

South Slough National Estuarine Research Reserve

Management Plan

2017-2022

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Chapter 1: Executive Summary

Plan Purpose and Scope

Since its founding as the nation's first National Estuarine Research Reserve, the South Slough National Estuarine Research Reserve (Reserve) has been a leader in improving the stewardship and understanding of Pacific Northwest estuaries and coastal watersheds. The Reserve is managed through a partnership between the National Oceanic and Atmosphere Administration (NOAA) and the Oregon Department of State Lands (DSL).

Federal regulations require that the Reserve prepares a five-year management plan to provide direction for Reserve programs. This plan, for 2017-2022, is the fourth edition of a Reserve management plan and supports the strategic goals of NOAA and DSL. Its geographic scope includes all lands within the formal boundaries of the Reserve.

Reserve management priorities for 2017-2022 include climate change, habitat protection, and invasive species. The strategic plan included in this document, which addresses these priorities, was developed through collaborative engagement with partners, including professional colleagues and public and private stakeholders. The strategic plan responds to needs through the integrated activities of the Research, Stewardship, Education, Public Involvement, and Coastal Training programs. The purpose of this plan is to provide a framework for program undertakings over the next five years, and to guide Reserve staff and stakeholders in management decisions.

In order to track and measure progress, the Reserve periodically submits reports to the National Estuarine Research Reserve System (Reserve System) and to DSL. As directed by Section 312 of the Coastal Resource Management Act, NOAA conducts periodic program reviews to ensure Reserve consistency with federal laws and NOAA policies. DSL regularly evaluates agency key performance measures related to Reserve undertakings and the objectives outlined in the 2017-2022 strategic plan provide measurable metrics.

Reserve Context

Designated on June 27, 1974, the 4,771-acre (1930.76-hectare) Reserve is located on the South Slough of the Coos estuary in Coos County, Oregon, about 220 miles southwest of Portland. The Coos Bay estuary comprises the largest and deepest port between San Francisco and the Columbia River. Coos County is home to about one third of Oregon's coastal population and the Reserve itself neighbors the two largest cities in the area, North Bend and Coos Bay. The Reserve encompasses a mixture of open water channels, tidal and freshwater wetlands, riparian areas, and forested uplands (Figure 1.1).

The South Slough has a long cultural history, having been inhabited for millennia by the Coos and Coquille Indians, and more recently by European descendants. The Tribal and European legacies within the Reserve still influence working partnerships and program activities.



Figure 1.1: Aerial view of the South Slough estuary, primarily showing Winchester arm. View is looking north.

Environmental influences and stressors to the Reserve and surrounding areas include proximity to the Cascadia subduction zone, sea level rise, ocean acidification, invasive species, fragmented habitat connectivity, and anthropogenic inputs, such as non-point source pollution.

Political, social, and economic influences on the Reserve include its proximity to one of Oregon's main fishing ports (Charleston) (Figure 1.3); its location as a site for local oyster cultivators; its existence as a public asset for residents and visitors of Coos County; and its role as a provider of educational services in the state and region.

The Reserve is composed of the Education Program, the Science Program, and Administration. The Education Program houses the education staff, the Coastal Training Program, and the Public Involvement Program, while the Science

Program houses research staff, the Monitoring Programs, and the Stewardship Program. All programs integrate to support the Reserve's mission and establish its niche.

Reserve Niche & Role in Addressing Coastal Management Issues

The Reserve's niche is to serve as a living laboratory and classroom, as well as a monitoring and reference site for coastal research and education. The Reserve also contributes to improving habitat connectivity and resiliency in its region. The niche is defined by Oregon's statutory management policy, which directs the Reserve to maintain the integrity of the estuary; protect the estuary from uses and activities that alter or affect its natural dynamics processes; and preserve the area for long-term research and education.

The Reserve's niche is also defined by its contributions to the Reserve System and to coastal management. The Reserve is a SWMP site, including acting as a Sentinel Site in the Reserve System. Reserve programs monitor ecological change over time and provide scientific information to coastal managers and residents for informing planning, resource management, and decision-making.



Figure 1.2: Science Program summer internship.

Priority Coastal Management Issues and Reserve Goals

The following priorities and goals compose the 2017-2022 strategic plan. Reserve programs will work together to address the following:

Priority Climate Change

Goal 1: Increase Reserve understanding of the local effects of sea level rise.

Goal 2: Increase Reserve understanding of ocean acidification in the Pacific Northwest.

Goal 3: Increase Reserve understanding of the relationships between climate change and ecosystem functions in Pacific Northwest marine and estuarine environments.

Goal 4: Increase communications about actual and potential climate change impacts to diverse audiences.

Priority Habitat Protection

Goal 1: Assess and monitor habitats in the Coos estuary in order to characterize conditions and changes in habitat use and availability.

Goal 2: Continue to build the ridgetop-to-estuary habitat restoration program.

Goal 3: Increase public awareness of Reserve stewardship practices, habitat-related research, and habitat protection.

Priority Invasive Species

Goal 1: Characterize and monitor the extent of invasive species affecting the Reserve.



Figure 1.3: The fishing port of Charleston, Oregon, at the mouth of the South Slough estuary.

Goal 2: Measure and track the impacts of invasive species in coastal habitats.

Goal 3: Reduce the impact of invasive species negatively affecting or threatening the Reserve.

Goal 4: Increase distribution of information about the status and impacts of invasive species to diverse audiences.

Reserve Programs Overview

Research, Monitoring, and Stewardship

The Reserve Science Program conducts and coordinates all estuarine research, monitoring and stewardship activities within the Reserve. The Science Program also often extends research and monitoring efforts into the Coos estuary, gathering and making available information necessary for improved understanding and management of estuarine systems.

The science team is overseen by a research coordinator and includes the watershed monitoring coordinator, the estuarine monitoring coordinator, a monitoring technician, and the stewardship coordinator. Additionally, research assistants, part-time or

temporary employees, specialists, interns, and volunteers aid in carrying out work related to specific, usually grant-funded, projects and tasks. The program is in charge of implementing national programs including SWMP), the Sentinel Site program, and a Habitat Mapping & Change program, which is part of SWMP.

The geographic scope of the Science Program extends from the Reserve, the South Slough, and the Coos estuary, throughout the Pacific Northwest and across the Reserve System.

Education, Coastal Training, and Public Involvement

The Reserve Education Program coordinates all public outreach, education, interpretation, and coastal training activities at the Reserve. The program is designed to enhance public awareness and understanding of estuarine ecosystems and provide appropriate opportunities for public education and interpretation.

The education team is overseen by the education program coordinator and includes an education program specialist, the coastal training program coordinator, a public involvement coordinator, and various temporary workers, interns, and volunteers. Education activities

include formal and informal education, public involvement and volunteer coordination, public programs and events, and training and technical assistance for coastal managers and residents. The Education Program is also in charge of implementing the national Teachers on the Estuary (TOTE) program at the Reserve.

The Education Program primarily draws participation from schools across Oregon and visitors from the West Coast, although tourists from throughout the United States and world visit the Reserve as well. The primary audience for the Reserve's educational efforts is within a six county area of southwestern Oregon; Coos, Curry, Douglas, Lane, Jackson, and Josephine. The geographic scope of the Public Involvement Program primarily includes, but is not limited to, the Southern Oregon coastal region. The Coastal Training Program focuses on coastal managers and decision makers in the lower Columbia biogeographic region.

Program integration for achieving goals

A highly communicative and inclusive working culture at the Reserve supports cross-program integration, which in turn facilitates success. For example, the staff at the Reserve collectively developed the 2017-2022 strategic plan so that strategic actions were priority based, instead of program based. Although each action has a programmatic lead, multiple sectors of the Reserve are tasked with coordinating actions to accomplish objectives and goals. Regular all staff updates, cross-program support and involvement, and a culture of respect at the Reserve, allow for collaboration and deeper community involvement.



Figure 1.4: Summer campers with seasonal education staff on a trail hike.

Major Changes Since the 2006-2011 Management Plan

The 2017-2022 strategic plan is priority based, with cross-sector goals that focus on climate change, habitat protection, and invasive species. Reserve programs are assigned as leads to objectives and actions.

This plan includes an explicit Facilities Plan, a Public Use Plan, and a Land Acquisition Plan.

A Public Involvement Program section has been added to the Program Foundations chapter.

The Stewardship Program section has been folded into the Science Program section of the Program Foundations chapter. Stewardship Program activities are also highlighted in the Land Acquisition Plan, Resource Protection Plan, and Public Use Plan.

Similarly, the Estuarine Monitoring Program and Watershed Monitoring Program are also captured in the Science Program section of the Program Foundations chapter.

The description of the Reserve setting is now folded into the Introduction, whereas in the last plan it was separate.

Chapter 2: Introduction

The South Slough National Estuarine Research Reserve (Reserve) is a 4,771 acre natural area located in the Coos estuary on the southern Oregon coast. The Reserve was designated in 1974 as the first unit of the National Estuarine Research Reserve System. The Reserve System was established by Congress as part of the 1972 Coastal Zone Management Act (CZMA) and is a network of estuarine habitats protected and managed for the purposes of long-term research, education, and coastal stewardship.

The Reserve is administered as a partnership between the National Oceanic and Atmospheric Administration (NOAA) and the State of Oregon (see Appendix A for 15 C.F.R. Part 921). The Reserve encompasses a mixture of open water channels, tidal and freshwater wetlands, riparian areas, and forested uplands.

The Reserve supports and coordinates research, education, and stewardship programs which serve to enhance a scientific and public understanding of estuaries and contribute to improved coastal watershed management. Over the past 40+ years, the Reserve has grown in the depth and scope of its programs and developed facilities to meet the needs of visitors and staff.

This document is the fourth revision of the Reserve Management Plan and sets a course for the Reserve to promote awareness about estuaries and provide information necessary for effective coastal watershed management. During the 2017-2022 planning period, the Reserve will focus efforts on applying

its resources to issues relevant to the Coos watershed and to activities that will benefit local communities.

Management Planning at the Reserve

Federal regulations require each National Estuarine Research Reserve to have a federally-approved management plan that provides direction for Reserve programs by identifying management priorities and actions. The management plan provides the basis for evaluation of the Reserve pursuant to Section 312 of the CZMA. Federal regulations also require that the Reserve management plan be updated every five years. The 2017-2022 Reserve Management Plan builds on the capacity that was developed during the last planning period by addressing issues and needs significant to the local community through guidance for the Reserve's programs and operations.

The 2017-2022 Reserve Management Plan provides an overview of the programs and operations of the Reserve, a description of the natural, physical, and sociocultural setting, and outlines the mission, vision, and guiding principles by which the Reserve operates. The plan also identifies strategic priorities, goals, objectives, and actions that the Reserve will focus on for the planning period.

This management plan has been developed in accordance with the regulations of NOAA. It is consistent with the congressional intent of Section 315 of the Coastal Zone Management Act of 1972, as amended, and with the provisions of the State of Oregon (Appendix G).

Introduction to the National Estuarine Research Reserve System

The National Estuarine Reserve System was created by the Coastal Zone Management Act of 1972 (16 U.S.C. 1451 et seq.), as amended, to augment the National Coastal Zone Management Program which is dedicated to comprehensive, sustainable management of the nation's coasts.

The Reserve System is a network of protected areas representative of the various biogeographic regions and estuarine types in the United States. Reserves are established for long-term research, education and interpretation to promote informed management of the Nation's estuaries and coastal habitats (5 C.F.R. 921.1(a)). The Reserve System currently consists of 29 reserves in 24 states and territories, protecting over one million acres of estuarine lands and waters (Figure 2.1).

The Reserve System is a partnership program between the National Oceanic and Atmospheric Administration (NOAA) and the coastal states. NOAA provides funding, national guidance and technical assistance. The state partner manages reserve resources on a daily basis working collaboratively with local and regional partners. For the South Slough National Estuarine Research Reserve, that state partner and administrative agency is the Oregon Department of State Lands.

National Estuarine Research Reserve System Goals

Estuaries are biologically rich, economically valuable, and highly vulnerable ecosystems. The vision and mission of the Reserve System reflect

the importance of these systems within our communities (see sidebar below).

The program goals, per Federal regulations 15 C.F.R. 921.1(b), outline five specific goals for the Reserve System:

1. Ensure a stable environment for research through long-term protection of National Estuarine Research Reserve resources;
2. Address coastal management issues identified as significant through coordinated estuarine research within the system;
3. Enhance public awareness and understanding of estuarine areas and provide suitable opportunities for public education and interpretation;
4. Promote Federal, state, public and private use of one or more Reserves within the System when such entities conduct estuarine research; and
5. Conduct and coordinate estuarine research within the system, gathering and making available information necessary for improved understanding and management of estuarine areas.

vision and mission

vision: Resilient estuaries and coastal watersheds where human and natural communities thrive.

mission: To practice and promote stewardship of coasts and estuaries through innovative research, education, and training using a place-based system of protected areas.

These foundational goals are complemented by those that are systematically set by the program every five years. Strategic planning has been an integral part of the National Estuarine Research Reserve System for nearly twenty years. The planning process is designed to bridge national program direction with local coastal management needs through a representative and participatory process that supports NOAA's mission of science, service, and stewardship. The 2017-2022 Reserve System Strategic Plan focuses on three core issues: environmental change, habitat protection, and water quality. The Reserve System Strategic Plan Goals are:

1. **Protected Places:** Enhance and inspire stewardship, protection, and management of estuaries and their watersheds in coastal communities through place-based approaches.

2. **Applying Science:** Improve the scientific understanding of estuaries and their watersheds through the development and application of reserve research, data, and tools.
3. **Educating Communities:** Advance environmental appreciation and scientific literacy, allowing for sciencebased decisions that positively affect estuaries, watersheds, and coastal communities.

Biogeographic Regions and Boundaries of the National Estuarine Research Reserve System

NOAA has identified eleven distinct biogeographic regions and 29 sub-regions in the United States, each of which contains several types of estuarine ecosystems (15 C.F.R. 921, Appendix A). When complete, the Reserve System will contain examples of estuarine hydrologic and biological types characteristic of each biogeographic region. As of 2017, the Reserve System includes 29 reserves.

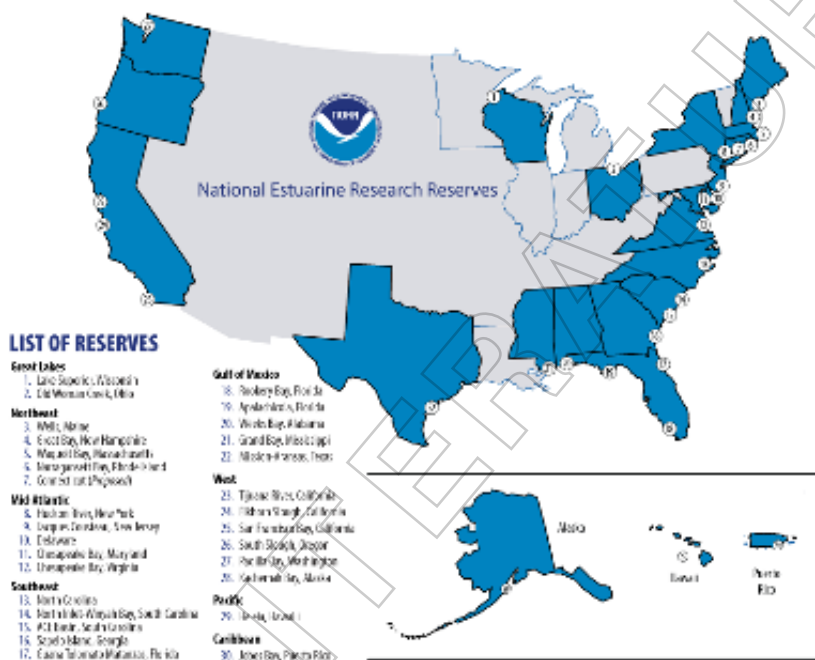


Figure 2.1: Map of the 29 National Estuarine Research Reserves representing most coastal regions.

Reserve boundary size will vary greatly depending on the nature of the ecosystem. Boundaries must include an adequate portion of the key land and water areas of the natural system to approximate an ecological unit and to ensure effective conservation. Reserve boundaries encompass areas for which adequate state control has or will be established by the managing entity over human activities occurring within the reserve. Reserve boundaries include a “core” area which is comprised of key land and water encompassing resources representative of the total ecosystem, which if compromised could endanger the research objectives of the reserve, as well as a “buffer” area designed to protect the core area and provide additional protection for estuarine-dependent species, including those that are rare or endangered. Buffer areas may also include areas necessary for facilities required for research and interpretation. Additionally, buffer areas are identified to accommodate a shift of the core area as a result of biological, ecological or geo-morphological change which reasonably could be expected to occur (15 C.F.R. 921.11 (c)(3)).

National Estuarine Research Reserve Administrative Framework

The process for federal designation of a National Estuarine Research Reserve has many steps and involves many individuals and organizations. While each reserve is a partnership program between NOAA and a coastal state, there are many entities that collaborate to support designation of a reserve. Other partners include federal and state agencies, non-profit groups, universities and members of the local community. For more information on the designation process see <http://nerrs.noaa.gov/about/designation-process.html>.

Upon designation, the reserve implements the approved management plan and is eligible for NOAA financial assistance on a cost-share basis with the state. A reserve may apply to NOAA for funds to help support implementation of the management plan largely funding operations, research, monitoring, education interpretation, training, stewardship, development projects, facility construction, and land acquisition. Management plans provide a vision and framework to guide reserve activities during a five year period and enable the reserves and NOAA to track progress and realize opportunities for growth. Each management plan contains the reserve goals, objectives, and strategies supported by programs focused on research and monitoring, education and outreach, training, and stewardship. They also outline administration, public access, land acquisition and facility plans and needs, as well as restoration and resource manipulation plans, if applicable. Reserves are increasingly confronted with complex questions regarding new uses in or near reserves that may or may not be compatible with the Reserve System’s mission. A thoughtful and comprehensive management plan provides a foundation for addressing these challenges to protect and manage reserve resources wisely and ensure the public and coastal decision makers value and protect coastal resources.

NOAA administers the Reserve System and establishes standards for designating and operating reserves, provides support for reserve operations and system-wide programming, undertakes projects that benefit the Reserve System, and integrates information from individual reserves and programs to support decision-making at the national level. Additionally, NOAA periodically evaluates reserves for

compliance with federal requirements and with the individual reserve's federally approved management plan, as mandated under Section 312 of the Coastal Zone Management Act (16 U.S.C. 1458; see also 15 C.F.R. 921.40).

NOAA currently provides leadership and support for three system-wide programs including the System-Wide Monitoring Program, the K-12 Estuarine Education Program, and the Coastal Training Program, as well as the NERRS Science Collaborative. NOAA also provides support for initiatives focused on the Reserve System's priorities: climate change, water quality and habitat protection.

The South Slough National Estuarine Research Reserve

The South Slough Sanctuary was established on June 27, 1974 under Section 315 of the Coastal Zone Management Act (CZMA). The South Slough Sanctuary, as it was originally known, was the first National Estuarine Sanctuary in the United States. The designation resulted from the concerted efforts of many citizens and elected officials who recognized the abundant resources and values provided by the South Slough.

The history of the Reserve began in 1971 when the Coos County Planning Department formed a committee to assist with the development of a county land use plan. The committee proposed a quarter-mile protection zone around South Slough which was approved by the public and the Planning Department.

In 1972, Congress passed the Coastal Zone Management Act which, with subsequent reauthorizations, recognizes that resources of

the coastal zone are of national significance and are rapidly disappearing. Section 315 of the 1972 CZMA established the National Estuarine Sanctuary Program.



Figure 2.2: An aerial view of the South Slough estuary, looking south from the Charleston bridge.

In 1973, of the twelve sites under consideration by NOAA, South Slough was chosen as the initial site for what is now known as the National Estuarine Research Reserve System. The State of Oregon was awarded \$400,000 in federal funds for initial land acquisition and management of the newly created Sanctuary, which was matched 50-50 with state funds, private contributions, and discounted land sales. The Nature Conservancy coordinated and negotiated the purchase of the original properties on behalf of the State of Oregon. The federal guidelines for the program required that the area chosen to be part of the Sanctuary include "water and land units constituting a natural ecological unit along with the ability to remain a healthy and viable system."

By 1978, the Division of State Lands (now the Department of State Lands) had purchased 72.6% of the area originally proposed for the Sanctuary. In 1986, Congress reauthorized the Coastal Zone Management Act and changed the name of the program designated under Section 315. Consequently, the South Slough Sanctuary

was renamed the South Slough National Estuarine Research Reserve.

Local Management of South Slough National Estuarine Research Reserve

The Reserve is managed under a partnership between NOAA and the State of Oregon. Oregon state law (O.R.S. 273.553 et seq., Appendix B) complements and reinforces federal regulations by providing for the protection and maintenance of Reserve resources through state policy. This set of state statutes established management policy for the Reserve and designates the Reserve Management Commission as the Reserve's immediate governing body (see Administration Plan, Chapter 5). The statutes also provide that management of the Reserve is subject to any agreements between the State of Oregon and NOAA (Appendix D).

Oregon statute also designates the Oregon Department of State Lands (DSL) as the Reserve's state partner agency. DSL manages Reserve resources on a daily basis, working collaboratively with local and regional partners, and is under

jurisdiction of the State Land Board. The State Land Board consists of the Governor, Secretary of State, and State Treasurer. All administrative decisions at the Reserve must comply with the policies of the State Land Board.

The DSL holds title to the lands within the Reserve and manages them as assets of the Common School Fund for the State of Oregon. The DSL provides oversight of the day to day management of the Reserve's resources, programs, and operations. The director of the DSL (or a designee) serves as permanent chair of the Reserve Management Commission.

Ecological Attributes

The 4,771-acre (1930.76-hectare) Reserve is located in the South Slough watershed, a part of the Coos estuary on the southern Oregon coast. Covering an area of approximately 600 square miles, the Coos estuary is the sixth largest estuary on the Pacific coast of the contiguous United States and the largest estuary completely within Oregon state lines (Figure 2.3). Coos Bay is about 220 miles southwest of Portland, Oregon. Like most estuaries found in Oregon, the Coos estuary is a river mouth that drowned as sea level began to rise 20,000 years ago. The South Slough watershed is a 19,295 acre sub-basin of the Coos watershed drainage. See Figure 2.4 for a map of the South Slough watershed and Reserve.

Regional weather consists of cool, moist winters and mild summers. Weather is generally warm and dry from May through September with an average rainfall of less than four inches (10 cm). Cooler, wetter weather occurs from October through April, when average annual rainfall is about 56 inches (142.24 cm).



Figure 2.3: The South Slough watershed in the context of the Coos watershed and the state of Oregon.

