

## PROTOCOL DEVELOPMENT SUMMARY

**Protocol:** NCCN Vital Signs Intertidal Monitoring

**Parks where protocol may be implemented:** This protocol will be implemented at LEWI, OLYM, and SAJH. On monitoring component, the extensive rocky intertidal monitoring, is being conducted at other NPS coastal parks (CABR, CHIP, PORE, REDW, ACAD) in addition to other West coast areas outside of NPS units.

### **Justification:**

The intertidal zone occupies the overlap between terrestrial and nearshore marine ecosystems. As such, the processes and organisms there are susceptible to anthropogenic stressors from both land and sea. The NCCN intertidal zone is an extremely rich reservoir of biodiversity that is important both ecologically and culturally. These areas host the highest diversity of marine invertebrates and macroalgae on the west coast of North America. At OLYM alone where no formal coastwide inventory has been conducted, over 350 species of invertebrates and macroalgae have been recorded. These biological communities serve a key functional role in the foodweb dynamics of the nearshore ecosystem, manifested through nutrient transport, and direct exchange of organisms between zones. Most benthic invertebrates and macroalgae have pelagic life-stages that live in the nearshore coastal ocean and contribute to its highly productive foodweb. Intertidal organisms are relied upon by Native American communities for ceremonial and subsistence purposes, and non-natives also exploit intertidal resources and appreciate the intrinsic beauty and wilderness character of the intertidal zone. Intertidal monitoring has developed over the past 20 years into a robust scientific field with sophisticated methodologies that are capable of detecting change in physical and biological characters at meaningful levels of resolution.

Ultimately, the intertidal monitoring program proposed here will allow park managers to detect meaningful changes in key intertidal communities and a fundamental physical characteristic of the nearshore ocean (temperature). Once detected, park managers can conduct targeted research or coordinate with other agencies to identify cause. Where causes are known, park managers can consider and implement a range of management actions to address changes. The nature of management actions will necessarily depend upon what factors are causing changes. Some factors are within control of the NPS (i.e. harvest, access issues), while others are outside of its control. In the latter case, park data may be useful to bolster evidence for a cause/change (i.e. climate change effects, commercial fishing impacts) that may ultimately be useful for altering behavior beyond park boundaries.

### **Monitoring Questions & Objectives:**

The overarching goal of this monitoring program is to detect substantive trends in community structure and species abundance in sand beach and rocky intertidal habitats, in addition to detecting trends in intertidal water temperatures. These vital signs are

parameters that best characterize the quality and/or natural function of the intertidal zone given the available funding and best available methodologies. This monitoring program is designed to detect changes in vital signs more as an early warning system, rather than as a program that identifies causal agents of trends. Given the parameters measured, it is hoped that the monitoring program may at least suggest possible root causes. The discovery of significant trends should serve as a trigger for further directed research to identify root causes and determine appropriate management actions.

Specific objectives of this monitoring program area:

1. Characterize the inter-annual natural variation in community composition, distribution and abundance of key species in upper elevation sand beach and rocky platform invertebrate and macroalgae communities.
2. Characterize the natural variation in intertidal water and air (when tidally exposed) temperatures across the geographical gradient found within the NCCN parks. This includes the longitudinal gradient from Puget Sound to the open coast, and the latitudinal gradient down the Washington coastline.
3. Monitor long term trends in these parameters to detect significant changes and trigger targeted research to determine causal stressors and formulate appropriate management actions.

Fiscal and logistical constraints (funding, number of low tide series, exposure time, and taxonomic complexity) limit the scope, objectives, number of sites, number of habitat types, and parameters that can be measured in the proposed monitoring program. Cobble, soft sediment, estuarine, and gravel habitats, in addition to surfgrass beds, intertidal fish assemblages, and biotic communities in the lower elevation zones of sand beach and rocky intertidal habitats are not considered here. Some of these facets may be added to the program in the future contingent upon the availability of additional funding.

### **Basic Approach:**

The sampling design proposed in this protocol consists of 3 components; 1) intertidal temperature monitoring, 2) sand beach community monitoring, and 3) rocky shoreline community monitoring. Community monitoring components focus on marine invertebrates and macroalgae (seaweeds) and do not address intertidal fish or highly mobile invertebrates (i.e. shorecrabs etc.). Below is a brief description of each protocol component.

#### ***Intertidal Temperature***

Water temperature is also a key indicator of climate change effects on the nearshore ocean. Intertidal organisms are regularly bathed in seawater and exposed to air for extended periods of time. Water and exposed surface temperatures can alter intertidal community structure by altering physiological rates and/or exceeding the physiological tolerances of organism. A set of temperature dataloggers will be deployed in each of the target parks at the mid intertidal level to assess seasonal and inter-annual water and

exposed surface temperature trends. Data loggers will continuously monitor temperature year-round on an hourly basis.

### ***Sand Beach Community Monitoring***

Sand beaches and their infaunal communities are particularly susceptible to global climate change, shoreline modification, and oil spills. Sand beach infaunal communities are key resources to migrating birds, and play an important role in nutrient recycling in the nearshore ocean. Sand beaches are dominant habitats in the NCCN. For example, in OLYM, sand beaches make up 30% of the coastline. Monitoring of invertebrates living in fine sand beaches will be conducted at target parks with appropriate exposed wave-dominated dissipative beaches. Three random transects that will be established annually at each target beach. Each vertical transect will be 60 m long perpendicular to the beach starting at the recent high tide line. Sampling stations will be spaced every 7.5 m along transects, where 4 sediment cores will be extracted and passed through a fine sieve to retain all infaunal organisms. All organisms will be counted and identified to the appropriate taxonomic level. The elevational profile of each transect will be surveyed, and sediment samples from each station will be collected to determine substrate composition.

### ***Rocky Shoreline Community Monitoring***

Rocky shorelines are some of the most charismatic, diverse ecosystems in the world, and are a major habitat in NCCN parks. In OLYM, rocky shoreline occupies approximately 21% of the coastline. These systems are susceptible to global climate change, oil spills, overharvest, and trampling effects. This monitoring component has two sub-components, **Extensive** and **Intensive** monitoring plots.

**Extensive** monitoring plots are comparable to the core rocky photo plots monitored by the Multi Agency Rocky Intertidal Network (MARINE) along the West Coast of North America. Fixed replicate plots at a site target core species (barnacles and mussels) with 5 replicate plots per target group. These plots are most useful for coast-wide comparisons of changes in core species abundances.

**Intensive** monitoring plots are larger areas than extensive plots and include an elevational gradient. These randomly located band transects are 10 m along shore and vary in width to cover the high and mid intertidal zones characterized by the barnacle and mussel bands. Plots are sampled using random point counts and random quadrats to estimate percent cover of sessile organisms and abundance of weakly mobile organisms respectively. Intensive plots are sampled to a higher taxonomic resolution than extensive plots to provide more detailed community information.

The Annual sequence of monitoring events appears in Table 1 below.

**Table 1: Annual monitoring event sequence.**

Month	Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec	
Week	1	15	1	15	1	15	1	15	1	15	1	15	1	15	1	15	1	15	1	15	1	15	1	15
Hiring																								
Training																								
Data Collection																								
Data Entry																								
QA/QC																								
Reporting																								
Records Mgmt																								

**Principal Investigator/NPS Lead:** Steven C. Fradkin (OLYM)

**Development Schedule, Budget, Expected Interim Products:**

The draft protocol has been completed and the protocol is currently in the NCCN peer-review process (as of April 15, 2008).