3
<i>Porphyra sp.</i>	2	1	1	1	2	5	7	1	10		4		7	1	3	7
<i>Prionitis sp.</i>	2	1		1		2	3	1	1		1			1	2	4
Unid. red alga						2										
Unid. red alga w/ mid rib									3							
<i>Phyllospadix sp.</i>	1			1	2		5	3	9					1	4	7

NO. OF ALGAL TAXA PER

SITE =

14 14 13 14 11 17 24 19 27 2 7 8 12 14 22 24

Fish:

Fish		1							1	1						
Sculpin				1		2	2		4					1	5	5

Invertebrates:

<i>Amphiporus sp.</i>									2							
Nemertean						2			1					1		
<i>Dugesia sp.</i>							1									
Feather duster										1						
Polychaete						1			1			2			1	
<i>Nephtys sp.</i>							1									
<i>Nereis sp.</i>												1				
<i>Phragmatapoma sp.</i>	1						1		1							3
Serpulid						1	2									
Bivalve	2															
<i>Mya arenaria</i>											1					
<i>Mytilus sp.</i>	3	1	1	1	2	3	4	5	10		5	2	10	1	5	4
<i>Penitella sp.</i>														1		
Quahog	1															
Razor clam (white)	2															

<i>Calliostoma sp.</i>									1							
<i>Haliotis cracherodii</i>																
Limpet	2	1	1		2	5	5	5	11		4	6	4	1	5	6
Limpet - <i>Collisella</i> sp.											5		1			
Limpet - small black											2					
Limpet - small striped											1					
Limpet (d.)	1															
<i>Littorina</i> sp.	2		1			2	3		11		1	1	2	1	4	6
<i>Lottia digitalis</i>											1					
<i>Lottia gigantea</i>																1
<i>Nucella</i> sp.	1		1				4	1	9		2	1		1	2	5
<i>Olivella biplicata</i> (purple olive)	6															
Snails	4	1	1	1	2	4	5	5	10		2	1	2	1	5	4
<i>Tegula brunnea</i>									1							
<i>Tegula funebris</i>	2						4		8					1	4	7
<i>Acanthodoris nanaimoensis</i>									1							
Aeolid						2	2	1	1					1		1
Dorid						2	3		2					1	2	3
<i>Hemissenda crassicornis</i>				1			1		2							
<i>Triopha</i> sp.				1		1	1									
<i>Onchidella</i> sp.(Leather "limpet")									2					1		
<i>Cryptochiton</i> sp.									1							1
<i>Katharina</i> sp.				1			2	3	10					1		2
<i>Lepidochiton dentiens</i>									1							
<i>Lepidozona</i> sp.							1									
<i>Mopalia</i> sp.	1		1				1		2			1				
<i>Tonicella</i> sp.						1										
<i>Anthopleura artemisia</i>			1				1	1								1
<i>Anthopleura elegantissima</i>	2	1	1	1	2	6	6	3	11		1	1		1	3	6
<i>Anthopleura xanthogrammica</i>	2	1	1	1	2	3	6	3	9		1		2	1	4	3
Burrowing anemone						2										
Burrowing tube anemone				1		1										
Christmas tree anemone							1									
<i>Urticina</i> sp. (red/grn polyp)															1	
<i>Aglaophenia</i> sp.	1						2									
Hydroid	2	1		1	1	4	5			1	1				1	
<i>Tubularia</i> sp.								1	2							
<i>Balanus nubilus</i>														1		
Bamacle - acom (Balanomorpha)	2	1	1	1		6	4	5	11		10	4	11	1	5	7
Bamacle - thatched (Balanomorpha)	2	1		1			1				3	1	2			1
<i>Pollicipes</i> sp.	2	1	1	1		3	2	5	10		4	3	11		5	4
<i>Semibalanus cariosus</i>			1													
<i>Semibalanus</i> sp.				1			1								1	
<i>Cancer antennarius</i>		1														
<i>Cancer magister</i>	2				1					1						
<i>Cancer magister</i> (carapace)	1				1					1	3					
<i>Cancer productus</i>					2		2									

coast will occur. The fall (2006) will bring about the completion of this report and database.

The protocol, combining methods from Point Reyes National Seashore and Glacier Bay National park, worked well for RNSP's coastline, though a few changes were made. These changes were done to tailor the protocol specifically to RNSP. Species check sheets were changed; certain species found in the other two parks are not found in RNSP and were left off the data sheet, whereas new species were added. We also implemented the use of a pedometer to measure segments, because much of RNSP's coast is very rocky, making it difficult to use a meter tape.

Thus far, with out any serious examination of the data trends, the types of species found seem to show patterns dependent on habitat. Upon completion of this study, park biologists will be able to use the database to examine these trends and pinpoint habitats and species locations that require special consideration using the database.

Given the ongoing nature of the project, this draft is not final. Most importantly missing is the database, which cannot be completed until the sampling is complete. The project focus this coming fall (2006) will be to fine-tune this database so that it is user friendly for park staff.

The information provided by this project will allow park staff to hone in on the physical attributes of different coastal segments of the Redwood National and State Park to get a broad perspective on where the majority of marine intertidal species diversity occurs. This will enable the park to focus it's limited resources on conservation of those sites deemed most important for maintaining the biodiversity along this relatively pristine stretch of coastline, in order to insure that future generations can continue to marvel at the remarkable marine resources it contains.

References

Muchow Rhea S et al. "Point Reyes National Seashore/ GoldenGate National Recreation Area Coastal Inventory Protocol, Draft." 2004
Sharman, L et al. "Alaska Coastal Inventory and Mapping Protocol". 1998.