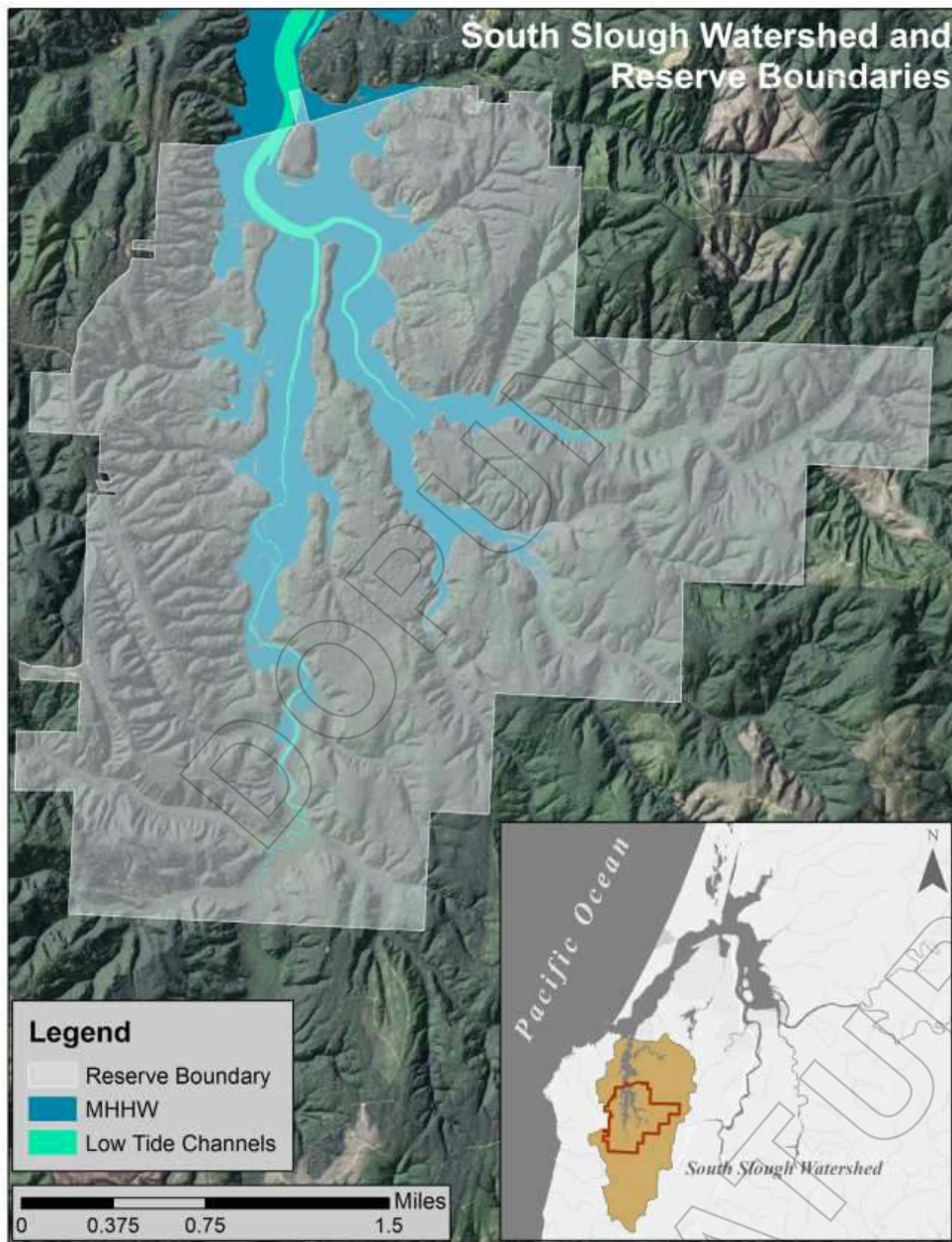


Figure 2.4: The South Slough Reserve in the context of the South Slough watershed.

Annual temperatures generally range between 40 and 75 F (4.5 - 24 C). In summer, high barometric pressure and northerly winds prevail, while in winter the wind is generally from the south and southwest. Winter storms are generally driven by southwesterly gales, which can exceed 75 mph (120 km/hr) (Rumrill 2006).

In the Reserve and surrounding estuary, heavy winter precipitation results in large volumes of fresh water and sediment inputs during and after storms. In the South Slough watershed, six perennial streams and more than 30 intermittent streams provide highly seasonal freshwater flows. Winchester Creek is the slough's largest tributary stream (Rumrill 2006) (Figure 2.5).

The influence of salt water in the slough is more pronounced during summers when freshwater input is low. Tides are mixed and follow a semi-diurnal pattern with two high tides and two low tides per day. Circulation patterns are strongly influenced by the tides and although they are complex and poorly understood (Uza 1995; Roegner and Shanks 2001), new progressions in three dimensional modeling may allow better understanding in the near future (Cooper 2012; Cornu and Souder 2015).

The South Slough watershed lies along a geologic syncline, or fold, which bears its name (Figure 2.6). Due to this formation, the slough's eastern and western slopes are of distinct geologic types. The eastern shore formation is typical of the Coos watershed, and is composed of highly-erodible Quaternary marine terraces of unconsolidated to semi-consolidated sand, silt, and clay (Figure 2.7). The terraces slope gently and are worn down along creek beds to sandstone and siltstone. The western side's Empire Formation, with scattered Quaternary marine terraces, is composed of hard impermeable sandstone (Rumrill 2006). The slopes are mantled with sand, silty loam, and loamy sand (Robinson 2009).

In Reserve waters, salinity, specific conductivity, nutrients, and chlorophyll concentrations vary greatly along the salinity gradient; nutrients and chlorophyll concentrations are at generally healthy levels (Cornu and Souder 2015). Water temperature, oxygen, and acidity (pH) are less responsive to changes in salinity, and are also at healthy levels in the Reserve (Cornu and Souder 2015).

A majority of the Reserve is composed of forested uplands that are typical of the Coos

watershed and the Coast Range (Figure 2.8). Virtually all of the forested portions of the Coos watershed have been logged at least one time in the past hundred years. Some areas have been logged two or three times. Surrounding the Reserve there is widespread evidence of ongoing clearcuts, and until recent years, most harvested areas were replanted exclusively with Douglas fir (*Pseudotsuga menziesii*) resulting in homogeneous regeneration stands. Within the Reserve, uplands are typically dense 15- to 75-year-old mixed conifer forests of Sitka spruce (*Picea sitchensis*), western hemlock (*Tsuga heterophylla*), Douglas fir, and cedars (*Chamaecyparis lawsoniana* and *Thuja plicata*). Other upland habitats include pockets of mixed hardwoods and brushy slopes (Figure 2.9).

Additional habitats in the Reserve include:

Freshwater ponds and marshes frequently form in the sediment which has accumulated immediately above the high tide line and just up- and downstream of beaver dams. Most freshwater wetlands occur in the extensive stream systems of the southern and eastern portions of the watershed. A few isolated wetlands exist in the uplands. Salt marshes line the estuary itself. Reserve investment in wetland restoration over the years has increased salt marsh coverage in the Reserve.

Extensive tide flats created by the abundant sediments carried into the Coos estuary cover areas just above the low-tide channel. They are usually composed of soft, unconsolidated mud or muddy sand and are often partially covered by mats of green algae. Open channels with muddy bottoms provide benthic habitat even at the lowest tides.

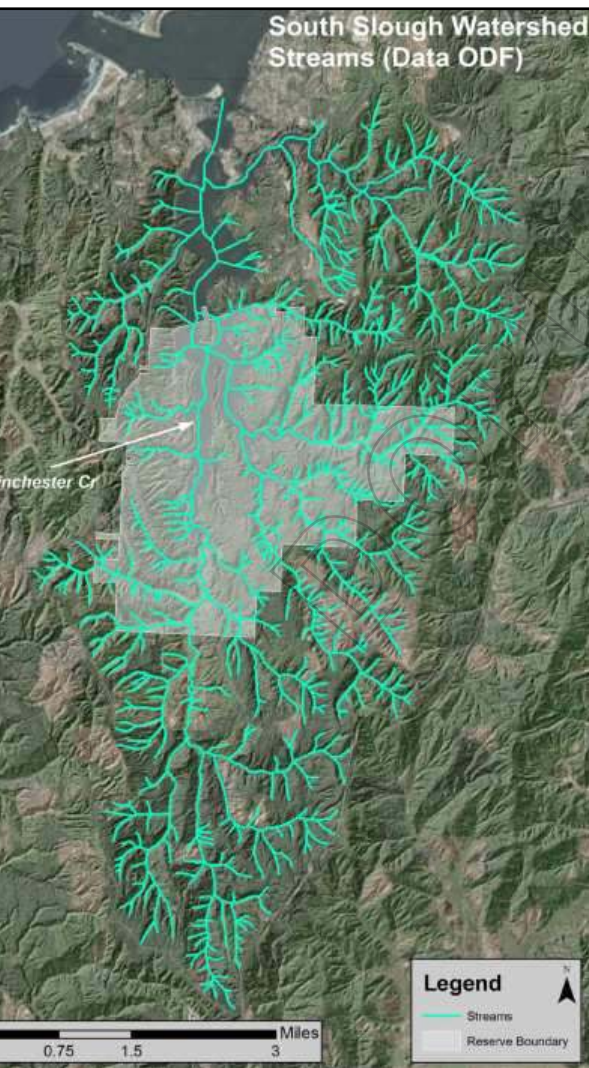


Figure 2.5: Rivers and streams contributing fresh water to the South Slough estuary. With a few exceptions, most streams other than Winchester Creek are designated as small. Small stream flows average 2 cfs or less throughout the year. Winchester Creek is considered a large stream and averages 10 cfs or more throughout the year. However, streams are very seasonal. For example, Winchester Creek winter discharge peaks from 2011-2013 were 120 cfs while summer base flows were closer to 2.6 cfs (Cornu et al. 2012; Cornu and Souder 2015).

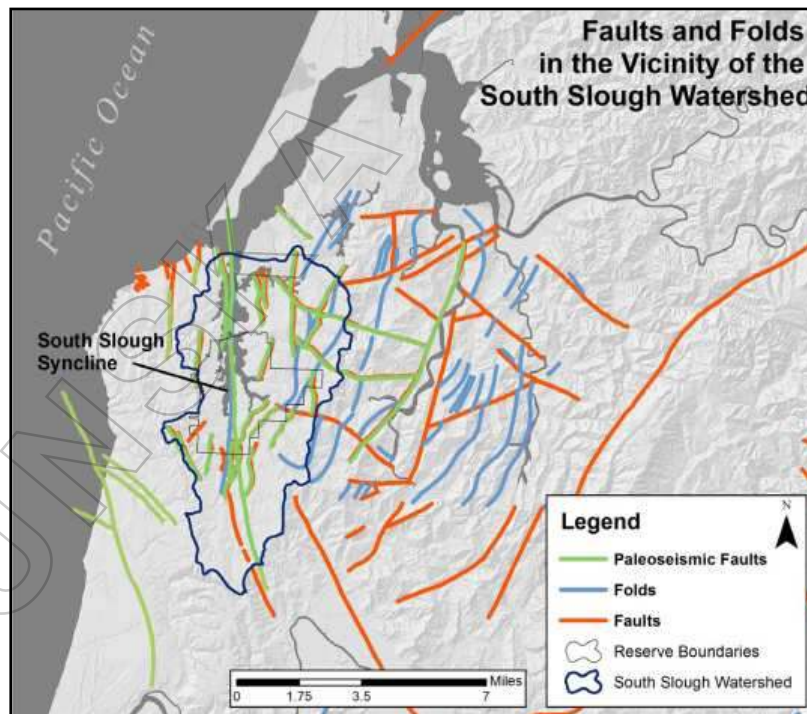


Figure 2.6: Faults and folds occurring in the vicinity of the South Slough watershed. Paleoseismic faults are highlighted, designating faults that were the source of significant earthquakes (6.0 or greater) in the past 1.6 million years. Data USGS 2005; DOGAMI 2009

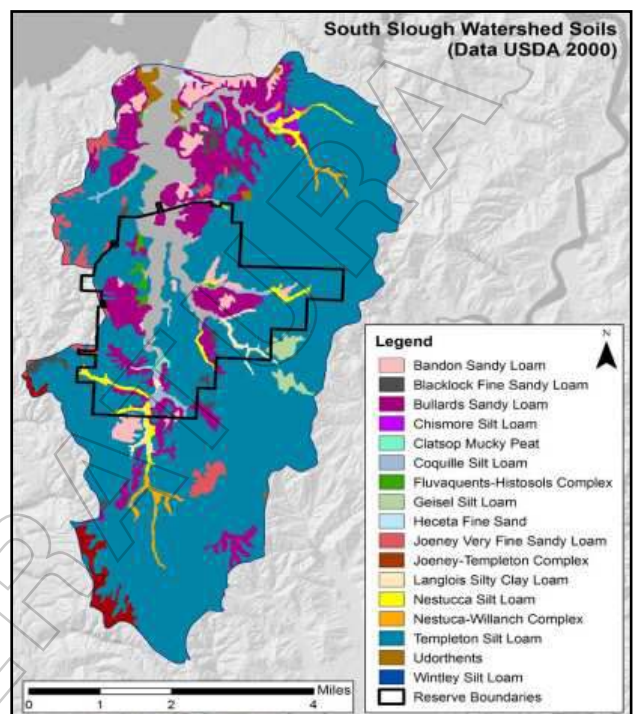


Figure 2.7: Distribution of soil types in the South Slough watershed, grouped by series (e.g., Bandon Sandy loam 0-7 slopes and Bandon Sandy Loam 7-12 slopes were grouped as Bandon Sandy Loam). Data USDA 2000.

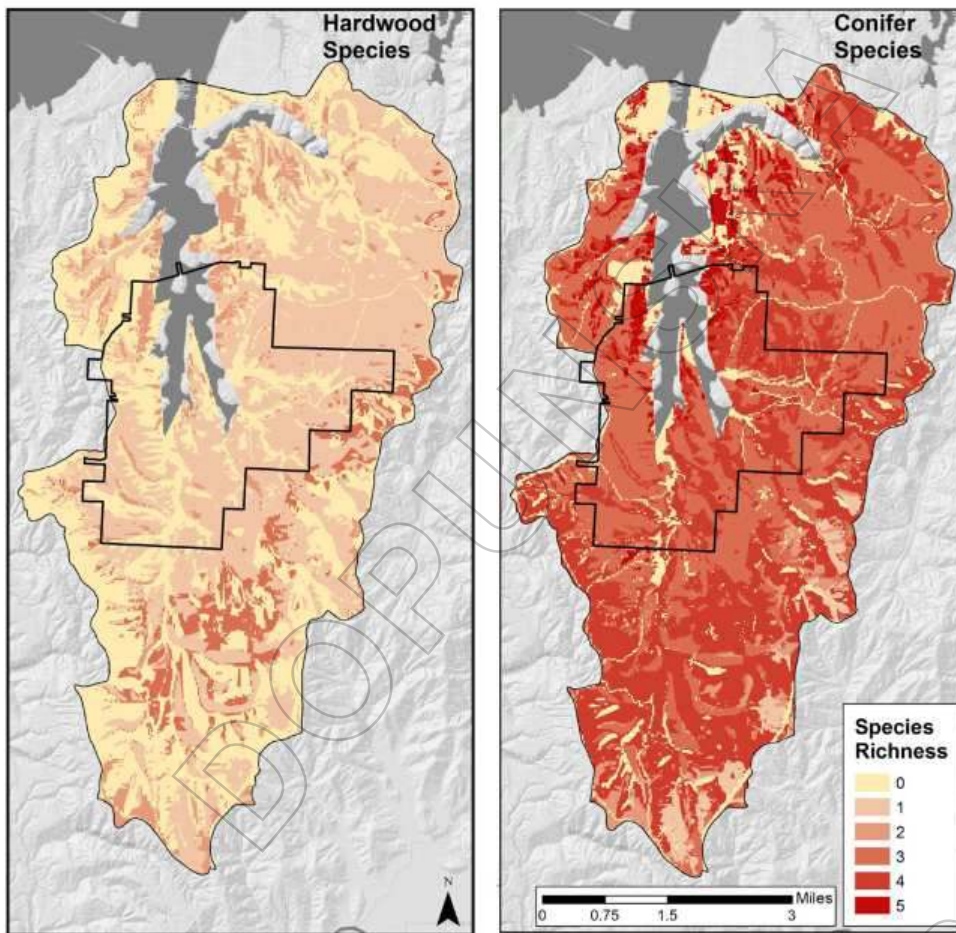


Figure 2.8 (both maps to the left): Conifer and hardwood tree species richness in the South Slough watershed. Lighter colors indicate fewer species counts than darker colors. Conifer species include but are not limited to: Douglas-fir, Port Orford cedar, incense cedar, western redcedar, western hemlock, shore pine, white fir, grand fir, and Sitka spruce. Hardwood species include but are not limited to: red alder, white alder, bay laurel, vine maple, and bigleaf maple. Black outline delineates Reserve boundary. Data: LEMMA 2014

The Reserve contains sand flats off the northwest corner of Valino Island and along Long Island Point's western shore. In late summer, up to 160 acres (64.74 ha.) of eelgrass may be found in the Reserve, with additional beds of unknown size in the northern part of the slough beyond the administrative boundary (Rumrill 2006) (Figure 2.10).

Table 2.1 contains common species and species of concern for the main habitat types within the Reserve.

For more information about ecological attributes of the South Slough, reference the site profile of the South Slough National Estuarine Research Reserve (Rumrill 2009): https://coast.noaa.gov/data/docs/nerrs/Reserves/SOS_SiteProfile.pdf

For more information about the state of the South Slough watershed, reference the State of the South Slough and Coastal Frontal Watersheds (Cornu et al. 2012): <http://www.partnershipforcoastalwatersheds.org/watersheds>

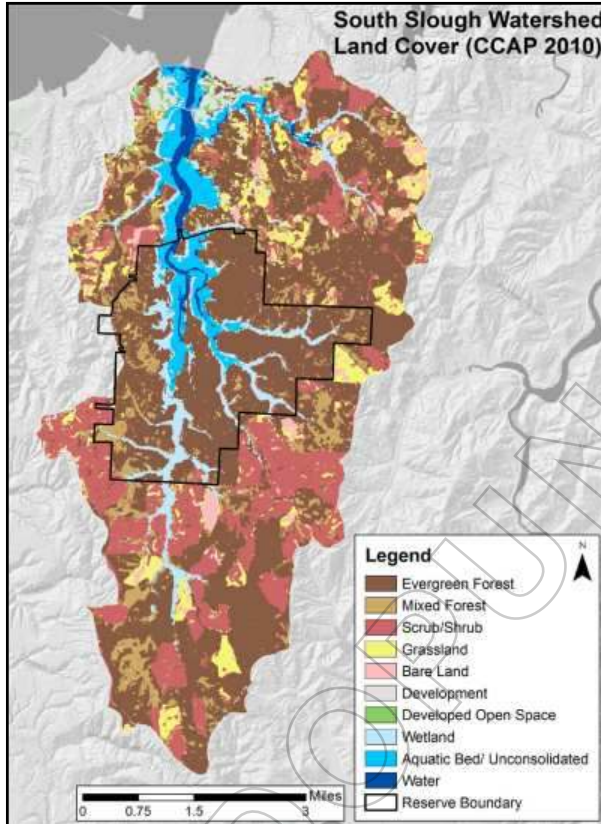


Figure 2.9: Land cover patterns in the South Slough watershed. Note the difference in land cover within the Reserve boundary (outlined in black) compared to outside of it. Scrub shrub cover describes areas dominated by shrubs less than 5 m tall. When forests are harvested using clear-cut methods, re-growth of young trees are classified as scrub shrub. Data: CCAP 2014

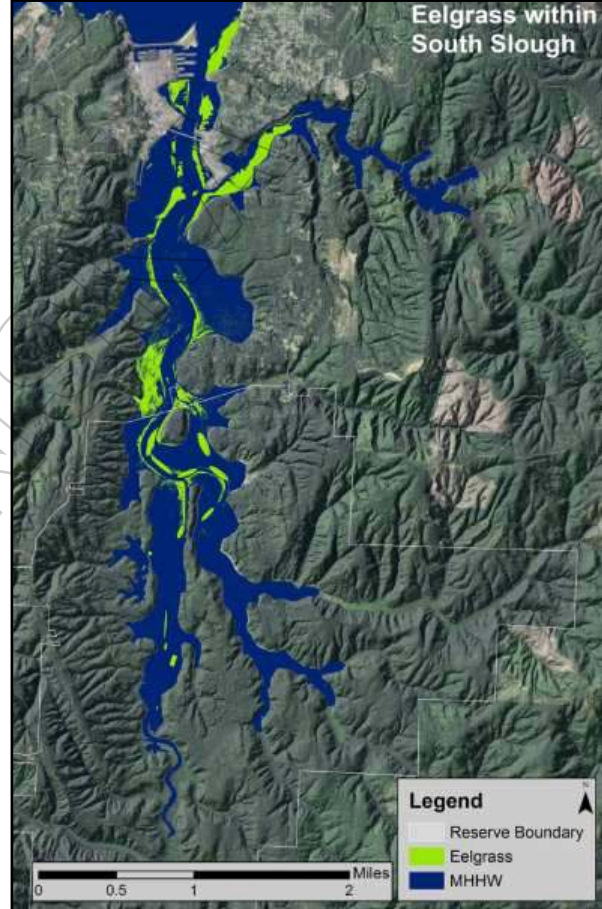


Figure 2.10: Distribution of eelgrass beds in the South Slough estuary. Eelgrass species include the native *Zostera marina*, and the non-native *Zostera japonica*. Data: Clinton et al. 2007.

Table 2.1: Common species found in the Reserve, both plant and animal, for each main habitat type. Species of Concern are also included.

Key Species in the Reserve			
Upland	Marsh (fresh and tidal)	Aquatic	Species of Special Concern
Evergreen huckleberry (<i>Vaccinium ovatum</i>)	American beaver (<i>Castor canadensis</i>)	Cutthroat trout (<i>Oncorhynchus clarkii</i>)	Coho salmon (<i>Oncorhynchus kisutch</i>)
Pacific sword fern (<i>Polystichum munitum</i>)	Baltic rush (<i>Juncus balticus</i>)	Dungeness crabs (juvenile) (<i>Metacarcinus magister</i>)	Marbled murrelet (<i>Brachyramphus marmoratus</i>)
Port Orford cedar (<i>Chamaecyparis lawsoniana</i>)	Fleshy jaumea (<i>Jaumea carnosa</i>)	Eelgrass (<i>Zostera marina</i>)	Mud shrimp (<i>Upogebia pugettensis</i>)
Roosevelt elk (<i>Cervus canadensis roosevelti</i>)	Lyngby's sedge (<i>Carex lyngbyei</i>)	Pacific lamprey (<i>Entosphenus tridentatus</i>)	Salt-marsh bird's beak (<i>Chloropyron maritimum palustre</i>)
Salal (<i>Gaultheria shallon</i>)	Pacific silverweed (<i>Potentilla anserina</i>)	Steelhead/Rainbow trout (<i>Oncorhynchus mykiss</i>)	Western bog lily (<i>Lilium occidentale</i>)
Salmonberry (<i>Rubus parviflorus</i>)	Pickleweed (<i>Sarcocornia perennis</i>)	Western brook lamprey (<i>Lampetra richardsoni</i>)	
Sitka spruce (<i>Picea sitchensis</i>)	Salt grass (<i>Distichlis spicata</i>)		
	Seaside arrowgrass (<i>Triglochin maritima</i>)		
	Skunk cabbage (<i>Lysichiton americanus</i>)		
	Slough sedge (<i>Carex obnupta</i>)		
	Tufted hairgrass (<i>Deschampsia caespitosa</i>)		

Social Attributes

The 2010 U. S. Census Bureau estimated that 63,043 residents live in Coos County nearly one-third of Oregon's coastal population. The shoreline of the Coos estuary is bordered by the municipalities of Charleston, Barview, North Bend, Coos Bay, Millington, Eastside, and Glasgow (Figure 2.11). The cities of Coos Bay and North Bend form the economic heart of the county. Collectively, they have about 25,662 residents (U. S. Census Bureau, 2010), making the area the largest population center on the Oregon coast.

The population surrounding the Reserve is predominately Caucasian (91.1 %) and according to the U.S. Census Bureau, 17.6 % of Coos County lives under the poverty level with 22.9 % of these citizens under the age of 18. Unfortunately, the average annual wage in the area

is one of the lowest in Oregon. The area has struggled with school district consolidations and closures over the last two decades and educational analyses indicate that school districts are still not meeting performance benchmarks (Cornu & Souder 2015).

In a 2014 community report that used Sustainability Tools for Assessing and Rating (STAR) various community aspects, the Coos Bay area ranked high when it came to having sufficient built environments and health and safety services. However, overall the community surrounding the Reserve ranked moderate in economic health, living-wage job availability, equity of social services, and in protecting natural systems. The area ranked poorly on climate adaptation, greenhouse gas mitigation, resource efficiency, and in access to education, art and cultural industries, and community cohesion (Cornu & Souder 2015).

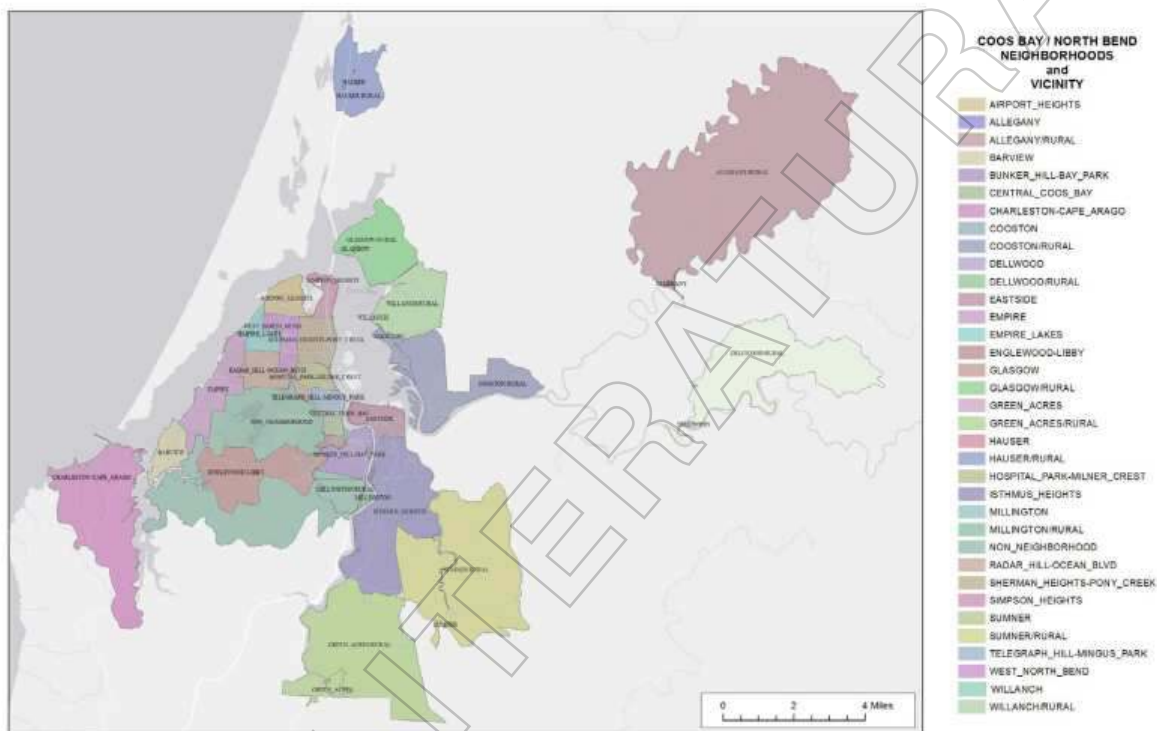


Figure 2.11: Neighborhoods in the Coos Bay-North Bend area.

Industry and Resource Use

To support an industrial center and shipping port, the navigational channel of the Coos estuary is routinely dredged to maintain adequate depths for commercial shipping. Other area industries include commercial fishing, seafood processing, wood product industries, healthcare, and tourism.

Commercial fishing supports a number of seafood processing plants in Charleston. Additionally, the Oregon Department of Agriculture leases several thousand acres of state-owned submerged lands in the Coos and South Slough estuary for commercial oyster cultivation. The presence of the commercial oyster industry and recreational clam harvest in the estuary encourages maintenance of excellent water quality.

Timber extraction has also been a primary industry in the Coos areas since Euro-American settlement. Within the South Slough watershed, approximately 70% of land is in private or county ownership, with most of these lands actively managed for timber production. Approximately 5% of the South Slough watershed is zoned for rural residential occupation. The remaining 4,771 acres (one-quarter of the watershed) comprise the Reserve.

Overall, the economic base of the Coos area is in a state of transition. For more than one hundred years after Euro-Americans arrived, the ocean and once dense forests of the Coos watershed supported large-scale commercial fishing, logging, and shipping operations. However, as these resources declined, so have their related businesses, resulting in an

uncertain economic future for the region. Many of the younger generations continue to move outside of the area to find gainful employment. At the same time, recreation and tourism are growth industries in the region. Retirees are also gravitating to the southern Oregon coast, and passive income (i.e., payments from pension plans, social security, stock investments) is a significant component of the area economy.

Archeological and Cultural Resources

ative Peoples

Archeological evidence indicates that the Coos estuary has supported a human population for at least 6,000 years. Along the shores of the South Slough, the Miluk people occupied small villages and seasonal camps. The Miluk villages were nearly autonomous gatherings of around 100 people. Permanent dwellings were typically pole frame lodge structures made with split cedar planks and partially set into the ground such that the floor was below ground level.

The Miluk people hunted, fished, and gathered all the food and fiber needed for subsistence. Wooden fish weirs, antler hooks, and nets were used to catch a variety of fish; elk and deer were trapped in large pits. Middens found along the shores of South Slough provide evidence that the estuary was a productive place to collect crabs and other shellfish. Berries, seaweed, and edible plants and roots added nutrition and variety to the diet of native peoples. The remains of several villages, wooden fish weirs, and middens still exist along Coos estuary shorelines, but in many cases have been buried or substantially disturbed by more recent human development.

When early Euro-American settlers arrived in the South Slough area during the 1850's, the Miluk speaking people lived in the southern part of the Coos estuary. Their area extended west to the ocean and south to the mouth of the Coquille River. The northern parts of the Coos estuary, along the Coos River, and areas as far north as Tenmile Creek were inhabited by the Hanis. The languages of the Miluk and Hanis people are both included in the Coos family of the Penutian family of languages. South and east of the Miluk area and extending into the upper Coquille watershed lived people who spoke one of the Athabaskan languages, thereby distinguishing them from the Hanis and Miluk people. The descendants of the Coos peoples and other neighboring tribes now comprise the Confederated Tribes of the Coos, Lower Umpqua and Siuslaw Indians. The descendants of the Athabaskan speaking people in the area now comprise the Coquille Indian Tribe. Soon after Euro-American settlement, the original inhabitants of the South Slough area were at first forbidden to own land and were later forcefully removed from the region.

Eventually, in the 1870s, land was surveyed and divided up into allotments which were granted to "eligible Indians (Tribal Members or the head of household for an eligible Tribal family). Eligible individuals could select an authorized parcel or one could be assigned to them. Although allotments provided Tribal peoples with land after their forceful removal, the Euro-American concept of parcel designation also perpetuated Tribal assimilation into Euro-American culture. Under the allotment program, Tribal families made new homes along South Slough or its tributaries. These families' names:

Wasson, Talbot, Elliott, Younker, Hanson, survive as place names for creeks, points and coves in the South Slough watershed (Caldera 2006).

uro American Colonization

Euro-American explorers came to the Coos estuary in the late 1700s and permanent settlement began in the 1850s. Due in part to a small gold rush in the 1850s, aggressive displacement of the native inhabitants ramped up. Euro-American settlement introduced homesteads, farms, logging operations, and commercial fishing to the area.



Figure 2.12: Euro-American settlers on a horse-drawn railcar.

Some of the most significant changes in the Coos estuary landscape were initiated in the late 1800s to support the new settlers' way of life. The town of Coos Bay (then Marshfield) was incorporated in 1874. At the convergence of the Coos and South Slough estuaries, the small fishing village of Charleston developed in the late 1880s. Stabilization of the bay mouth was initiated in the late 1880s, and marshes were filled and forests logged to support local families in agriculture and marine commerce. Coal was mined in small amounts from 1854 to 1920.

Houses, barns, windmills, a school house, and other structures were built in the coves and low hills of the South Slough watershed through the 1920s, although settlement was never dense. Families supported themselves by logging and ranching, sometimes on a substantial scale. Transportation to and from slough homesteads was almost entirely by boat, and dependent on favorable tides (Caldera 2006).

Valino Island was the site of a speakeasy during Prohibition, but no physical structures remain visible there today. Many of the early buildings and homesteads in the watershed were abandoned during the Depression and have collapsed or been razed. The sites of several older buildings, including an old schoolhouse and a shake mill, are known, but are now indicated only by small piles of decaying lumber. Two of the last buildings of this period still standing in the South Slough watershed are the Fredrickson house and shed.

Cultural resource protection in the Reserve

Reserve staff works closely with both the Coquille Tribe and the Confederated Tribes of the Coos, Lower Umpqua, and Siuslaw Indians, as well as with the Oregon State Historic Preservation Office, to plan, document, and protect cultural resources in the Reserve. The Reserve also works with federal partners to support cultural resource protection via compliance with Section 106 of the National Historic Preservation Act. Projects in the Reserve incorporate archeological consultations and cultural planning before implementation. Some projects in the Reserve are entirely for the purpose of cultural restoration, such as the recent refurbishment of the Fredrickson shed.

Threats and Stressors

Natural stressors

Invasions by non-native, noxious plant and animal species, including terrestrial, wetland, and aquatic species, pose a threat to the Reserve and will continue to do so for the foreseeable future. Invasive species often enter the Reserve as accidental passengers during human transport. Species of particular concern include gorse (*Ulex europaeus*), English ivy (*Hedera helix*), reed canary grass (*Phalaris arundinacea*) (Figure 2.13), *partina* spp., and green crabs (*Carcinus maenas*). Although some invasive species are not yet present here or occur in low numbers, the Reserve is motivated to minimize their damaging effects early. Presence of invasive species may go unnoticed for some time, and noxious species jeopardize biodiversity, habitat quality, and the economy.



Figure 2.13: Field of invasive reed canary grass in the Wasson Creek. Reed canary grass is an aggressive invader that outcompetes native wetland plant species, often approaching 75-100% cover in the areas it invades (Houlahan and Findlay 2004, Mulhouse and Galatowitsch 2003).

Two major upland pathogens serve as stressors to trees in the Reserve. Swiss needle cast is caused by a fungal infection (*Phaeocryptopus gaeumannii*) in Douglas-fir trees. The infection causes Douglas-fir needles to yellow and prematurely shed, reducing tree growth. Port Orford cedar root rot (*Phytophthora lateralis*) also affects the Reserve as a non-native soil-borne pathogen, infecting Port Orford cedars, and to a lesser extent Pacific yews (Goheen and Willhite 2006). The root rot moves up the tree via evapotranspiration and kills the inner bark, often resulting in complete mortality to Port Orford cedars.

Wildfire is another stressor that threatens the Reserve. As the climate shifts to hotter and drier conditions, and unmanaged growth continues in the uplands, a wildfire originating in the Reserve or its neighboring forest poses a potential risk to the overall health of the South Slough ecosystem, facilities, and bordering lands.

The Reserve and the Coos Bay region sit astride the slow collision of tectonic plates that form the Cascadia subduction zone. This zone is the source of frequent minor earthquakes and occasional, powerful sub earthquakes. It lies parallel to the coast of the lower Columbian biogeographic region, roughly 150 to 400 miles offshore. The stressors of earthquakes are linked to the added threat of tsunamis.

Anthropogenic stressors

Oil or chemical spills, or accidents involving hazardous materials shipped to or from the International Port of Coos Bay, are anthropogenic stressors that could drastically impact the Reserve. Strong tidal currents

render South Slough particularly vulnerable to any water-borne spills during flood tide.

Additionally, the South Slough estuary receives a variety of direct point and non-point source pollutants. Point source water pollution ranges from that generated by waterside businesses in Charleston (e.g. fish processing plant outfalls) to occasional actions by private individuals along the shoreline or aboard boats. Non-point source pollutants enter the estuary indirectly as components of road runoff and runoff from rural and urban activities and industrial sites.

The North Bend Water Board supplies drinking water throughout Coos Bay from reservoirs on Pony Creek and oe Ney Slough. The board's right to water from Winchester Creek is senior to the Reserve's right to keep water in the stream to protect fish. In 2013, the board informed the Reserve Management Commission that it intended to seek additional sources of fresh water to meet growing residential and commercial demand; it may exercise its right to water from Winchester Creek if other sources prove unfeasible.



Figure 2.14: A yarder, which uses a system of cables to pull felled logs up to the landing where they can be processed for transport.

Though commercial timber harvesters try to be conscious of their impact on the environment, the Reserve experiences stressors associated

with timber harvest, including habitat fragmentation (upland and in-stream); contamination by herbicides and pesticides; habitat homogenization (e.g. reproduction stands); and sedimentation.

Illegal uses can also be a threat to the Reserve.

Dumping, littering, and target shooting are constant problems within the Reserve. Occasionally, people deface Reserve structures and signs. Other anthropogenic stressors include increased shoreline development surrounding the Reserve; forest product theft; nearby channel dredging and its associated impacts on sediment movement, water quality, and habitat.

Climate phenomena, impacts, and Reserve sensitivity

There are two cyclic climate phenomena that affect the Reserve. The El Niño Southern Oscillation occurs every two to seven years and causes an increase in ocean temperatures and a decrease in precipitation, though it can sometimes lead to more powerful winter storms and thus flooding. The Pacific Decadal Oscillation experiences both positive and negative phases which switch every few decades. Locally, a positive phase results in warmer ocean temperatures, and a negative phase results in cooler ocean temperatures (Cornu and Souder 2015).

Climate change impacts in Oregon include warming air temperatures, increasing acidity in nearshore marine waters, increased storminess, and increasing water temperatures (Cornu and Souder 2015). Precipitation and atmospheric weather patterns are also changing. Sea levels are rising along portions of the Oregon coast, a process which may

be either offset or exacerbated by uplift or subsidence of local coastal margins (Cornu and Souder 2015). Ruggiero et al. (2010) reported that the estimated long term rate of coastal wetland loss, due to rising seas, is greater for the Pacific coast than any other areas of the U.S.

In a report by Trueblood and colleagues on *Climate Sensitivity of the National Estuarine Research Reserve System* (2013), the Reserve and its surrounding area ranked very high on social sensitivity to climate change impacts, but also ranked high in ecological resiliency. The high social sensitivity ranking stems from the area's low per capita income and other socioeconomic barriers, including dependency on natural resource extractive industries. This dependency may limit the community's ability to rapidly respond to climate impacts as they occur (Trueblood et al. 2013).

For more information on stressors see the Reserve's Disaster Response Plan (2015).



Figure 2.15: A Climate Reference Network (CRN) station located in the Reserve's Fredrickson Marsh. This station is part of a NOAA program to monitor long-term changes in precipitation and temperature. The CRN station also has secondary sensors to monitor wind speed, relative humidity, and solar radiation. It was installed in 2008.

Boundaries & Land Use

The area of land that comprises the South Slough watershed is roughly shield-shaped and approximately twice as long as the slough waterbody itself (see Figure 2.4). The South Slough watershed is dominated by steep, forested slopes; defined on the east, south, and west by prominent ridges with numerous small streams draining into South Slough. Major sections of the estuarine shoreline are bounded by sandy bluffs. The southern half of the watershed, beyond the Reserve boundaries, contains the springs and creeks which feed Winchester Creek, the slough's largest tributary stream.

The northern administrative boundary of the Reserve crosses the slough immediately north of Valino Island. The rest of the boundary stair steps through the watershed; to the west is Seven Devil's Road, to the south and east are county and private forestlands.

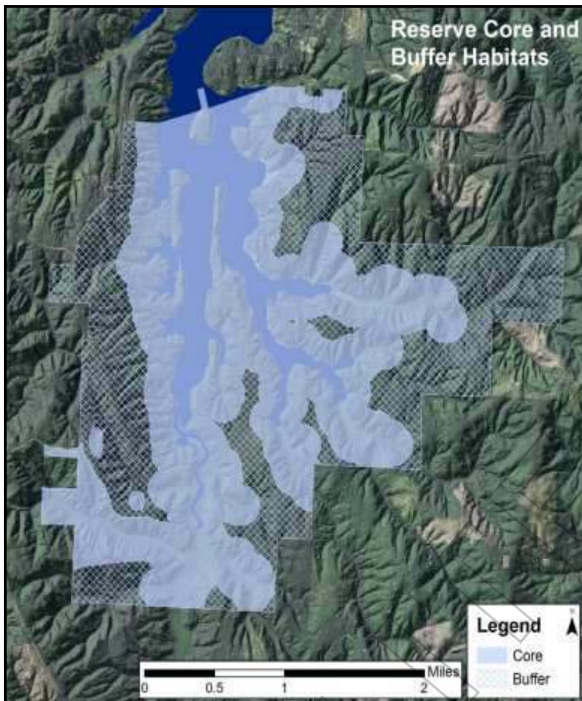


Figure 2.16: Lands within Reserve boundaries categorized as core or buffer habitats.

Core and Buffer

For the purposes of this plan, Reserve lands are categorized into two zones: core (3,055 acres) and buffer (1,716 acres) (Figure 2.16).

The core includes:

All estuarine waters, lowlands, and wetlands in the Reserve. Much of the Reserve's research is focused on these areas and they are considered key habitat in the Reserve. The riparian corridors surrounding the estuary and waterways. Though definitions for these areas are flexible, this plan defined riparian corridors as .125 mi from a predicted 4ft sea level rise mark (Cornu and Souder 2015, USDOC 2012) in order to fully include areas adjacent to and affected by the waterways. These areas are integral to the function of lowlands and waterways. Forested uplands within .125 mi of the predicted 4ft sea level rise mark. Forested uplands are the most prevalent habitat type in the Reserve.

Port Orford cedar research sites.

The Wasson Creek drainage. As the location of upcoming research, restoration, and monitoring efforts, this area is central to ongoing programs at the Reserve.

The buffer is primarily forested uplands.

Although the Reserve considers the entirety of Reserve lands as "core" to programs and habitat protection, the forested uplands do provide considerable buffer to the lowlands and estuarine waters. The upland buffer also includes the Interpretive Center and most of the Reserve's trails.

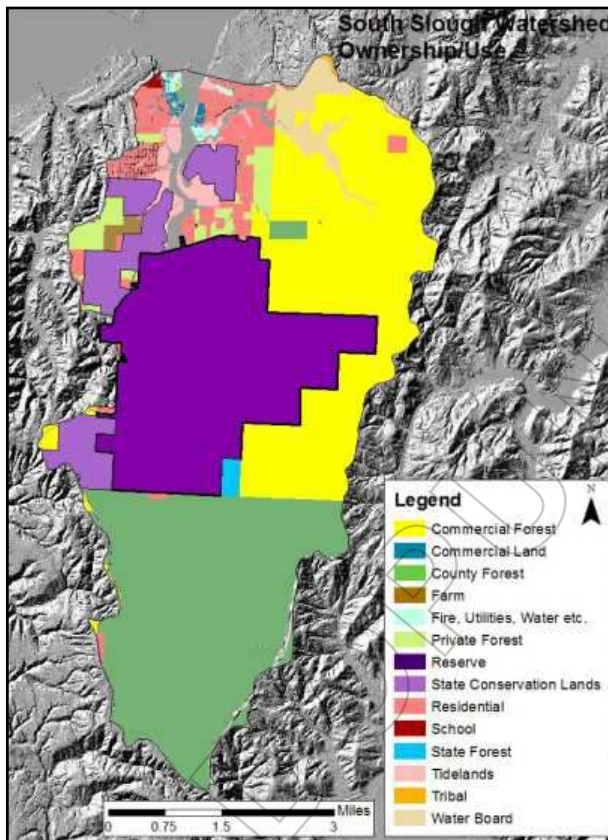


Figure 2.17: Ownership and uses of land within the South Slough watershed.

Land ownership & use

All 4,771 acres of land within the Reserve are owned by the Oregon Department of State Lands. Land within the Reserve is used for the purposes of research, education, and stewardship. Land ownership and use adjacent to the Reserve is mostly forest managed for commercial timber production, especially to the south and east. The lands along the western and northeastern Reserve boundary abut privately owned and mostly residential parcels, while the privately owned lands to the north of the Reserve also include small businesses in Charleston (Figure 2.17).

References:

- Caldera, M. . (Ed.). (2006). *South Slough Adventures: Life on a Southern Oregon Estuary*. Second edition. Palm Springs, CA: Watchmaker Publishing.
- Clinton, P. ., Young, D.R., Specht, D.T., and Lee H. (2007). A Guide to Mapping Intertidal Eelgrass and Nonvegetated Habitats in Estuaries of the Pacific Northwest USA, U.S. Environmental Protection Agency, Washington, D.C., EPA 600 R-07 062, 2007
- Coastal Change Analysis Program (C-CAP). (2014). C-CAP FTP Download, GIS data files, viewed 23 October 2014: <http://coast.noaa.gov/ccapftp>
- Cooper, M. (2012). Competing stakeholders look forward to estuary model. Cascade: UO College of Arts and Sciences, Fall 2012. Accessed 22 September, 2015. <http://cascade.uoregon.edu/fall2012/natural-sciences/competing-stakeholders>
- Cornu, C.E., Souder, ., Hamilton, ., Helms, A., Rimler, R., oyce, B., Reasor, F., Pedersen, T., Wright, E., Namitz, R., Bragg, ., and Tanner, B. (2012). Partnership for Coastal Watersheds Stats of the South Slough and Coastal Frontal Watersheds. Report prepared for the Partnership for Coastal Watersheds Steering Committee. South Slough National Estuarine Research Reserve and Coos Watershed Association. p.225
- Cornu, C. E. and Souder, . (Eds.). (2015). Communities, Lands & Waterways Data Source. Partnership for Coastal Watersheds, South Slough National Estuarine Research Reserve, and Coos Watershed Association. Coos Bay, OR.
- Dello, K. D. and Mote, P.W. (Eds.). (2010). Oregon Climate Assessment Report. Oregon Climate Change Research Institute. College of Oceanic and Atmospheric Sciences, Oregon State University. Corvallis, OR.
- Goheen, E.M. and Willhite, E.A. (2006). *Field guide to the common diseases and insect pests of Oregon and Washington conifers*. R6-NR-FID-PR-01-06. Portland, OR: USDA Forest Service, Pacific Northwest Region. 327 p.
- Houlahan, . E. and Findlay, C. S. (2004). Effect of invasive plant species on temperate wetland plant diversity. *Conservation Biology* 18(4): 1132-1138.
- uza, H. K. (1995). Water quality model for South Slough, Coos Bay, Oregon. Master's thesis. Portland State University. 107 pp.
- Landscape Ecology, Modeling, Mapping and Analysis (LEMMA). (2014). GNN Species Maps, GIS data files, viewed 4 December 2014: <http://lemma.forestry.oregonstate.edu/data/species-maps>
- Mulhouse, . M. and Galatowitsch, S. M. (2003). Revegetation of prairie pothole wetlands in the mid-continental US: twelve years post-reflooding. *Plant Ecology*, 169, 143–159.
- Oregon Department of Forestry (ODF). n.d. GIS Data Export, accessed 11 May 2015: <http://www.oregon.gov/odf/Pages/gis/GISDataExport.aspx>

Oregon Department of Geology and Mineral Industries (DOGAMI). (2009). Oregon Geologic Data Compilation. Accessed 26 October 2015: <http://spatialdata.oregonexplorer.info/geoportal/catalog/search/resource/details.page?uuid=7BD9B42C23-07E9-496F-8188-7C06A6D0E891>

Robinson, J. (2009). Upper Watershed Restoration Action Plan. South Slough National Estuarine Research Reserve. Charleston, OR. 107 p.

Roegner, G.C. and Shanks, A.L. (2001). Import of coastally-derived chlorophyll a to South Slough, Oregon. *Estuaries*. 24: 244-256.

Ruggiero, P., Brown, C. A., Komar, P.D., Allan, J.C., Reusser, D.A. and Lee, H. II. (2010). Impacts of climate change on Oregon's coasts and estuaries. Oregon Climate Change Research Institute, OR.

Rumrill, S.S. (2006). The Ecology of the South Slough Estuary: Site Profile of the South Slough National Estuarine Research Reserve. South Slough National Estuarine Research Reserve. Charleston, OR. 238 p.

South Slough National Estuarine Research Reserve. Oregon Department of State Lands. (2015). Disaster Response Plan. http://www.oregon.gov/dsl/SS/Documents/SSNERR_DRP_FINAL2015.pdf

Trueblood, D., Robinson, P., Curtis, K., Gao, J., Genskow, K., Jones, J., Veroff, D., Leight, A.K., Martino, E., and Wood, B. (2013). Climate Sensitivity of the National Estuarine Research Reserve System. Report to NOAA's Climate Program Office., 79 p.

U. S. Census Bureau. (2010). Coos County quickfacts. Accessed August 2015. <http://quickfacts.census.gov/qfd/states/41/41011.html>

U. S. Department of Agriculture (USDA). (2000). Soil Survey Geographic (SSURGO) Database for Coos County, Oregon. U.S. Department of Agriculture, Natural Resources Conservation Service, Fort Worth, Texas.

U.S. Department of Commerce (USDOC). (2012). NOAA Coastal Services Center Sea Level Rise Data: 1-6 ft Sea Level rise Inundation Extent. Accessed 19 June 2015: <http://coast.noaa.gov/digitalcoast/tools/slr>

U.S. Geological Survey (USGS). (2005). Fault Lines. Accessed 26 October 2013: <http://spatialdata.oregonexplorer.info/geoportal/catalog/search/resource/details.page?uuid=7B99AA3A13-0354-4579-A0D4-463C433D6952>

Chapter 3: Reserve Strategic Plan

The 2017-2022 strategic plan for the South Slough National Estuarine Research Reserve (Reserve) was guided by a suite of partnerships, professional exchanges, and a long-term engaged presence in the communities that surrounds South Slough. NOAA's current strategic plan for the National Estuarine Research Reserve System (Reserve System), along with current Reserve System national priorities, also framed the design. Staff consulted working partners, coastal decision makers, regional educators, and natural resource managers. Staff also reviewed ongoing research and met numerous times during development to refine the Reserve's strategic plan. As a result of the collaborative process, the Reserve identified climate change, habitat protection, and invasive species as the top priorities for the 2017-2022 period.

Alignment with other strategic targets

The current Reserve System strategic plan, for all national research reserves, identifies system priorities as environmental change, habitat protection and water quality. The South Slough Reserve identified each of these priorities as highly relevant as well and aligned the 2017-2022 plan directly to climate change and habitat protection foci. However, as a Reserve with a long-standing and well established water quality monitoring program, this priority was already threaded throughout many Reserve projects and priorities. This plan is designed to expand the applications of the water quality monitoring program and thus water quality is integrated into the goals, objectives and actions below.

The Reserve also spent time aligning the 2017-2022 strategic plan to established (2014) evaluation metrics compliant to Section 312 of the Coastal Zone Management Act. For the Reserve, these include increasing formal education contact hours by ten percent, implementing at least eight research and monitoring projects that address coastal management issues, and providing at least six opportunities for community involvement in the control of invasive species. While these targets are on a shorter timeline than this five year plan, they are represented in the strategic plan to identify the desired impacts Reserve programs will make during this management plan period.

Overarching outcomes and aims for 2017-2022

One overarching desired outcome of Reserve work over the next five years is that programs will help increase local and regional understanding of climate change, habitat protection, and invasive species. For the education program, a desired outcome is improving students' and teachers' understanding of priority issues. For research and stewardship, outcomes include contributions to the scientific community in climate science and habitat restoration monitoring, in addition to the development of a framework for early detection and rapid response regarding invasive species. For the Coastal Training Program, desired outcomes include increased use of science-based information by coastal decision makers when evaluating management options related to priority issues. While the 2017-2022 strategic plan details

explicit goals, objectives, and actions for the planning period, the Reserve does not want to lose the broader aims of programmatic endeavors. The following bullet points provide an overview of the enduring Reserve goals:

Advance scientific understanding of the South Slough, Coos Bay, and other Pacific Northwest estuaries and coastal watersheds through research, monitoring, and education.

Provide technical assistance and advisory services for the effective management of estuaries and coastal watersheds.

Use innovative programming and delivery to increase understanding of estuarine and coastal watershed ecosystems.

Evaluate, manage and restore (if possible) the habitats and ecosystem processes within the South Slough Reserve, and collaborate with local, regional and national organizations on estuarine and coastal watershed projects.

Maintain public access to the Reserve through exceptional facilities and trails, using innovative design and construction methods that minimize ecological impacts.

Evaluate education program effectiveness in reaching key audiences and addressing priority issues.



Context for the 2017-2022 strategic plan design

In order for this strategic plan to be the most effective and comprehensive guidance document for the Reserve, detailed actions are included in the plan. Although these actions do not embody the entirety of steps that will be made toward achieving objectives and goals, they are included to provide clarification and guidance for staff and readers alike. The actions are fundamental for helping staff take steps in achieving Reserve objectives and goals over the next five years and hopefully provide insight on how the Reserve plans to address priorities.

Finally, it is important to note that priorities for the 2017-2022 strategic plan are not sector based. The research, education, coastal training, stewardship, public involvement, and administration programs of the Reserve work in a fully integrated fashion to address Reserve priorities. Each of the goals, objectives, and actions outlined in the strategic plan has a symbol to indicate the lead or co-lead sectors for the line item, but by no means does this reflect the scope of contributors to the effort. Furthermore, the implementation of the strategic plan would not be possible without the support of Reserve administration, facilities staff, volunteers, and interns. Although they are not explicitly noted as a lead on strategic line items, their influence is integral. Ultimately each component of the 2017-2022 strategic plan is designed to uphold the vision, mission, and core principles of the Reserve; an unachievable task without the integrated efforts of all sectors.

Figure 3.1: Canoe paddle trip with Reserve partners and stakeholders, including staff and members of the Coquille Indian Tribe and the Confederated Tribes of the Coos, Lower Umpqua, and Siuslaw Indians.

Reserve Priority Coastal Management Issues

Climate Change

The Oregon coast is vulnerable to many climate related changes, particularly sea level rise and changes in ocean acidity (pH). In the Coos estuary, the fate of built environments (e.g. roads, hardened shorelines) and ecosystems (e.g. tidal wetlands, eelgrass beds) is unknown as sea levels change. An increase in sea level may influence habitat and species distributions as well as infrastructure, which concerns commercial economies, coastal accessibility, and human safety. Decreasing ocean pH (acidification) is also a local concern, as it has serious implications for water quality, shellfish industries and ecosystem services. Ocean acidification has already had noticeable effects in the Pacific Northwest, including impairment of shellfish production in Netarts Bay and Willapa Bay (Rumrill 2006).

Habitat Protection

Habitat protection is important for sustaining the ecological integrity of the estuary and for protecting the Reserve for long-term scientific and educational uses. The Reserve and surrounding areas have a long history of human influence on ecosystems, from built infrastructure to industrial timber harvest. Consequently, habitats in the South Slough watershed are fragmented. Reconnecting, protecting, and improving habitats for upland, lowland, aquatic, and threatened species will benefit Reserve resiliency, in addition to watershed health.

Vision, Mission, and Core Principles

Vision:

Resources developed at the South Slough Reserve will support the informed management of the Coos estuary and watershed, providing a model for regional, national, and global coastal management.

Mission:

To improve the understanding and stewardship of Pacific Northwest estuaries and coastal watersheds.

Core Principles:

Strengthen the understanding of estuaries in the Pacific Northwest through increased knowledge about South Slough and the Coos estuary.

Solicit and incorporate the advice and partnership of others.

Prioritize stewardship of the South Slough estuary.

Develop projects to advance multiple Reserve goals.

Structure Reserve activities around key audiences and themes.

Invasive Species

The South Slough Site Profile (Rumrill 2006) identifies invasive species as one of the largest threats to the biodiversity and ecological integrity of the estuary. Over 100 non-native aquatic species and nearly 50 invasive terrestrial species have been documented in the Coos estuary and lower watershed. Movement of

cargo ships and recreational boats through Coos harbor, as well as commercial fishing, aquaculture, and resource extraction create continual opportunities for the introduction of non-native and invasive species to the area. These species have economic implications (e.g. tree mortality from Port Orford cedar root-rot), and habitat implications (e.g. displacement of native wetland plant communities with reed canary grass).

Climate change, habitat protection, and invasive species are locally relevant topics with long-term socioeconomic and environmental implications. The Reserve is primed to help investigate these topics at a local scale, while contributing to greater understanding through regional and national networks. Due to the integrated and complex nature of these priority coastal management issues, these topics are set to drive Reserve research and education for the 2017-2022 period.

The symbols below reference which Reserve program will serve as the lead on strategic goals, objectives, and actions.

Symbols used in plan to signify sector lead(s):

 = Research


 = Education


 = Stewardship


 = Coastal Training


 = Public Involvement


Priority 1: Climate Change


Goal 1: Increase Reserve understanding of the local effects of sea level rise. 


Objective By , begin to characterize sedimentation and vertical accretion rates in Coos estuary tidal wetlands 


Action 1: Use the Reserve's local geodetic control network to determine precise elevations of the water level sensors at all water quality stations of the System-wide Monitoring Program (SWMP) operated by the Reserve. 

Action 2: Quantify changes in tidal inundation regimes at key tidal wetlands in the estuary using long-term water level data from NOAA's tide stations, SWMP stations, and tribally managed water quality monitoring stations. 

Action 3: Collect sediment dynamics data at existing and newly established sites to quantify tidal wetland sedimentation and vertical accretion rates in the Coos estuary, including at Sentinel Site stations in the South Slough. 

Action 4: Coordinate the Reserve's development as a Sentinel Site within the NERR system. 

Objective By , characterize the density and spatial distribution of tidal wetlands at the Reserve's sentinel site stations 

Action 1: Complete an implementation plan to qualify the Reserve as a fully functional Sentinel Site within NOAA's Sentinel Site Program. 

Action 2: Map the spatial distribution of emergent marshes, eelgrass beds, and forested wetlands at Sentinel Site stations. ®

Action 3: Collect percent cover, shoot density, and elevation data associated with emergent marsh plant communities, eelgrass beds, and forested wetlands at Sentinel Site stations (Figure 3.2). ®

Action 4: Establish groundwater wells and groundwater level data loggers at Sentinel Site stations to characterize tidal wetland groundwater level regimes and quantify changes. ®

Action 5: Evaluate relationships between plant community characteristics of tidal wetlands and water quality, elevation, groundwater level, sedimentation, vertical accretion, and tide level data. ®



Figure 3.2: Staffer Talo Silver assisting with Real-time Kinematic Surveys at Hidden Creek Marsh, to establish elevation changes in tidal wetlands.

Goal 2: Increase Reserve understanding of ocean acidification in the Pacific Northwest. ®

Objective By , begin characterizing water column carbon dynamics in the South Slough. ®

Action 1: Establish and implement data collection protocols for partial pressure of carbon dioxide (pCO₂) and high resolution pH instruments deployed in the South Slough. ®

Action 2: Analyze, summarize and distribute data from pCO₂ and pH instruments deployed in the South Slough. ®®

Action 3: Use data from the pCO₂ and pH sensors to help interpret long-term time series pH trends from the SWMP water quality stations in the South Slough. ®

Action 4: Facilitate the collection and interpretation of data to help characterize ocean acidification in southern Oregon offshore and nearshore waters to inform results in the South Slough. ®

Goal 3: Increase Reserve understanding of the relationships between climate change and ecosystem functions in Pacific Northwest marine and estuarine environments. ®

Objective Through the Partnership for Coastal Watersheds, facilitate the local development of a climate change vulnerability assessment for Coos Bay. ®®

Action 1: Work with Partnership for Coastal Watersheds stakeholders to guide the development of the assessment. ®®

Action 2: Work with University of Oregon and other scientists to expand the capacity of the Coos estuary hydrodynamic model to test various climate change scenarios (Figure 3.3).^(R)

Action 3: Assist partners, including the Pacific Northwest Coastal Blue Carbon Working Group, to better understand climate change impacts on ecosystem services in coastal communities.^{(R)(C)}

Objective By , begin to describe relationships between climate change and biological processes in the Coos estuary.^(R)

Goal 4: Increase communications about actual and potential climate change impacts to diverse audiences.^(E)

Action 1: Evaluate potential effects of changing water quality (i.e. pH, water temperature) and sea level rise on local biota, including native fish and shellfish.^(R)

Objective By , strengthen Reserve staff skills in communicating about climate change.^(E)

Action 2: Work with partners, including the Pacific Northwest Coastal Blue Carbon Working Group, to quantify carbon stocks, sequestration rates, greenhouse gas emissions and ecosystem drivers in estuarine habitats.^(R)

Action 1: Apply the National Network for Ocean and Climate Change Interpretation (NNOCCI) methods to staff trainings in climate interpretation.^(E)

Action 2: Facilitate staff trainings on climate science, either in-house or by providing staff with opportunities to attend external climate science events.^{(R)(E)}

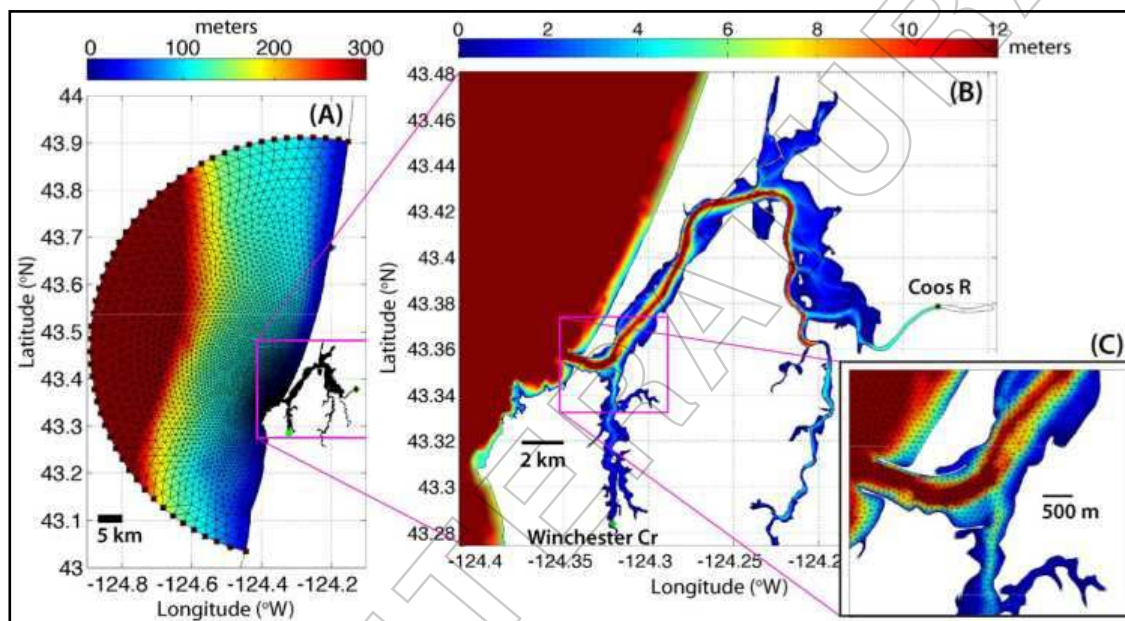


Figure 3.3: Prototype hydrodynamic model for the Coos estuary from University of Oregon professor David Sutherland. (A) Full model domain for preliminary runs showing grid cells (triangles) on top of bathymetry (color). Green dots indicate location of river inputs. (B) Zoom-in on boxed region in A, showing bathymetry of Coos Bay. Note color scale changes and model grid is omitted for clarity. (C) Zoom-in on boxed region in B, showing grid near the estuary mouth, with the same bathymetry color scale as B.

Objective Assess the needs of coastal decision makers for information and trainings related to at least two climate change impacts and/or coastal resiliency issues. ©

Action 1: Expand the coastal training target audience to include new local stakeholders, such as local business owners and associations, in need of information or trainings on climate issues. ©

Action 2: Identify key climate and resiliency information and training needs. ©

Action 3: In collaboration with stakeholders, design training or technical assistance to meet their needs. ©

Action 4: Provide stakeholders with relevant climate and resiliency information and training opportunities. ©

Objective By , incorporate climate change research into at least four formal education programs ©

Action 1: Provide professional development workshops, including Teachers On the Estuary (TOTE), to help teachers incorporate climate change science into classrooms using new and existing curricula. ©

Action 2: Facilitate the delivery of climate science results to K-12 students through NOAA's K-12 Estuary Education Program (KEEP). ©

Action 3: Incorporate climate science curricula into formal education using Estuaries 101 and NOAA education products (Figure 3.4). ©

Action 4: Develop new exhibits and publications that incorporate climate science and emphasize its implications for the Reserve. ©®

Action 5: Incorporate local and regional climate change information into decision maker trainings. ©

Objective By , incorporate climate change research into at least two informal education activities ©

Action 1: Emphasize Reserve climate science research (including Sentinel Sites) and community level solutions at public outreach events. ©

Action 2: Incorporate climate science into interpretive programming. ©

Action 3: Add the Reserve's climate-related research (e.g. Sentinel Sites) to online educational portals. ©



Figure 3.4: School group learning about salt marsh habitats.

Priority 2: Habitat Protection

Goal 1: Assess and monitor habitats in the Coos estuary in order to characterize conditions and changes in habitat use and availability. (R)

Objective By , create maps of the habitats within Reserve managed lands (S)

Action 1: Assess current maps and habitat data to determine data needs for mapping. (R) (S)

Action 2: Work with partners to acquire information for habitat maps. (R) (S)

Action 3: Utilize NOAA resources to support creating Reserve habitat maps. (R) (S)

Action 4: Update and refine the Coastal and Marine Ecological Classification Standard (CMECS) maps for the Coos estuary. (R) (S)

Action 5: Engage interns to assist staff with mapping and ground-truthing as part of their job-training experience. (P)

Objective By , initiate a long term strategy to monitor the effectiveness of Reserve restoration projects (R)

Action 1: In conjunction with stakeholders, identify priority projects to monitor. (R)

Action 2: Refine protocols and metrics to quantify the effectiveness of previous and ongoing restoration work. (R)

Action 3: Continue to use ongoing SWMP water quality and Sentinel Site data to inform the effectiveness monitoring program and results. (R)

Action 4: Implement effectiveness monitoring for restoration projects as they are developed and funded. (R)

Objective By , begin an annual monitoring program to track and evaluate the use of estuarine habitats by fish and invertebrate communities in the Coos estuary (R)

Action 1: Quantify levels of habitat use by estuarine-dependent species in at least six locations of the Coos estuary. (R)

Action 2: Evaluate the use of estuarine habitats and tributaries by fish and invertebrate species. (R)

Action 3: By 2018, start identifying the environmental requirements and adaptive potential for fish assemblages and invertebrate species. (R)

Action 4: By 2018, begin to use water quality, habitat, and species assemblage data to make habitat use comparisons among study sites. (R)

Goal 2: Continue to build the ridgetop-to-estuary habitat restoration program. (S)

Objective By , develop a ridgetop to estuary restoration plan for the Passon Cree Watershed Restoration Project (S)

Action 1: Use data and stakeholder input to determine appropriate and effective restoration prescriptions. (S)

Action 2: Develop a funding strategy for restoration implementation. (S)

Action 3: Comply with local, regional, Tribal, and federal requirements in restoration implementation. (S)

Objective By , begin to develop adaptive stewardship and restoration projects for Reserve priority areas. (S)

Action 1: In conjunction with stakeholders, identify high priority areas in need of stewardship and or restoration project work (may include land acquisition & recreation planning). (S)

Action 2: Develop appropriate and adaptive plans. (S)

Action 3: Use Reserve administration and facilities resources to coordinate restoration and stewardship planning and implementation. (S)

Goal 3: Increase public awareness of Reserve stewardship practices, habitat-related research, and habitat protection. (E)

Objective Incorporate habitat protection and restoration education into at least two Reserve outreach programs. (E)

Action 1: Assess the needs of restoration scientists and decision makers for information or training related to preserving or restoring habitat connectivity in coastal ecosystems. (C)

Action 2: Design and deliver needs based workshops to appropriate audiences, on restoration and or habitat connectivity topics. (C)

Action 3: Develop and present restoration demonstrations to appropriate audiences based on projects at the Reserve. (S)

Action 4: Partner with local schools and universities to incorporate habitat protection and restoration education into natural resource programs. (E) (S)



Figure 3.5: Teachers On the Estuary participants learning about wetland plant communities.

Objective Fully incorporate the use of local data into at least two for al education pathways, to help illustrate connectivity of estuarine and arine habitats. (E)

Action 1: Using TOTE and other professional training opportunities, train teachers to understand and use data in their classrooms (Figure 3.5). (E)

Action 2: Increase the use of Reserve data in K-12 formal education programming. (E)

Action 3: Continue to improve the engagement of students and citizen scientists in data collection and monitoring. (E)

Action 4: Distribute Community, Lands, and Waterways environmental inventory information to users. (C) (R)

Objective Develop educational tools that build public awareness and engage residents in stewardship practices at the Reserve. ^(E)

Action 1: Identify best practices that help staff reduce ecological impacts from special events and programs. ^(P)

Action 2: Improve interpretive signage at entries and along trails to reduce negative impacts of trail use, increase knowledge of habitat protection, and increase public stewardship of the Reserve. ^(S)

Action 3: Continue to incorporate habitat and water quality stewardship themes and practices into educational field trips. ^(E)

Action 4: Expand field trips to the Reserve to reach broader audiences, including decision-makers. ^(C)

Action 5: Develop informal programming for public outreach events to highlight habitat protection and stewardship practices in the Reserve. ^{(P)(S)}



Figure 3.6: Invasive European green crabs (*Carcinus maenas*) captured in traps deployed to monitor population extent in the Coos estuary.

Priority 3: Invasive Species

Goal 1: Characterize and monitor the extent of invasive species affecting the Reserve. ^(R)

Objective By [blank], begin to map the presence and extent of invasive species impacting the Reserve. ^(R)

Action 1: Use data to map the presence of invasive species affecting or threatening the Reserve, while identifying data gaps. ^(R)

Action 2: Utilize invasive species partnerships to support creating maps. ^(R)

Action 3: Engage interns to assist staff with mapping and ground-truthing as part of their job-training experience. ^(P)

Objective Initiate an invasive species monitoring program within five years. ^(R)

Action 1: Work with partners to identify existing and emerging invasive species of high priority. ^{(R)(S)}

Action 2: Identify invasive species data or data gaps, to inform the monitoring program. ^(R)

Action 3: Identify and develop opportunities to engage the public, including interns and volunteers, in the monitoring of invasives. ^{(R)(P)}

Action 4: Integrate appropriate SWMP Sentinel Site data into the invasive species monitoring program. ^(R)

Goal 2: Measure and track the impacts of invasive species in coastal habitats. ^(R)

Objective Within one year of compiling baseline data, develop and begin implementing research projects to investigate the effects of priority invasive species on coastal ecosystems. (R)

Action 1: Work with partners to identify existing and emerging invasive species of high priority and develop scientific questions related to the study of invasive species impacts. (R)

Action 2: Conduct laboratory and/or field experiments to determine the impacts of high priority invasive species on ecological communities. (R)

Goal 3: Reduce the impact of invasive species negatively affecting or threatening the Reserve. (S)

Objective By 2025, start identifying and implementing appropriate methods for minimizing the effects of at least three priority invasive species in the Reserve. (R)(S)

Action 1: Prioritize invasive species management areas and establish a strategy for removal and control of key species. (R)(S)

Action 2: Work with partners to identify suitable and effective methods to reduce the impacts of high priority invasive species. (R)(S)

Action 3: Emphasize early detection and control measures to reduce risks and spread of emerging invasive species. (R)(S)

Objective Conduct at least six annual events for the removal of invasive species annually. (S)



Figure 3.7: Bree Yednock and Eric Dean (background) during a staff-wide effort to pull invasive purple loosestrife (*Lythrum salicaria*) from Barview Marsh, near the mouth of South Slough.

Action 1: Provide training for staff, volunteers, interns, and students to identify and properly remove invasive species. (S)

Action 2: Provide staff, volunteers, interns, and student groups with opportunities to learn about invasive species through removal and effectiveness monitoring events. (S)(P)

Action 3: Use accessible on-line tools to support identification and training efforts. (E)

Goal 4: Increase distribution of information about the status and impacts of invasive species to diverse audiences. (E)

Objective Incorporate invasive species concepts into at least three education pathways. (E)

Action 1: Work with partners to increase Reserve access to resources and materials available for invasive species education. (E)

Action 2: Provide outreach that illustrates the ecology and impacts of invasive species. (E)

Action 3: Develop a formal educational activity that demonstrates the ecology and impacts of invasive species. (E)

Action 4: Incorporate invasive species themes into workshops for decision-makers. (C)

Action 5: Support internships and volunteer coordination for invasive species projects and outreach. (P)

References:

NOAA Office of Coastal Management. 2017. The National Estuarine Research Reserve System: Strategic Plan 2017-2022. National Oceanic and Atmospheric Administration. <https://coast.noaa.gov/data/docs/nerrs/StrategicPlan.pdf>

Rumrill, S.S. 2006. The Ecology of the South Slough Estuary: Site Profile of the South Slough National Estuarine Research Reserve. South Slough National Estuarine Research Reserve. Charleston, OR. 238 p.

Chapter 4: Program Foundations

This chapter is divided into two main sections: *Science Program Foundations* and *Education Program Foundations*. The Education Program is further divided into Education (formal and informal), Coastal Training Program, and Public Involvement.

Reserve System Program Overview

The National Estuarine Research Reserve System's mission provides that reserves are protected and managed to afford opportunities for long-term research while emphasizing education, interpretation, and outreach. The Reserve System recognizes it has a responsibility to provide training for coastal decision makers. Science and education programs at each reserve are designed to fulfill the Reserve System goals as defined in the federal regulations (15 C.F.R. 921(b)) (see sidebar).

Research

Expand capacity to monitor changes in water quality and quantity, habitat, and biological indicators in response to land use and climate change drivers.

Improve understanding of the effects of climate change and coastal pollution on estuarine and coastal ecology, ecosystem processes, and habitat function.

Characterize coastal watersheds and estuary ecosystems and quantify ecosystem services to support ecosystem-based management of natural and built communities.

Increase social science research and use of social information to foster coastal stewards that value and protect estuaries.

Education and Coastal Training

Enhance the capacity and skills of teachers and students to understand and use Reserve System data and information for inquiry-based learning; and

Increase estuary literacy and promote active stewardship among public audiences through the development and delivery of tools and programs addressing climate change, habitat protection, and water quality.

Improve the capacity and skills of coastal decision makers to use and apply science-based information in decisions that affect estuaries and coastal watersheds.

Reserve System Goals include:

Address coastal management issues identified as significant through coordinated estuarine research within the system;

Promote federal, state, public and private use of one or more reserves within the system when such entities conduct estuarine research;

Conduct and coordinate estuarine research within the system, gather and making available information necessary for improved understanding and management of estuarine areas.

Enhance public awareness and understanding of estuarine areas and provide suitable opportunities for public education and interpretation;

Conduct and coordinate estuarine research within the system, gathering and making available information necessary for improved understanding and management of estuarine areas.

Chapter 4.1: Science Program Foundations

Reserve System Research Program

The National Estuarine Research Reserve System's mission provides that reserves are protected and managed to afford opportunities for long-term research. (See Reserve System goals and objectives at beginning of chapter)

The Reserve System's research, monitoring, and stewardship programs provide the scientific basis for addressing coastal management challenges. Reserve science activities provide valuable information about estuarine resources to increase understanding and awareness of their importance to a variety of audiences including scientists, resource managers, educators, and the general public.

Currently, there is one focused effort to fund estuarine research in the Reserve System. The National Estuarine Research Reserve System Science Collaborative, a partnership between NOAA and the University of Michigan, is a program that focuses on integrating science into the management of coastal natural resources. Currently administered through the University of Michigan, the program integrates and applies the principles of collaborative research, information and technology transfer, graduate education, and adaptive management with the goal of developing and applying science-based tools to detect, prevent, and reverse the impacts of coastal pollution and habitat degradation in a time of climate change. The program is designed to enhance the Reserve System's ability to support decisions related to coastal resources through collaborative approaches that engages the people who

produce science and technology with those who need it. In so doing, the Science Collaborative seeks to make the process of linking science to coastal management decisions, practices, and policies more efficient, timely, and effective and share best practices and examples for how this can be done.

Reserve System Monitoring Program

The System-Wide Monitoring Program (SWMP) provides standardized data on national estuarine environmental trends while allowing the flexibility to assess coastal management issues of regional or local concern and is guided by the SWMP Plan. The principal mission of the monitoring program is to develop quantitative measurements of short-term variability and long-term changes in water quality, biological systems, and land use and cover characteristics of estuaries and estuarine ecosystems for the purposes of informing effective coastal zone management. The program is designed to enhance the value and vision of the reserves as a system of national references sites and focuses on three ecosystem characteristics:

1. **Abiotic Characteristics:** Abiotic measurements are supported by standard protocols, parameters, and approaches that describe the physical environment including weather, water quality, hydrological, and sediment related parameters. The monitoring program currently provides data on water temperature, specific conductivity, percent saturation of dissolved oxygen, pressure, pH, turbidity, salinity, concentration of dissolved

oxygen, and pressure corrected water depth. Meteorological data include air temperature, relative humidity, barometric pressure, wind speed, wind direction, rainfall, and photosynthetically active radiation (PAR). In addition, the program collects monthly nutrient and chlorophyll a samples and monthly diel samples at one SWMP data logger station. Data is Federal Geographical Data Committee compliant and available via the Reserve System Centralized Data Management Office.

2. Biotic Characteristics: As funds are available, reserves are focusing on monitoring habitats and biodiversity.
3. Watershed and Land Use Classifications: The Reserve System is examining the link between watershed land use and coastal habitat quality by tracking and evaluating changes in coastal habitats and watershed land use and cover. This element is guided by the Reserve System Habitat Mapping and Change Plan.

Building on these foundational elements, the Reserve System is developing a network of Sentinel Sites and the capacity to assess the impact of sea level lake level changes and inundation on the diverse set of coastal vegetative habitats represented in the system. Reserves are implementing a suite of activities, as described in the 2016 Reserve System Sentinel Site Guidance Document, to assess the relationship between vegetative communities (marsh, mangrove and submerged aquatic vegetation) and sea level. Reserves are adding surface elevation tables and monitoring pore water chemistry along vegetation monitoring transects and linking their SWMP stations to

a network of specialized spatial infrastructure to allow precise measurement of local sea level and lake level changes and subsequent impacts to key habitats. The Reserve System is working in partnership with NOAA's National Geodetic Survey and the Center for Operational Oceanographic Products and Services to support the development of sentinel sites.



Figure 4.1: Science staff collecting elevation data at a Reserve Sentinel Site.

South Slough Reserve Science Program

The Science Program at the South Slough National Estuarine Research Reserve is dedicated to scientific investigations and monitoring projects that have direct applications for improving coastal management. In order to achieve this, the Science Program is composed of three main programs:

1. Research
2. Monitoring
3. Stewardship

During the 2017-2022 planning period the Science Program will continue to:

Advance scientific understanding of the South Slough, Coos Bay, and other Pacific Northwest estuaries and coastal watersheds through research, monitoring, and education.

Assess and monitor the status of estuarine habitats and biotic indicators in order to track short-term variability and long-term changes in estuarine habitats and communities.

Provide technical assistance and advisory services for the effective management of estuaries and coastal watersheds.

Evaluate, manage and restore (if possible) the habitats and ecosystem processes within the South Slough Reserve, and collaborate with local, regional and national organizations on estuarine and coastal watershed projects.

During this planning period, the Science Program will also continue to work toward applying monitoring data to resource management problems, sustaining system-wide monitoring efforts, developing a better understanding of the connections among watersheds, estuaries, and near shore environments, and promoting the use of the Reserve for research that supports national priority issues and informed coastal management.

Geographic Scope

The geographic scope of the Science Program at the Reserve encompasses the Reserve, the South Slough and the Coos estuary, and extends throughout the Pacific Northwest and across the Reserve System.

Target Audience

The Science Program focuses on the following audiences:

- Sovereign tribal nations in the Coos Bay region and along the Oregon coast
- Decision makers, natural resource and land managers, planning agencies
- Local city (Coos Bay and North Bend) and county (Coos) governments
- Academic research communities (e.g. universities)
- K-12 students, undergraduate and graduate college students, teachers
- Conservation organizations
- Watershed councils and associations
- Economic and development entities (e.g. International Port of Coos Bay, South Coast Development Council) and commercial firms (oyster growers)
- Reserve staff, the Reserve System, and NOAA



Figure 4.2: Science program participants learning about field survey methods.

Science Community and Partners

The Reserve's science community includes broadly trained wetland, estuarine, marine, and upland biologists. Through the coordination of advisory working groups, the Reserve brings in additional expertise and resources

from partners to design effective research, monitoring, and stewardship plans that address diverse needs and priorities. The Reserve's science staff frequently works collaboratively with the following partners and stakeholders:

Federal Entities: U.S. Forest Service, U.S. Fish and Wildlife Service, Bureau of Land Management, U.S. Coast Guard, NOAA Office for Coastal Management, the Integrated Ocean Observing System (IOOS), and other NOAA offices and affiliates

Tribes: Coquille Indian Tribe, Confederated Tribes of Coos, Lower Umpqua and Siuslaw Indians, the Confederated Tribes of Siletz Indians, Confederated Tribes of the Grand Ronde

State and Regional Agencies: Oregon Departments of State Lands, Fish and Wildlife, Forestry, State Parks and Recreation, Environmental Quality, and Transportation, Agriculture, Land Conservation and Development, Northwest Association of Networked Ocean Observing Systems (NANOOS)

Local Governments: Coos County; Curry County; Cities of Coos Bay and North Bend
Higher Education: The University of Oregon and Oregon Institute of Marine Biology (OIMB), Oregon State University, Portland State University, Southwest Oregon Community College

Non-profit Organizations: Friends of South Slough, Coos Watershed Association, Coquille Watershed Association; Oregon Sea Grant

Collaborative Groups: Partnership for Coastal Watersheds, Gorse Action Group, Pacific Marine and Estuarine Fish Habitat Partnership

ta , acilities, and nfrastructure

Permanent full-time staff positions include:

Research Coordinator Lead Scientist
Watershed Monitoring Coordinator
Estuarine Monitoring Coordinator
Stewardship Coordinator
Monitoring Technician

Additional staff include temporary workers, interns, who are usually supported with grant funding when it is available. Volunteers are also regularly involved in the Science Program.

Science facilities and infrastructure include:

Reserve Science Center laboratory (Figure 4.3)

Offices in the Reserve Science Center building

Boats, trailers, motors, vehicles (available to all staff)

Temporary housing for visiting researchers, students, and interns

Maintenance shop and yard for equipment and vehicle storage and numerous tools for construction and repairs

Facilities listed and described in the Reserve Facilities Plan (Chapter 6) are also available to the Science team and its partners



Figure 4.3: Reserve Science Center laboratory located at the Oregon Institute of Marine Biology.

Many of the Reserve's local and regional research and monitoring projects are grant-funded and involve the assistance of temporary staff and interns, local and regional graduate and undergraduate students, and in-kind work by Reserve partners and volunteers. Additionally, the Reserve serves as a research site for projects that span the coast of Oregon, the Pacific Northwest, or the entire West Coast. These projects are often led by independent academic researchers (e.g. professors, graduate students), but also include governmental agencies (e.g. Environmental Protection Agency, Oregon Department of Fish and Wildlife).

Information Gained Since Last Plan

Since the last management plan was approved in 2006, the Reserve has gained a great deal of information:

Climate change

Several years of vegetation bio-monitoring data are available for the Reserve's primary Sentinel Site station and six other bio-monitoring sites in South Slough (2010; 2015; 2016; ongoing). With the establishment of a high-precision vertical control network, improved elevation data are available for monitoring projects throughout the Reserve (2010; ongoing).

Water quality

In collaboration with NOAA and the Cooperative Institute for Coastal and Estuarine Environmental Technology (CICEET) at the University of New Hampshire, SWMP water quality data from four reserves (Padilla Bay, South

Slough, Elkhorn Slough, Tijuana River) were synthesized for nutrient and dissolved oxygen patterns (2007). Water quality analyses show a significant increasing trend in pH over the last 10 years at all SWMP stations in the South Slough, although over the last four years pH has been decreasing (2010; ongoing). Through support from the Science Collaborative, four secondary SWMP water-quality monitoring stations have been established in Isthmus Slough, Catching Slough, North Point (McCullough Bridge), and on the Coos River (2013) (Figure 4.4).

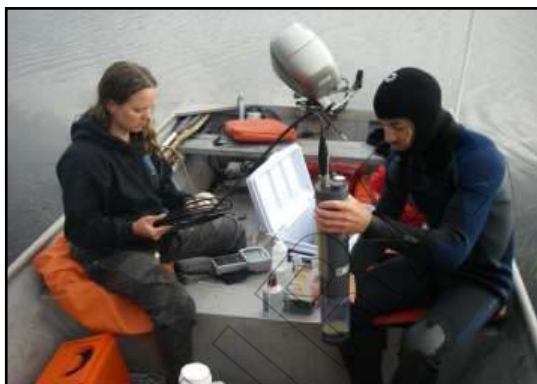


Figure 4.4: Science staffers Ali Helms and Adam Demarzo downloading abiotic data from a sonde at one of the Reserve SWMP stations.

Preliminary results (2013) from the secondary SWMP stations have shown that summer values for dissolved oxygen and temperature do not meet Oregon Department of Environmental Quality's standards for healthy estuarine waters at three of the four stations (Isthmus Slough, Catching Slough, and Coos River). Real-time water quality equipment and data access tools (CDMO Web Services and NANOOS Visualization System)

have enhanced the Education Program and increased the use of SWMP data by local stakeholders including teachers, researchers, and West Coast oyster growers (NVS launched 2009; ongoing)

ecology

Research completed by a Reserve System graduate research fellow increased knowledge on the ecology and life history of *Enteromorpha linza* (bull kelp) in the South Slough estuary (2006)

The population ecology of the diatom *Pseudo-nitzschia* within the South Slough estuary was studied by a Reserve System graduate research fellow (2007)

Research by a Reserve System graduate research fellow provided new information on species interaction dynamics between seagrasses and macroalgae and the role of nutrient sources on interaction outcomes in the South Slough estuary (2011)

Research by a Reserve System graduate research fellow evaluated community structure, plant interactions, seedling performance, and seed bank composition of six salt marshes along the South Slough estuarine gradient (2011)

Research by University of Oregon students and NOAA graduate research fellows has improved the Reserve's understanding of native oyster reproduction, larval movement, recruitment, and feeding capacity in the Coos estuary (2013)

- o Reserve staff and interns determined native oyster recruitment is low in South Slough compared to other locations in the Coos estuary (2014; ongoing)

Some Port Orford cedar trees sampled in the Reserve have shown increased genetic resistance to Port Orford cedar root rot (*Phytophthora lateralis*), compared to trees sampled from other parts of their native range (2013-2015; ongoing)

The value of large woody debris for salmonids, as both providing complex structural habitat and promoting invertebrate prey abundance, was researched and compared to adjacent sites with no woody debris (2008)

With the assistance of Reserve staff and others, the Oregon Department of Land Conservation and Development drafted estuarine habitat classification maps for the Coos estuary using the Coastal Marine and Ecological Classification Standard (CMECS) (2014; ongoing)

The Reserve has a better understanding of circulation in the Coos estuary from the hydrodynamic model created by partners at the University of Oregon through the Partnership for Coastal Watersheds (2015; ongoing)

Habitat Restoration

The Reserve's Upper Watershed Restoration Action Plan (2009) provided new information about the uplands in the Reserve and a foundation for future restoration projects

In collaboration with CICEET and Green Point Consulting, development of a tidal wetland reference condition database and a temperature sensor method for detecting tidal inundation in least-disturbed tidal wetlands provided new tools for restoration projects (2011)

In collaboration with the NOAA Restoration Center and five Reserves (South Slough, Wells, North Carolina, Chesapeake Bay Virginia, and Narragansett Bay), research on tidal wetland plant, soil, and hydrologic response to restoration using performance benchmarks from a local reference system identified that Reserve System can provide long term reference sites for local tidal wetland restoration projects (2012)

Port Orford cedars planted in restoration sites show low mortality rates in their first two years of monitoring (2013-2015; ongoing)

invasive species

Three Reserve System graduate research projects provided new information about invasive species in the Reserve: one investigated the changes to nutrient and carbon cycling, soil properties and ecosystem processes by *Phalaris arundinacea* (reed canary grass) and *ostrea japonica* (japanese eelgrass); a second explored the invasion of the burrowing isopod *Sphaeroma quoianum* in the Coos estuary, and a third tracked the settlement and growth of the marine bryozoan *chi oporella japonica* and epifaunal community development in the South Slough estuary (2009, 2010, 2012)

Data are available on the distribution and density of two non-native snails (*Asiinea parasitologica* and *Yosotella yosotis*) in the Coos estuary (2010)

Two introduced species found in the South Slough estuary the colonial sea squirt *Didemnum veillum*, a relatively recent arrival, and nutria (*Myocastor coypus*),

a long-established exotic mammal have taken on new significance as nuisance species within the Reserve (2010, 2012)

and user outreach

The *State of the South Slough and Coastal Frontal Watersheds* project summarized newly collected and existing data that describes environmental and socio-economic conditions in the South Slough and coastal frontal watersheds (2012)

Through efforts of the Partnership for Coastal Watersheds, the *Coos Community, Lands and Waterways Data Source* (Data Source) was created to provide a comprehensive compilation of existing status and trends that characterize environmental and socio-economic conditions in the Coos estuary and surrounding communities, and describes anticipated effects of climate change in the Coos estuary and surrounding area (2015; ongoing)

The Data Source also identified large data gaps for the Coos estuary, including (2015; ongoing):

- o Eelgrass distribution and cover
- o Bathymetry
- o Native clams, native crabs, lamprey, and sturgeon populations
- o Sediment composition and contamination
- o Water quality (nutrients and pollutants)

Results from a qualitative resource condition evaluation and scoring process (2008 Resource Condition Scorecard), addressing environmental conditions and trends of water, habitat, and living resources in the Reserve, provided information for research, monitoring, and education projects and local stakeholders (2008).

Science Program Delivery

System-Wide Programs, National Programs, and National Priorities

The Science Program implements the System-Wide Monitoring Program (SWMP) and the Reserve System's Climate Change Initiative in a number of ways. Two full-time staff carry out abiotic SWMP monitoring in the Reserve (Figure 4.5). They are responsible for maintaining and collecting data from core water quality stations, nutrient stations, and weather stations, implementing quality assurance control procedures, analyzing the data, and translating and interpreting data for education programs. The Reserve maintains one real-time SWMP weather station, which was located on the OIMB campus from 2001-2014. Due to the installation of a wind turbine by OIMB, the weather station has been relocated to the south end of the Reserve. Core SWMP water and weather monitoring components are supported by funds from NOAA and NANOOS. NANOOS funding is used to maintain telemetry equipment at five of the Reserve's water quality stations, which send data to online data portals developed by NANOOS.

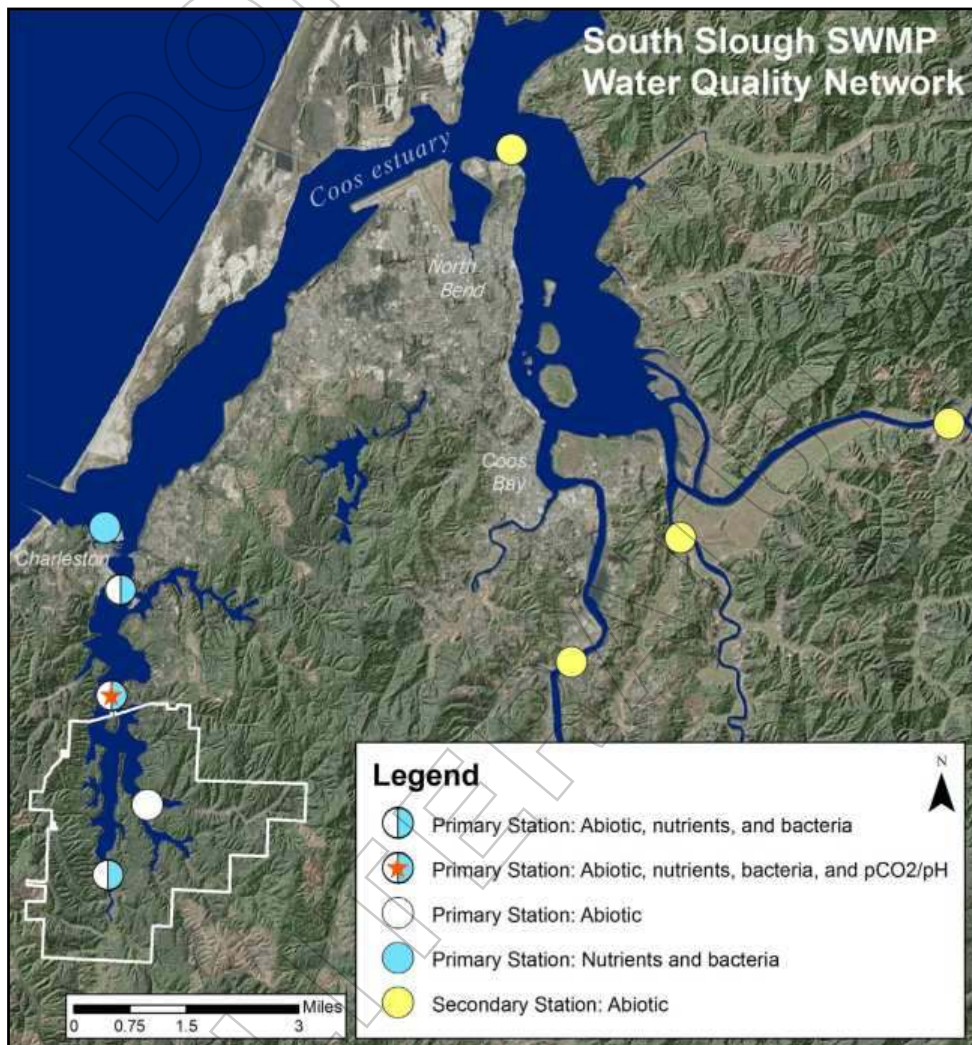


Figure 4.5: The extent of South Slough Reserve's SWMP program. Reserve boundaries outlined in white.

The Reserve participates in the Reserve System's Sentinel Sites program (Figure 4.6). In 2016, science staff created the South Slough Sentinel Site Plan and a Vertical Control Plan that outlines the Reserve's strategy for implementing Sentinel Site Application Module No. 1. Over the next five years, science staff will complete the installation of the necessary infrastructure for making Hidden Creek Marsh an official Sentinel Site station.

In accordance with the habitat mapping and change component of SWMP, science staff are working towards creating maps for Reserve-managed lands that show watershed and land use classification and the spatial distribution of habitats. Reserve habitats had previously been delineated using the Reserve System's habitat and land cover classification system. Over the term of this plan, science staff will work to validate habitat classifications and convert them to the CMECS. The Reserve is also partnering with Oregon's Department of Land Conservation and Development to apply the CMECS to the entire Coos estuary. The completion of habitat maps for the Reserve is a strategic objective for this planning period.

Science Program Goals for 2017-2022

The Reserve worked with partners and stakeholders to identify important research and monitoring projects to implement during the next five years. These projects are grouped into three priority themes: *climate change*, *habitat protection*, and *invasive species*. The specific goals of the Science Program are outlined below, along with examples of how the program will work to achieve the goals.

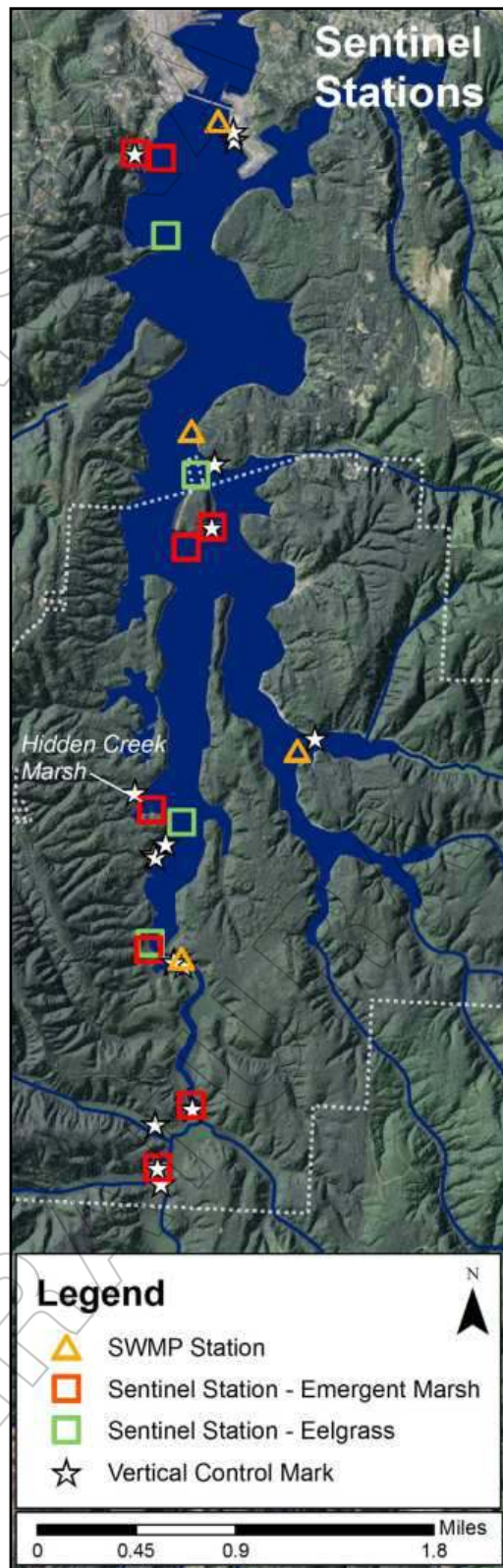


Figure 4.6: Locations of South Slough Reserve's Sentinel Site stations and vertical control marks. Hidden Creek Marsh is the primary sentinel station. Reserve boundary outlined in dashed white.

Climate Change Goal 1: Increase Reserve understanding of the local effects of sea level rise.

Much of this goal centers on formally establishing the Reserve's Sentinel Site station at Hidden Creek and continued monitoring at the Reserve's secondary bio-monitoring sites. Monitoring work (including emergent marsh, eelgrass, and shrub-scrub bio-monitoring, surface elevation change, estuary water level change, ground water levels, and mapping) is coordinated by the Estuarine and Watershed Monitoring Coordinators and carried out by a combination of staff, interns, volunteers, and student scholars. Monitoring occurs at the Reserve's primary sentinel site station (Hidden Creek Marsh) and seven secondary sites every three years, depending on available funding for materials and supplies (Figure 4.6).

Climate Change Goal 2: Increase Reserve understanding of ocean acidification in the Pacific Northwest.

The Reserve will continue to refine protocols for studying pH dynamics in estuaries. Data from the Reserve's high resolution pH and pCO₂ (partial pressure of carbon dioxide) sensors in South Slough will be analyzed and used to help interpret data collected at the Reserve's SWMP water quality stations. Science staff will continue to be involved in efforts by the West Coast Ocean Acidification and Hypoxia Panel to develop of a West Coast acidification monitoring network.

Climate Change Goal 3: Increase Reserve understanding of the relationships between climate change and ecosystem functions in Pacific Northwest marine and estuarine environments.

Reserve science staff will continue involvement with the Pacific Northwest Coastal Blue Carbon Working Group through a research project funded by the Reserve System Science Collaborative to quantify carbon stocks in estuarine wetlands across the Pacific Northwest. Wetlands within the Coos estuary and South Slough Reserve will be included as study sites for the project and Reserve science staff will provide logistical support and coordination of local fieldwork.

Climate Change Goal 4: Increase communications about actual and potential climate impacts to diverse audiences.

The Reserve's science staff will work closely with the Education and Coastal Training Program sectors to provide trainings on climate science and develop science-based education products (e.g. exhibits, publications) to illustrate local and regional impacts of climate change.

Habitat Protection Goal 1: Assess and monitor habitats in the Coos estuary in order to characterize conditions and changes in habitat use and availability.

The Reserve is investigating the use of estuarine habitats and tributaries by fish and invertebrates. Through 2017 science staff will continue to implement a multi-year project funded by a grant from the Pacific Marine and Estuarine Fish Habitat Partnership (PMEP) that involves monthly sampling at six locations in the



Figure 4.7: Volunteers and staff pulling in a beach seine at Barview.

South Slough and seasonal sampling at three sites in the upper Coos estuary to characterize spatial and temporal patterns of fish and invertebrate assemblages (Figure 4.7).

Habitat Protection Goal : Continue to build the ridgetop-to-estuary habitat restoration program.

The restoration program at the Reserve is coordinated by the Stewardship Coordinator and focuses on ridgetop to estuary watershed function. The Reserve has a long track record of successful tidal marsh restoration projects and is now extending work into riparian and upland habitats. With the information gained from the Reserve's 2009 Upper Watershed Restoration Action Plan, the Wasson Creek drainage was identified as the highest priority for habitat improvement and protection. The Wasson technical advisory group is working towards having a ridgetop to estuary restoration plan completed by end of 2017. The Science Program will also continue to work with partners, such as Oregon State University extension, to identify and develop community driven habitat protection opportunities that will be helpful for natural resource management and regional land owner education.

Invasive Species Goal 1: Characterize and monitor the extent of invasive species affecting the Reserve.

The Reserve is mapping the presence and extent of high priority invasive species affecting the reserve. Science staff are partnering with the Gorse Action Group to map the presence of gorse (*Ulex europaeus*) in the Coos and adjacent coastal watersheds. The distribution of reed canary grass (*Phalaris arundinacea*) and Himalayan blackberry (*Rubus arvensis*) have been mapped at the Wasson restoration site to provide baseline information on their spatial coverage. These maps will be modified following the implementation of restoration work and with data collected during post-project monitoring. A survey of European green crabs (*Carcinus maenas*) in 2016 led to the development of a map showing the spatial distribution of green crabs throughout the Coos estuary, including South Slough (Figure 4.8). Maps will be updated during this planning period as more data are collected through Science Program monitoring projects.



Figure 4.8: Survey map from 2016 green crab trapping effort.

Invasive Species Goal : Measure and track the impacts of invasive species in coastal habitats.

Science staff will work with partners to develop research projects to investigate the impacts of invasive species on native communities. Projects focused on European green crabs, Japanese eelgrass (*Ostrea japonica*), and reed canary grass are of particular interest to the Reserve's Science Program.

Invasive Species Goal 3: Reduce the impact of invasive species negatively affecting or threatening the Reserve.

Invasive species control at the Reserve focuses on upland species, which pairs well with outreach and education opportunities. The Reserve's Stewardship Coordinator continues to organize events that bring community groups and students to the Reserve, where they learn about the impacts and concerns related to invasive species, receive training on control techniques for invasive plants, and assist with removing invasives from key areas in and around the Reserve.

Intended Outcomes

By focusing on the above goals over the next several years, the Science Program will gain an improved understanding of its three priority issues as described below:

Climate change The Science Program will better understand the impacts of climate change on the sustainability of estuarine habitats in the Coos estuary, particularly impacts from sea level rise. In coordination with the Pacific Northwest Blue Carbon Working Group, the Reserve will have a better understanding of car-

bon stocks and sequestration rates in estuarine habitats in the Reserve and how they compare to similar habitats in other estuaries of the Pacific Northwest. The Reserve will also have an improved understanding of estuarine acidification and water column carbon dynamics and have baseline time series datasets of estuarine pCO₂ and pH to contribute to those interested in estuarine ocean acidification.

Habitat protection The Science Program will have updated information on fish assemblages and habitat use in South Slough and Coos Bay. Specifically, the Reserve will better understand fish usage at restoration sites over time and distributions of native fish in the South Slough watershed (e.g. lamprey and Coho salmon). The Reserve will also develop and implement ridgetop to estuary focused restoration projects in high priority areas, such as Winchester Creek, the Wasson drainage, and for endangered species. Furthermore, the Science Program will gain a better understanding of the estuary and its dynamics through the hydrodynamic modeling system currently in development.

Invasive species Through monitoring and research efforts, the Reserve will have a better understanding of the distribution and abundance of high priority invasive species in the Coos estuary, as well as improved mapping, modeling, and control of key invasive species affecting the Reserve. Specific research will be done on Port Orford cedar root rot (*Phytophthora lateralis*), continuing to contribute to regional monitoring efforts. Control efforts will focus primarily on upland and marsh species, although the Reserve will take advantage of research opportunities to experiment with controlling all invaders.

Program Integration

The Science Program provides technical support to the Reserve's Education Program in several ways. Information gained through research, monitoring, and experimental habitat restoration work is regularly integrated into education programs. Science staff provides field training to education staff, giving them detailed information on current monitoring and research projects. In addition, science staff often present to classes and teachers, mentor interns, advise students, and lead field trips.

The Science Program also, in part, guides the work of the Coastal Training Program. The results of research and monitoring projects are a major source of information for decision-maker participants in coastal training events. The science team provides presentations and demonstrations for coastal training programs.

The science team works closely with the Public Involvement Coordinator to develop and review intern and volunteer position descriptions, conduct interviews, and provide mentoring and evaluation for interns and volunteers.

The science team is also involved in helping guide the Friends of South Slough (FOSS) planning and project efforts. In particular, science staff attend monthly board meetings, annual budget planning meetings, and offer guidance and assessment of current projects to ensure that they align with the Science Program.

Staff regularly seeks opportunities to integrate their activities to be mutually reinforcing (e.g. a proposal to fund education programs and teacher workshops based on research data). Education and coastal training staff, as well as other employees, help shape the Science Program's direction by keeping staff informed of education and training needs, and of new developments in the Reserve or in local community management.

Results and Evaluations

At the beginning of each year, the Science Program implements an annual review and projection of projects, to assess their alignment to priorities, determine needs, and evaluate progress. The Reserve also submits annual updates on performance metrics to both the Department of State Lands and to NOAA. Reserve staff report progress and news three times a year to the Reserve Management Commission and grant-based work is contingent on reports documenting successful outcomes of project proposals.

Additionally, the Science Program, like all Reserve programs, is reviewed periodically to assess accomplishments, needs, and recommendations for program enhancements (Section 312 reviews). Each new research opportunity is evaluated by the Reserve staff to determine whether it fits the priorities of the Reserve, the Reserve System, and NOAA, as well as the Reserve's core principles. Finally, Reserve staff receives individual annual performance reviews and evaluations by DSL management.

Science Program Needs

Fill data gaps identified by the Communities, Lands & Waterways Data Source

Facilitate the update of the Coos Bay Estuary Management Plan including refining Oregon State's estuary habitat classification maps

Facilitate continued development of the Coos estuary hydrodynamic model to help coastal decision makers develop adaptive management responses to changes in sediment transport dynamics and sea level rise in the Coos estuary

Facilitate the development of a mobile-friendly, real-time depth gauge at the McCullough Bridge SWMP station

Expand partnership and funding opportunities to investigate coastal blue carbon and other ecological services provided by estuaries

Continue to investigate the sustainability of tidal wetlands in the Coos estuary and South Slough in the face of sea level rise

Continue water quality monitoring of South Slough and the Coos estuary

Pre- and post-restoration monitoring of vegetation communities and fish and wildlife populations

Mapping and monitoring of invasive species

Develop methods for early detection of invasive species

Continued development of the ridgetop to estuary restoration program and associated projects.

Science Program Needs and Opportunities

Needs

The needs in the left sidebar were identified by stakeholders, staff, and Reserve management.

Each of these needs informed the Reserve Strategic Plan (Chapter 3) and are guiding current and or planned research.

Capacity, Limitations, and Opportunities

Capacity for many science projects will be determined largely by the success of funding proposals. Grants will continue to be instrumental for funding long term, multi-dimensional projects, especially those that require expertise or equipment not currently available to Reserve staff (e.g. hydrodynamic model development, aerial imagery captures, etc.). Involvement of interns and student researchers will also continue to provide additional temporary capacity for science, monitoring, and stewardship projects.

Barriers to developing capacity include a lack of funding for new projects (materials, equipment, and staff), and limited staff availability to implement work related to existing, intermittently funded (e.g. Sentinel Site stations) and unfunded system-wide projects (e.g. habitat mapping).

To some extent those limitations can be offset through resources provided by partners, collaborative relationships with others, and working with education and training staff to identify cross-disciplinary funding opportunities that involve graduate and undergraduate students in both science and education.

Chapter 4.2: Education Program Foundations

The Education Program at the Reserve comprises formal and informal education, the Coastal Training Program and the Public Involvement Program. The following sections outline program context at the national level, followed by specific program delivery, goals, and needs for South Slough's: *Education Program* (which focuses on K-12, teacher, and community education), *Coastal Training Program*, and *Public Involvement Program*.

Education Program - National Level

The National Estuarine Research Reserve System's mission includes an emphasis on education, interpretation, and outreach (See Reserve System goals and objectives in the Chapter 4 introduction, page 4-1).

The Reserve System provides a vehicle to increase understanding and awareness of estuarine systems and improve decision-making among key audiences to promote stewardship of the nation's coastal resources. Education and interpretation incorporate science-based content into a range of programs and methodologies that are systematically tailored to key audiences around priority coastal resource issues.

Reserves conduct formal and informal education activities, as well as outreach activities that target culturally diverse audiences of educators and students, environmental professionals, resource users and the general public. Education and public programs, interpretive exhibits and community outreach programs integrate elements of Reserve System

science, research and monitoring activities and ensure a systematic, multi-faceted, and locally focused approach to fostering stewardship.

The Reserve System is committed to preparing tomorrow's future leaders with the knowledge and understanding of our nation's oceans and coasts to be responsible stewards. To fulfill this commitment, the Reserve System has created the K-12 Estuarine Education Program (KEEP) to increase the estuary literacy of students, teachers and the general public. The KEEP Program helps students and teachers learn about essential coastal and estuarine concepts, develop data literacy skills and strengthen their critical thinking, team building, and problem-solving skills. K-12 and professional development programs for teachers include the use of established coastal and estuarine science curricula aligned with state and national science education standards and frequently involves both on-site and in-school follow-up activity.

Conservation action education is another priority for the Reserve System. Conservation action education programs foster behavioral change to promote resource conservation. These programs work with audiences whose choices directly impact the integrity of our estuaries and their associated watersheds.

Coastal Training Program - National Level

The Coastal Training Program (CTP) emerged as a Reserve System education initiative in 2001, evolving from the Coastal Decision-Maker Workshops that became part of the basic operations for all reserves in 1998. The CTP is

designed to provide scientific information and skill-building opportunities to coastal decision-makers, facilitate networking and collaborations at local and bio-regional levels, and increase understanding of the consequences of human activities within the coastal landscape.

The CTP uses a variety of formats including seminars, hands-on skills training, participatory workshops, and technology demonstrations. Partnerships are essential to the CTP and programming is coordinated with the efforts of state coastal management and Sea Grant programs, along with local and regional agencies and organizations.

The Coastal Training Program provides up-to-date scientific information and skill-building opportunities to coastal decision makers responsible for making decisions affecting coastal resources. Through this program, reserves ensure that coastal decision makers have the knowledge and tools they need to address local critical resource management issues.

Coastal decision makers are defined as individuals whose duties include making decisions that affect the coast and its resources. The target decision-maker groups vary according to reserve priorities, but generally include groups such as local elected or appointed officials, managers of both public and private lands, natural resource managers, coastal and community planners, and coastal business owners and operators. They may also include groups such as farmers, watershed councils, professional associations, recreation enthusiasts, researchers, and more. Reserves are uniquely positioned to deliver

pertinent information to local and regional decision makers given their place-based nature. Coastal Training Program coordinators know the local people, places, and science are able to skillfully convene training participants and experts to address coastal management issues. Coastal training programs are built upon solid and strategic program documents, including an analysis of the training, market and assessment of audience needs. Coordinators then work with the results to identify how their program can best address local and Reserve System priority issues.

Partnerships are integral to the success of the program. Reserves work closely with several other NOAA programs, as well as a host of local partners in determining key coastal resource issues, target audiences, and expertise to deliver relevant and accessible programs.



Figure 4.9: Mushroom workshop, a popular program offered to the public where participants hike to collect mushrooms then bring back to the Reserve Interpretive Center to learn about what they found.

South Slough Reserve Education Program

The Education Program at the Reserve began in the late 1970's with an emphasis on providing structured on-site activities for students and teachers, interpretive displays and information about general estuarine themes, and opportunities for the public to learn about and experience estuaries. The Education Program is built on the belief that when people are aware of the functions and values of estuaries and coastal watersheds, they are motivated to support the management and protection of these habitats.

During the past several decades, the Reserve has greatly expanded its interpretive facilities, trails, technological capacity, partnerships, and staff, which have enabled the Reserve to reach new audiences with a larger scope of educational offerings.

The Education Program strives to provide activities that appeal to a range of interests, ages, and backgrounds. Audiences can be categorized as formal, including professional participants and students, and informal, including the public. Formal audiences also include participants from traditional and non-traditional education settings, from pre-school to lifetime learning groups. Formal professional audiences may include members of community organizations, service clubs, and educators, along with coastal decision-makers.

The informal audience includes people who visit the Visitors' Center and trails at the Reserve and participate in interpretive programs, as well as those who attend off-site exhibits and events in which the Reserve participates.

The Reserve provides school-based education programs and implements national education initiatives guided by the Reserve System. The Reserve also offers a variety of public programs, including guided hikes and paddling trips, various lectures and seminars, volunteer training, children's activities, and hands-on learning experiences (Figure 4.9).

Additionally, the Education Program coordinates the development of interpretive materials and exhibits for the Reserve.

Geographic Scope

The Education Program draws participation from schools across Oregon and visitors from the West Coast, although tourists from throughout the United States and world visit the Reserve as well. The primary audience for the Reserve's educational efforts is within a six county area of southwestern Oregon: Coos, Curry, Douglas, Lane, Jackson, and Josephine counties.

The Reserve hosts teachers, students, and other program participants, predominately from the Pacific Northwest, but at times from across the nation. For example, the Reserve annually hosts students from the Williams-Mystic Maritime Studies Program in Connecticut. Distance learning methodologies and partnerships have significantly extended the reach of the Reserve's education program, providing increased visibility and expanded opportunities for new audiences.

Information Gained Since Last Plan

Completion of the Education Program Market Analysis and Needs Assessment (Gaskill and Kulluson, 2012) provides the latest available guidance for program development and expansion.

The market analysis surveyed providers of coastal education from all across Oregon through an on-line survey and via two regional focus groups. Questions focused on the background of the response organization, programs offered, topics covered, professional development, and program marketing. Additional responses were gathered at professional environmental education meetings in southern Oregon and at South Slough.

The needs assessment targeted teachers and administrators in the six counties of Oregon outlined in the Geographic Scope description. Teachers in three grade bands, upper elementary (grades 3-5), middle school (grades 6-8), and high school (grades 9-12) were asked to respond to an on-line survey. Questions focused on grades taught, teaching experience, profile of the student population, topics and activities taught related to coastal education, delivery methods, use of field experiences, and recognition of South Slough. 190 of 1,300 teachers responded for a response rate of 15%.

Major findings included:

Pre-service and in-service teacher professional development was identified as an opportunity for future growth
Teacher professional development should emphasize skill building in partnership formation for collaboration with other providers and for seeking program funding

Identified focal areas of educator interest included: coastal hazards, marine and estuarine biology and ecology, data analysis, climate change and sea level rise, best management practices, and interdisciplinary research

Climate change impacts and coastal ecology were identified as strong areas of interest

Teachers identified the following areas where support is needed: education materials and activities, age appropriate background materials, professional development, sampling equipment, and funds to support these activities

A sustained long-term professional development relationship was identified as the key to successful training

Field experiences with a multi-day component and distance learning opportunities were identified as the best methods to meet needs

Responses from school groups, formal and informal program participants have also contributed to the information gained since the last plan. Program participant feedback has included evaluation surveys at the conclusion of interpretive programs, feedback from summer campers and their parents, and collection of data about program attendance. Feedback has influenced the types of programs offered as well as the design and delivery of summer camps.

The Oregon Coast Education Program (OCEP), a teacher professional development program, has also provided information resultant of teacher workshops and professional networking. Every teacher workshop has included pre- and post-surveys. The information gained from these has been compiled into recommendations

to improve the workshops and guide future directions for OCEP. When planning future workshops, lessons learned about format, length, delivery method, and topics covered have been used to evolve agendas.

Needs identified by teachers in surveys have informed identification of best practices in field experience, connections to Next Generation Science Standards (NGSS), and access to teaching resources as goals for the program. Sharing the OCEP model with OCEP partners and through professional meetings have led to a better understanding of how to deliver effective professional development to teachers.

Since the last management plan, feedback from partners has also included the idea that coastal education needs to adopt a holistic view that unifies the understanding of relationships between watersheds, estuaries, the ocean, and Earth's climate. Consequently, the Reserve acknowledges the importance of reaching beyond coastal communities to better understand and reach the major population centers of Oregon with services and products supported by scientific research and best practices.

Target Audience

The Education Program targets and serves a variety of audiences. The type of audience determines the nature of the content, methods, and location of instruction.

The primary emphasis for formal education at the Reserve is the Kindergarten-to-12th grade Estuary Education Program, known as KEEP. The KEEP audience includes students from kindergarten through grade 12, and



Figure 4.10: Summer campers proudly displaying their work.

comprises roughly 70 percent of the Reserve's 6,000 annual education program participants. Geographic proximity is a defining characteristic limiting participation in this program and thus a large portion of students come from Coos County, with the remaining coming mostly from the other five counties of southwestern Oregon.

Audiences for professional development include teachers, both formal (e.g. K-12 professional and pre-service teachers) and informal educators (e.g. volunteer instructors, interpretive aides), participating in various teacher-training and volunteer skill-building activities. The target audience for professional development programming mainly includes educators from the Pacific Northwest.

Since 2009, collaborative planning with a network of partner institutions forming OCEP has provided professional development and evaluated the needs of teachers in Oregon. Through this process teachers from the Oregon Coast, the Willamette Valley, the Portland Metro area, and Central Oregon have been identified as target participants. Oregon State University Extension Service and the Oregon Natural Resources Education Program also provide access to teacher professional

development opportunities. Partnerships with new learning centers, or hubs, focused on science, technology, engineering, and math education (STEM) have further advanced outreach to teachers in the state.

With support from the Friends of South Slough, the Education Program runs a series of summer camps from June through July for elementary through high school aged students (Figure 4.10). The majority of campers are local residents or family of local residents.

Informal education and public interpretation is focused mostly on visitors and local residents; these consumers are primarily self-selecting. The geographic range of this audience is seasonal. With the end of the school year and arrival of tourists, the audiences increase to include all visitors of the southern Oregon coast. However, with the decline of tourism in fall, informal education refocuses on local populations.

Education Program Themes

Long-time, cross-audience educational themes at the Reserve include:

Estuarine ecology encompasses a complex system of relationships between living and non-living elements connecting through the watershed, from ridge-top to estuary. Habitat protection and restoration within the watershed, estuary, and ocean help to support a sustainable estuarine ecosystem. Study of land and water use, habitat change, and water quality support improved understanding of the estuarine ecosystem and the activities necessary to protect these functions. Invasive species pose significant threats

to the stability and integrity of coastal watersheds and controlling and monitoring invasive species is a part of ecosystem protection.

Emerging educational themes at the Reserve include:

Impacts of global climate change, such as sea level rise and the spread of invasive species, may pose significant threats to the stability and integrity of coastal lands and waters.

Through education and training, residents of coastal communities will be better able to increase resiliency of estuaries and shore lands to these and other climate-related effects.

Partnerships

For implementation of KEEP, the Reserve works locally with schools and districts in Coos County, and to a lesser degree, in Curry, Douglas, Lane, Jackson and Josephine counties. Primary partner institutions include North Bend, Coos Bay, and Bandon schools, the Oregon State University Extension, and the University of Oregon's OIMB.

The Education Program also works with the Oregon Environmental Literacy Program to advance an environmental literacy plan adopted by the state in 2010. The education program coordinator is a member of the regional leadership team and program council.

Partnerships that facilitate teacher training and professional development at the Reserve include: Portland State University, the Hatfield Marine Science Center, and the Oregon Coast Aquarium. The Oregon Coast STEM Hub is a

regional resource for teachers, students and informal educators. The Reserve is a partner and holds a seat on the leadership council.

Collaboration with the Oregon Natural Resources Education Program at Oregon State University, and the Oregon Coast Education Program network, also provides opportunities for professional development. This network provides access to facilities, personnel, and training resources. Education staff actively participates in, and are leaders of, the Northwest Aquatic and Marine Educators (NAME), a regional guild of the National Marine Education Association that includes institutions and educators from Alaska, British Columbia, Washington, and Oregon.

Participation and leadership in engagement with these networks, and other broader impact activities, increase the stature, visibility, and effectiveness of the education program throughout the Pacific Northwest.



Figure 4.11: Education program about to head out on the water in the Reserve's flagship canoe, "Chmoosh."

Staff, Facilities, and Infrastructure

The Reserve's ability to implement education programs depends on maintaining sufficient staff, funding, materials, facilities, and

operational support to meet the needs of the target audiences. The Education Program is currently operating at capacity. However, the Education Program continues to actively seek opportunities through recruitment of volunteers, efficient operation of fund-based programming, and solicitation of additional grant funding to enhance delivery.

Permanent full-time education staff positions include:

- Education Coordinator
- Education Program Specialist
- Coastal Training Program Coordinator
- Public Involvement Coordinator

Addition staffing resources:

Temporary workers, interns, and volunteers are regularly involved in the Education Program. These positions are usually supported with grant funding and fluctuate over time. In addition, funds from the FOSS support a seasonal part-time gift shop assistant position and a seasonal full-time camp leader position to help coordinate the Reserve's summer camps.

Education facilities and infrastructure include:

The Visitors' Center is a 6,755 square foot room that welcomes visitors with interactive exhibits designed to encourage further exploration of the estuary

The Visitors' Center also serves as a base for workshops, field trips, lectures, classroom, and laboratory activities

- o The auditorium seats 70 participants in lecture format and can accommodate about 30 participants in a classroom set-up. The auditorium is also equipped for video conferencing for large groups.

- o The classroom offers wet lab space and can accommodate 25 students.

The Visitors' Center also houses the entire education staff and part of the administrative staff

Guided kayak trips of South Slough are provided for groups that have their own vessels

An eight-passenger canoe is available to lead small groups on the water (Figure 4.11)

For some programs, Education may use the Reserve's motorized water craft

The Reserve trail system is integral to the implementation of education programming (Figure 4.12)



Figure 4.12: Class discovering coastal forest habitats on one of the Reserve trails.

Facilities listed and described in the Reserve Facilities Plan (Chapter 6) are also available to the education team and its partners.

The Education Program partners with institutions locally and regionally to expand staff and facility capacity. Primary partners include Southwestern Oregon Community College, Oregon State University Extension, the Oregon Institute of Marine Biology (OIMB), Oregon Coast STEM Hub and other natural resources agencies.

Education Program Delivery

ystem-wide Programs, National Programs, and National Priorities

The education program uses information products developed by the Reserve System, such as SWMP data, to develop teaching materials for students. Through OCEP and professional development, the Reserve connects teachers with Estuaries 101 activities to use as preparation and reflection for field experiences at the Reserve. In support of national products, elements of the local curricula are designed to work with products available through NOAA (e.g. the www.estuaries.noaa.gov website, the Estuary Live video library collection, the SWMP data graphing tool, and other resources). All three OCEP coastal education modules contain activities which connect to national products.

Workshops for teachers and students, such as the Bringing Wetlands to Market curriculum on climate change, provide a good opportunity to implement national programs like the Teachers on the Estuary (TOTE) component of the KEEP. This curriculum also exemplifies the link to the Climate Change Initiative and provides a forum for discussing and sharing information about the resiliency of coastal communities to the effects of climate change.

During the period covered by this plan, greater emphasis will be given to the use of national products when relevant. Historically, support for TOTE programs has been funded through NOAA Bay-Watershed Education and Training Program (B-WET) grants and delivered by the OCEP leadership team. With increased support

for TOTE from the Reserve System, TOTE workshops will be delivered by the Reserve and focus on connecting teachers with national products such as the Sentinel Site program (Figure 4.13).



Figure 4.13: Students monitoring a salt marsh plot for vegetation. Salt marsh biomonitoring is a key component of the Sentinel Site Program.

Activities and Methodologies

Education activities include formal and informal education, summer camps, public involvement and volunteer coordination, public events, and training for educators, coastal managers, and decision makers. Programs focus on connecting participants with estuary habitats and Reserve research. The design of these activities is based on information gained from the MA NA and response to program offerings.

Over the course of this management plan, the Reserve will continue to incorporate field based activities for KEEP students and teachers that address priority areas. The majority of school programs occur in the field with students exploring the habitats of the estuary, and depending on grade level, students participate in data collection or other science focused activities. The content and delivery method is varied

depending on grade level and age appropriateness.

Teachers have the responsibility to incorporate these field experiences into their classroom teaching. Educational staff capacity makes it difficult to connect with students in the classroom which is why the Reserve has increased its focus on teacher professional development to help connect the classroom to field experiences.

In the next several years, the Reserve will expand its professional development program for teachers. Methods for this effort will include teacher professional development workshops hosted at the Reserve and at partner sites, support of educators engaging students in best practices related to field and classroom-based study, and provision of relevant curriculum and scientific data, research, scientists, and technology. TOTE workshops will connect teachers with data products that can be used in conjunction with data collection activities happening in the Reserve. The OCEP model of teacher professional development is also evolving to look beyond the individual teacher by incorporating best practices and implementation by teachers across the school. Through TOTE workshops, OCEP and the Reserve's partnership with the Oregon Coast STEM Hub, long-term professional development relationships will continue to be built.

Informal programs reach a wide audience from toddlers to retired citizens. Informal programs are delivered in a variety of formats from lecture, to hands-on workshop to exploration of local habitats.

Education Program Goals for 2017-2022

Over-arching educational goals at the Reserve include:

Use innovative programming and delivery to increase understanding of estuarine and coastal watershed ecosystems.

Expand and maintain awareness about coastal environments and the Reserve to enhance understanding and interest in the benefits offered by coastal watersheds. Continually evolve the educational program themes and goals to use current scientific information.

Provide a variety of high-quality educational experiences to facilitate understanding of long-time and emerging themes.

Evaluate education program effectiveness in reaching key audiences and addressing priority issues.

In order to address the over-arching goals for the Reserve's Education Program, and to identify priorities for the 2017-2022 planning period, the Reserve worked with partners and stakeholders to identify locally and regionally relevant priorities. Program delivery activities are grouped into three priority themes in the Reserve's Strategic Plan (see Chapter 3): *climate change*, *habitat protection*, and *invasive species*.

The specific goals of the Education Program are outlined below, along with details on how the goals will be addressed.

Climate Change Goal 4: Increase communications about actual and potential climate change impacts to diverse audiences.

The TOTE program, as identified in the Reserve Sentinel Site Plan, will work with Science

Program staff to deliver a TOTE workshop.

A demonstration Sentinel Site plot will be established at Hidden Creek for teachers and students to collect their own data related to the effort. Students and teachers will be able to compare their data with the Reserve System's data and evaluate results. Through KEEP, Reserve education staff will also use Estuaries 101, NOAA education products, and locally developed activities to cultivate understanding of climate science in students and teachers.

Climate science will be incorporated into displays at the Visitors' Center and into outreach materials (Figure 4.14). The Reserve's Sentinel Site at Hidden Creek will be highlighted in interpretive programs where appropriate. Sentinel Site work and other climate change research will be shared with the public through the Reserve's and partners' websites.

Habitat Protection Goal 3: Increase public awareness of Reserve stewardship practices, habitat-related research and habitat protection.

Education staff will develop a natural resource program for 8th to 12th grade students that includes habitat protection and restoration



Figure 4.14: Visitors exploring the displays at the Reserve Interpretive Center.

science themes. Through TOTE and other professional development workshops offered through the Reserve, teachers will be able to learn about habitat protection and restoration projects and their applications outside of the Reserve. Education Program themes will continue to promote the importance of habitat protection and water quality.

Invasive Species Goal 3: Reduce the impact of invasive species negatively affecting or threatening the Reserve.

Science service projects will be offered to KEEP participants and provide for the control of invasive species within the Reserve. Summer camp and stewardship events will also provide Reserve program participants with opportunities to learn about invasive species and their control. Students and teachers will learn how to identify and properly remove locally important invaders. Projects may also include monitoring for effective removal of invasive species.

Invasive Species Goal 4: Increase distribution of information about the status and impacts of invasive species to diverse audiences.

The Reserve will work with partners to make invasive species education materials available to KEEP participants and the general public. Invasive species education will be delivered at targeted outreach events. Education staff will create a KEEP activity that addresses the impact and ecology of invasive species.

Intended Outcomes

In general, outcomes of education activities typically relate to the particular audience and method of interaction, where the introduction

of content and teaching materials serves a specific purpose. The following reflects desired outcomes for formal and informal audiences:

Formal: Coastal and estuarine watershed education experiences are integrated with teaching in schools using best practices in field-based education.

Formal: Teachers have access to and use the tools, support, training and resources necessary to incorporate watershed and coastal education experiences into their curriculum.

Formal and informal: The frequency and quality of coastal and estuarine education for program participants is increased within the focal area in southwestern Oregon and is informed by Reserve System science, data products, curriculum, and tools.

Informal: Participants have a better understanding of estuaries and how their daily lives connect to natural habitats.

Behavior change may also be specific to the particular program, method, or activity conducted and therefore measurement of the change depends upon the anticipated actions. Ultimately, intended outcomes align with the Reserve's mission of creating a public that values and protects the estuary.

With this perspective, the following changes in behavior have been identified as desirable achievements that may be measured through pre- and post-program assessments or other means of evaluation:

Participants exhibit greater understanding and appreciation for estuaries and coastal environments and the values these natural systems provide.

Participants partake in actions to protect, restore, and maintain estuaries and coastal environments.

By focusing on the priority goals in the Strategic Plan (Chapter 3) over the next several years, the Education Program will provide an improved understanding of the three priority issues as described below:

Climate change Through TOTE and KEEP, teachers and students will use climate related data to advance their understanding of climate change science. Visitors will be aware of the climate change research conducted by the Reserve and use the Reserve as an information source.

Habitat protection Best stewardship practices will be demonstrated by the Reserve. A natural resource program for high school students will be developed and assessed. There will be an increase in the use of data by teachers and students to advance their understanding of the need for habitat protection. Students and the general public will help to collect data for the Reserve and will learn about methods and applications of habitat protection in the region.

Invasive species A better network of partners and shared resources will be able to address invasive species issues. Invasive species education materials and activities will be developed and shared. Program participants will be able to identify and safely remove invasive species. There will be a reduction in the amount of invasive species on the Reserve.

Program Integration

Education staff and volunteers, and the activities they typically lead, are the primary



Figure 4.15: Education Coordinator Joy Tally, left, shows teachers how to pull in a beach seine net on a mudflat near Charleston.

tools for sharing the Reserve's research with students, teachers, and other program participants. One of the field experiences currently offered by the Reserve is the opportunity for students to participate in ongoing fish seining research (Figure 4.15).

Science, training, and education staff join forces to represent the Reserve at community festivals and other public events. Volunteers at the Reserve provide a substantial service by helping to interpret or demonstrate the results of the Reserve's science projects. The AmeriCorps supported Estuary Explorers program brings together volunteering with science education to underfunded local schools.

Education staff, when needed, assist science staff with research and monitoring activities. In turn, science staff working directly on research, monitoring, and stewardship activities occasionally teach classes, present at workshops, or lead field trips. Science, education, and training staff also collaborate to develop funding proposals that include both scientific and educational objectives.

Results

Education Program results are shared frequently with local, state, and regional audiences through professional conferences and directly upon request with partners. Presentations highlight tools, curriculum, resources, and pedagogy. Professional sharing is facilitated by the various networks with which the Reserve works; Northwest Aquatic and Marine Educators, the Oregon Environmental Literacy Program, the Oregon Coast STEM Hub and OCEP.

Results are regularly documented for the Reserve Management Commission in thrice-annual reports including periodic data summaries and narratives describing education program activities. Occasional presentations are provided to the management commission detailing specific aspects of the education program including status updates on special projects, documentation of changes in education techniques, and review of planning studies such as needs assessment and market analysis results.

Further documentation of results is included in periodic grant related reports for specific projects funded through external sources. The level of documentation of results for projects such as the OCEP provides substantial benefit to the overall management of South Slough's Education Program and has been used by partner institutions to inform their own program development.

Performance Monitoring & Evaluation

Current evaluation methods for education are limited. Measures of audience impacts are var-

ied and lack cohesiveness. Without appropriate evaluation tools and a strategy to employ these tools and assess the results, the impacts of the various elements of education programs are not well documented. One of the core principles in the Reserve Strategic Plan is to develop an integrated evaluation plan to assess the effectiveness of education programs to reach key audiences and address priority issues.

Evaluation metrics used at the Reserve include documenting basic performance indicators, such as number of participants, duration of programs, duration of preparatory effort, content defined by learning objectives, and post program anecdotal evidence provided by instructors. A limited number of post program evaluation surveys are provided for specific types of programs.

The most comprehensively evaluated aspect of education programming is the teacher training associated with OCEP. These activities are evaluated by design with tools and techniques informed by a professional, independent evaluator. Evidence and substantial documentation of outcome achievement is available through summary reports, provided over the course of the project's evolution, from 2009 to present. This work, along with support from the Reserve System's TOTE work group, will ensure that teacher professional development will continue to be modeled on best practices and lessons learned.

In the coming years, the Reserve will work to develop a comprehensive education evaluation strategy, including identifying appropriate evaluation tools, incorporated with an overall strategy for measuring effectiveness.

Specifically, staff needs to understand the impact of two elements of the education program: KEEP and public interpretation. Multiple challenges exist in building or selecting an appropriate set of evaluation tools that will consistently yield meaningful results.

Program designs, including specific learning objectives, exist for most programs. However, current staff lacks the capacity to review and synthesize these data in a comprehensive way, which can be used to inform the development of an evaluation strategy. Support for this work has been sought through the NOAA Hollings Scholar program. While the funding for this scholarship has been awarded, and qualified applicants have been sought for several years, the Reserve has failed to attract a qualified candidate.

During the next five years, the Reserve will reconsider its strategy for accomplishing this work, perhaps using funding provided through one of its education partners.

Education Program Needs and Opportunities

Needs and Capacity

Between ongoing programs, formal and informal education requests, and established professional development events, the Education Program at the Reserve is operating at capacity. Capabilities of the Education Program are already largely determined by supplemental grant funding, success with volunteer recruitment and training, and assistance from partner institutions. And the demand for education continues to grow as the staff builds awareness of the Reserve throughout the region.

The results of the market analysis and needs assessment indicate a strong interest in grade level-appropriate content and curricula related to Reserve System driven coastal science. As a part of the overall Education Program needs, curricula review is important to establish consistency with NOAA's education priorities and the NGSS. However, the capacity at the Reserve to develop new curricula, or revise existing curricula to integrate new science and data, is limited. As programs and activities are modified, alignment to current science and NGSS are emphasized.

As staff time and opportunity permits, the Education Program would like to revise current educational offerings and develop new formal education opportunities. This would include building stronger KEEP curricula. Outreach for new and revised education programs will rely heavily on digital communications, which is another area that needs development. An updated Reserve website with the ability for on-line registration will help program participants to interact with the Reserve.

Stakeholders have also identified teacher trainings as a high need in the region. Consequently, emphasis has been placed on providing teachers with professional development opportunities facilitated by the Reserve. This work is undertaken primarily through partnerships and successful funding proposals. While the direct consequence of this approach is an increase in the number of formal educators using the resources provided, these activities also contribute to an increase in demand for staff and volunteers to lead learning experiences for students. Raising funds through grants, fees for

teacher training, and collaboration with partner institutions, are critical determining factors in the continued success of increased requests.

Regarding informal education, successful recruitment and training of volunteers is the most likely method of enhancing capacity to do work. Seasonal program demands during spring, summer, and fall regularly outstrip the capacity of the Reserve to meet all program requests. Development of programs supported by fees and administered by the Friends of South Slough has proven an effective means of establishing programs such as the Summer Science Camps. This pathway also affords opportunities to augment education staff with seasonal, temporary positions. Nonetheless, the Education Program would benefit from more permanent, full-time staff who could build capacity in a sustainable fashion. For more information on this see the Administration needs section (Chapter 5).

Limitations and Opportunities

The geographic distance from major metropolitan areas has been a challenge for the education program. Schools and potential program participants must make a substantial commitment of time and resources to visit the Reserve. This barrier has been exacerbated in recent years by poor economic conditions, in the state and the nation, which have negatively impacted school budgets and affected travel trends.

The declines in traveling program participation have been offset somewhat by an approach that focuses more heavily on partnerships with coastal education providers to hold events at other estuaries in Oregon. The opportunity to regionalize the understanding of Pacific Northwest estuaries and coastal watersheds is consistent with the Reserve's mission, and reduces

the emphasis on classroom visits to the Reserve. Pursuing these solid, long-term partnerships is an opportunity the Reserve continues to develop.

Furthermore, the Reserve will continue to emphasize teacher training and alignment with TOTE and KEEP to broaden the impact of educational resources and address opportunities. In particular, the Reserve will target recruitment efforts for teacher training workshops within the six counties of southwestern Oregon.

The limitation of staff capacity is significant, as the demand for programs increase and the opportunities to advance the Reserve's mission are restricted by available personnel and resources. Opportunities to further expand the education staff through partnerships with programs like AmeriCorps, internships, and trained volunteers, must be considered as only a temporary means of advancing the overall effort.

Grant funded opportunities are another temporary means of advancing the program's goals, while providing an important testing ground for ideas, techniques, and development of new approaches and partnerships. The drawback to funding positions through grants and partnerships, is those positions frequently require new initiatives which increase workload but not necessarily program capacity. A more realistic long-term approach will involve securing permanent financial resources to fund staff positions dedicated to areas with growth potential, such as teacher professional development, and service in support of KEEP field and classroom experiences.

South Slough Reserve Coastal Training Program

ecographic cope

The Reserve's Coastal Training Program (CTP) provides training, technical assistance, and information to coastal managers and decision makers in the lower Columbia biogeographic region. Within this region, activities are focused in Coos Bay, Oregon's largest coastal population center, and along the southern Oregon coast. While coastal training audiences occur primarily around the Coos Bay area and along the southern Oregon coast, they also extend throughout the coastal zone. Partnerships leverage coastal training to inform decision-making at regional scales.

Information Gained Since Last Plan

New information is available about the risk that climate change poses to Oregon's coastal communities (see sidebar).

New information is available about the fate of Oregon's inter-tidal marshes as sea levels rise. Although the greatest hope for inter-tidal marshes is that they will accumulate sufficient sediment to keep up with rising sea levels, or else migrate to suitable land upslope, Oregon's coastal margin is paralleled by steep coastal mountains that limit the areas available for marshes to migrate. What land might be available is often privately owned and used for other purposes, typically agriculture.

Rising seas also pose a significant threat to transportation throughout Oregon's coastal zone since the majority of roads and highways were built along estuarine and lowland river

shores, reducing the availability of marsh migration zones, and exacerbating the threat to critical infrastructure from sea level rise.

There is new information about the role of estuaries as sinks for carbon, and about the utility of salt marshes and eelgrasses to sequester carbon in a process now referred to as blue carbon or coastal carbon. Estuarine wetlands may be among the most efficient lands, acre for acre, for storing carbon (Pendleton and Sutton-Grier, et al, 2013). The CTP and Reserve science staff are assisting the Pacific Northwest Coastal Blue Carbon Working Group to explore various aspects of carbon management in collaboration with partners in Oregon, Washington, and California.

Climate related risks to coastal communities

- Longer, more intensive coastal storms
- Higher, more energetic waves
- Increased flooding in bays and estuaries
- Erosion of beaches, coastal bluffs
- Damage to shoreline property and infrastructure (e.g., roads and highways)
- Ocean acidification and hypoxia
- Changes in currents, upwelling, and ocean circulation
- Reduced water availability in some areas
- Increased risk of wildfire
- Invasions of non-native, noxious species

(Dello and Mote 2010; DLCD 2011)

There is new information about the need for improved storm water management in coastal communities using green infrastructure and low-impact designs, and new interest in determining how green infrastructure might be used to protect critical coastal infrastructure (e.g., highways and bridges in low-lying coastal areas adjacent to eroding bluffs) from erosion and floods.

There is new awareness of the needs of computer mapping specialists and geographic data managers and administrators for training and assistance to address a range of challenges and barriers that limit the usefulness of environmental data and data products, services, or tools.

Finally, a major source of new local information gained since the last management plan is the Community, Lands, & Waterways Data Source, developed through the Partnership for Coastal Watersheds. The Data Source is a detailed assessment of local environmental and socio-economic attributes, and discusses potential effects of climate change on various aspects of the Coos estuary.

Target Audience

Target audiences have remained largely consistent since 2006 and will continue to include entities active in habitat restoration and management: planners, watershed councils, sovereign tribal nations, conservation groups, and state and federal agencies. Audiences will expand to include engineers, construction contractors, municipal officials, and others engaged in storm water management; computer mapping specialists and data managers and administrators, and geographic information specialists working

in related fields such as geospatial and marine spatial planning. Engaging local businesses also appears to be an emerging coastal training audience at several reserves. The CTP coordinator will also reach out to agricultural stakeholders to increase awareness of sea level rise and marsh migration.

Coastal Training Program Themes

The Reserve's coastal training strategy identifies six priorities including: a) habitat restoration (Figure 4.16), b) invasive species, c) water quality, d) near shore ocean processes, e) human impacts on protected areas, and f) climate, coastal hazards, and energy. The priorities have been in place since the program's inception. They support and extend the Reserve System's strategic priorities, as outlined in this management plan. For example, the near shore ocean processes priority supports coastal training related to ocean acidification and hypoxia.



Figure 4.16: Wetland scientists, educators and stakeholders tour the Ni-les tun Marsh at Bandon National Wildlife Refuge during the Restoration Project Monitoring workshop in 2013.

Partners

Primary CTP partners include Oregon's Coastal Management Program (OCMP) and Oregon Sea Grant, both of which are required by NOAA as program advisors. Other partners include Oregon State University Extension Service, the Coos Watershed Association, the Institute for Applied Ecology, the Oregon Chapter of the Urban and Regional Information Services Association (ORURISA), the South Coast GIS Users Group (SCUG), Southwest Oregon Community College, Oregon Coast Community College, the Pacific Marine and Estuarine Fish Habitat Partnership, the Pacific Northwest Coastal Blue Carbon Working Group, and NOAA-OCM West Coast Regional Office.

The CTP recently engaged with new partners (e.g., Oregon Department of Transportation (ODOT), Green Girl Landscape Design) to plan and present training in best practices for using green infrastructure storm water management in small western Oregon cities. The CTP will work with NOAA OCM (West Coast office), and ODOT to explore ways to extend green infrastructure to protect shorelines and critical infrastructure, respectively, along the dynamic Pacific Northwest coast.

Potential new partners may include local governments, agricultural groups, local businesses, stakeholders active in coastal hazard resiliency planning and other activities related to climate, energy and coastal hazards.

Staff, Facilities, and Infrastructure

CTP staff consists of the program coordinator, who is assisted by other education program staff when applicable. The CTP coordinator

works out of a dedicated office at the Interpretive Center and has access to vehicles, presentation and communications equipment, and can draw upon the expertise of science and stewardship staff as needed.

Facilities for training are available at the Interpretive Center auditorium, which can accommodate about 30-40 people for workshops that involve break-out groups. Travel often presents an obstacle to participation in trainings; as a result, CTP often looks for opportunities to use venues more central to the geographic distribution of the target audience (e.g., Coos Bay for a southern coastal event; Newport or Lincoln City for a coast wide audience).

In addition to the Visitors' Center at the Reserve, local training venues include community colleges, Coos History Museum, the Mill Casino and Hotel, Bandon National Wildlife Refuge office, and Curry County Electrical Co-op. The OIMB, local community centers, and public libraries also provide venues. State and federal agencies sometimes have large meeting rooms or multi-purpose areas that they will make available for workshops. Local business and service organizations looking for speakers can also be an outlet for CTP programming and can often provide the meeting space.

Coastal Training Program Delivery

ystem-wide Programs, National Programs, and National Priorities

The CTP coordinator collaborates with coastal training staff at other reserves and with NOAA's Office for Coastal Management to address

biogeographical regional issues and system-wide work. These efforts include service on the Reserve System's committees and work groups, coastal training sector work groups, and contributions to various grant funded projects, such as those funded through the Science Collaborative (UM). The CTP will be contributing to the development of Sentinel Site outreach products; national coastal training products and services; system-wide capacity for unmanned aerial vehicles and systems (drones) (Figure 4.17), and the adaptation of green infrastructural methods generally to improve coastal hazard resilience in the Pacific Northwest.



Figure 4.17: John Bragg, CTP coordinator at South Slough Reserve, and Sue Bickford (geographic information systems (GIS) specialist at Wells Reserve, Maine) display aerial drones used for monitoring and high-resolution, low altitude imaging at an unmanned aerial vehicles workshop, Sept. 16, 2016, in Lincoln City, Oregon.

Activities and Methodologies

To receive CTP funding, NOAA initially requires each reserve to conduct a training market analysis, identify one or more target audiences, assess those audiences' needs for training, and develop a training strategy. Training strategies are updated every five years. NOAA does not require a new needs assessment as part of the revision; in practice, though, CTP

coordinators are continually reassessing their training audiences' needs using on-line surveys, informal means, or both. Need assessments take into account the recommendations of OCMP and Oregon Sea Grant, of Reserve staff, of stakeholder groups such as the Partnership for Coastal Watersheds, PMEP, ORURISA, and the PNW Coastal Blue Carbon Working Group, and coastal businesses.

Training typically involves workshops that combine lecture presentations, discussions, small group activities, and field trips when appropriate.

The Reserve will submit a revised strategy for NOAA's approval in 2017. The strategy will emphasize new topics and audiences identified in 2016, including implementing green infrastructure and low impact designs for storm water management, adapting green infrastructure to protect sensitive resources and critical infrastructure from coastal hazards, climate change adaptation and resilience, and computer mapping accessibility to inform coastal resource management. Addressing this range of topics will address all six of the coastal training priorities.

Coastal Training Program Goals for 2017-2022

Program delivery for all Reserve sectors, including the CTP, will be guided by the three priority issues identified in the Reserve's Strategic Plan (see Chapter 3): *climate change*, *habitat protection*, and *invasive species*. The specific goals related to addressing these priority issues for the CTP are outlined below, along with details of how program delivery actions will address the goals:

Climate change Goal 3: Increase Reserve understanding of the relationships between climate change and ecosystem functions in Pacific Northwest marine and estuarine environments.

Coastal training staff will work with Reserve science staff and partners, including the Coos County Planning Office and the Science Collaborative, to organize and facilitate end user workshops that will inform the Reserve of community needs related to climate change and ecosystem function. The CTP will also help facilitate the Partnership for Coastal Watersheds exploration of a climate change vulnerability assessment for Coos Bay. The CTP will assist the Pacific Northwest Coastal Blue Carbon Working Group to better understand carbon sequestration potentials in Pacific Northwest estuaries by conducting a needs assessment of end users in 2017, and that providing feedback to other Reserve programs. The CTP will also work with science staff to determine how to increase decision makers' awareness of the Reserve's Sentinel Site program and data.

Climate change Goal 4: Increase communications about actual and potential climate change impacts to diverse audiences.

The CTP, through its week-to-week work with OCMP, has identified the need for training to address a variety of coastal hazards and increase the resiliency of communities to climate change effects. The CTP will work with partners and stakeholders to improve coastal communities' abilities for response to catastrophic storms and floods, or earthquakes and tsunamis, and resultant loss of critical infrastructure. The CTP will also work with ORURISA to resolve data challenges and barriers finding

and using relevant data to address these needs.

The CTP will work with municipal, state, private, and NOAA partners to increase understanding of green infrastructure as a lower-cost alternative to reduce runoff, pollution, and undesirable impacts to downstream habitats and species; attract new stakeholders and audiences related to green infrastructure, and explore green infrastructure applications beyond storm water management to improve resilience to climate-related coastal hazards in the Pacific Northwest (Figure 4.18).

Using the results of a survey of local service clubs conducted in 2016, the CTP will present a series of at least five lectures on environmental change related to sea level rise, invasive species, changes in water quality, and other issues identified in the survey assessment. The lectures will be presented in an overall context of improving the resilience of coastal communities. The CTP will work with science staff and the Oregon Ocean Acidification and Hypoxia Monitoring Team to facilitate outreach and public awareness of ocean acidification and its effects in estuaries.



Figure 4.18: Audience at the Reserve's 'Introducing Green Infrastructure for Coastal Resilience' workshop, March 25, 2016.

Intended Outcomes

The CTP will work with the stewardship program to incorporate habitat protection and restoration education into lecture series and outreach programs; provide information, training, or both related to preserving or restoring habitat connectivity in coastal ecosystems. Trainings will be planned to consider habitat protection and restoration as tools for accomplishing multiple goals. The CTP will use projects currently being planned for the Wasson Creek watershed and other Reserve-managed lands in a conservation action education framework.

The CTP will work with science staff and partners (Coos Watershed Association, Gorse Action Group, etc.) to increase awareness of invasive species, their impacts to landscapes, and developments in control. The CTP will also seek opportunities to hold conversations with rural and agricultural stakeholders to provide them with options about the fate of coastal marshes in the face of rising seas.

Invasive Species Goal 4: Increase distribution of information about the status and impacts of invasive species to diverse audiences.

The CTP will incorporate invasive species themes in both decision maker workshops and as an element of lectures on environmental change, with the goal of improving awareness and understanding of strategies to reduce the spread of invasive species.

Outcomes of the Reserve's CTP efforts over the 2017-2022 period include improved regional understanding of climate change, habitat protection, and invasive species issues and increased access to information, skills, and methods for decision makers and program participants.

The Reserve expects that participants in coastal training workshops or courses will apply the lessons they have learned in their day to day work. Post-event evaluations generally demonstrate that participants have increased their knowledge and understanding of the material presented, and affirm their intent to apply the lessons learned.

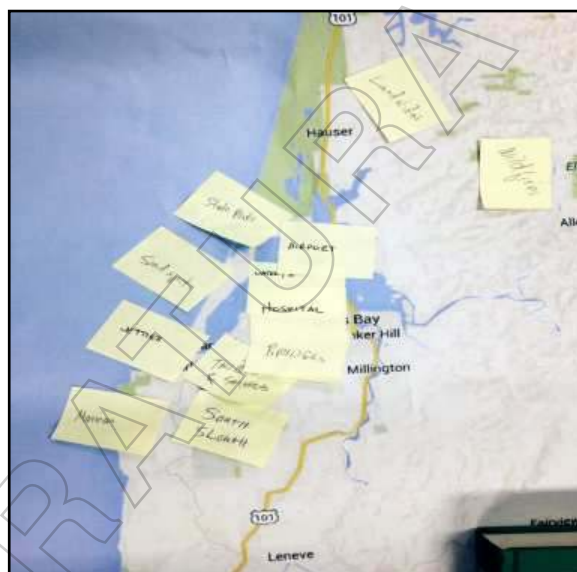


Figure 4.19: At a 'Climate Adaptation for Coastal Communities' workshop in Newport, coastal training participants used Post-it notes to locate coastal resilience hazards in Oregon's coastal zone.

Program Integration

The CTP coordinator participates in regularly scheduled full-staff, education-staff and science-staff meetings to identify links, overlaps, and points of intersection for training or technical assistance. All of the Reserve's staff maintains close communications to ensure that various disciplines are aware of needs and opportunities to engage in joint action. Through the implementation of the cross-sector 2017-2022 Strategic Plan (Chapter 3), CTP will better integrate with other Reserve program areas. For example, CTP will work more closely with science staff to implement the collective actions required to achieve climate change objectives and goals.

Results and Evaluations

Training is evaluated using metrics adapted by the Reserve System and reported to the Reserve System's performance monitoring data base. Typically target audiences voluntarily fill out a feedback form after training. Two other methods for CTP evaluation are feedback from networking relationships with training partners and NOAA's periodic Section 312 reviews of the Reserve's operations and programs. Feedback from training partners is routinely and informally incorporated into the training strategy. CTP staff and training partners invariably compare notes on what worked and what didn't after a training event.

Coastal Training Program Needs and Opportunities

Needs and Capacity

The CTP will revise its training strategy in 2017. The CTP is in the process of reviewing previous needs assessments, reaching out to newly identified target audiences, and developing training and technical assistance opportunities accordingly. Although the coastal training program is currently operating within capacity demands, a need for additional staff and resource support may arise as new projects are developed.

Limitations and Opportunities

Travel distances pose substantial barriers to participating in CTP activities and events at the Reserve. Training to address the needs of a coastal zone wide audience, anywhere in the coastal zone, can involve as much as a half day for one way travel to the training venue. To address this barrier the CTP tries to hold training events on the south coast, but depending upon the mix of training partners, funders, and stakeholders, and the travel limitations of the target audience, often a centrally-located workshop venue is required.

As CTP expands its target audience, it is also clear that more information is needed about the training needs of local governments, businesses, and agricultural stakeholders. Local training workshops in the cities of Coos Bay and North Bend and at the Reserve would be feasible and appropriate for these new audiences.

South Slough Reserve Public Involvement Program

The Reserve is a community resource that naturally draws the interest of the public. The public involvement program provides a means for people to make meaningful connections to the Reserve by increasing active involvement. In turn, these individuals provide support and assistance to the Reserve by helping fulfill its operational, research, stewardship and educational goals. There are three main components of the public involvement program:

Volunteers

Volunteers donate their time by participating in activities related to ongoing research, education, and facilities projects at the Reserve.

Interns

Interns receive real-world work experience and training and often receive a small stipend in exchange for their commitment to a set amount of time and involvement in a project

Information outreach

This involves the Reserve's participation at community events and festivals, marketing activities, and participation in community groups, organizations, and boards

Geographic Scope

The geographic scope of the public involvement program primarily includes, but is not limited to, the Southern Oregon coast region.

Target Audiences

Target audiences for the volunteer and intern programs include older teens, college students, and adults of all ages and backgrounds. The volunteer and intern programs typically target residents of Coos County, but also include students from distant locations who are studying in Oregon.

The internship program has expanded the scope of the audience to a national level with the attraction of being able to participate in active scientific research.

Information outreach has a larger target audience which includes all ages and backgrounds, but primarily focuses on residents and visitors to the Southern Oregon coast. In general, anyone who is able to travel to the Reserve and participate in public programs or take advantage of the amenities offered at the Visitors' Center is part of the target audience.



Figure 4.20: Octoberfish festival in Charleston, Oregon.

Partners

The Public Involvement Program partners with many community and educational organizations including: The Friends of South Slough, Bay Area Chamber of Commerce, Southwestern Oregon Community College, the Oregon State University System, North Bend, Coos Bay and Bandon high schools, the Bay Area Visitor and Convention Bureau, Coos Bay and North Bend downtown associations, the Charleston Merchant's Association, Surfrider Foundation, South Coast Business Employment, Stop Oregon Litter and Vandalism (SOLV), the Charleston Community Enhancement Corporation, the Coos Watershed Association, and the South Coast Development Council Rural Tourism Studio.

Staff & Facilities

The establishment of the Public Involvement Coordinator position in 2001 provided the Reserve with a staff member dedicated to the development and implementation of a public involvement program. The program includes coordinating volunteers and interns, in addition to public outreach in community organizations and at local events. The Public Involvement Coordinator works closely with the Friends of South Slough (FOSS) to coordinate volunteer activities and to implement the internship program, which is funded through grants awarded to FOSS. The Public Involvement Coordinator is assisted by other education staff when applicable for training volunteers and interns.

The Visitors' Center and Science Laboratory serve as the primary workstations for volunteers and interns. While the field

components of many projects occur throughout the Reserve and in the community, the starting and ending point for most activities occurs at one of these two sites. Additionally, volunteers and interns with the appropriate training and licensing, drive state vehicles and operate vessels, tools, and machinery associated with the projects that they accept.

The Public Involvement Program also uses folding tables, display boards, traveling exhibits, festival tents, signs and banners when performing off site marketing and outreach duties. Developments in technology and culture have allowed the program to harness the power of social media in the absence of a dedicated marketing budget.



Figure 4.21: Participants at the Reserve's 40th anniversary event helping load canoes after a paddle trip.

Public Involvement Program Delivery

Volunteer Program

The Reserve continually invests in volunteer recruitment and training, which has paid off by increasing community support and supplementing staff work. For example, in the 2013-2015 Oregon fiscal biennium, volunteers contributed 12,323 hours of their time and their talents to support the mission of the Reserve, a value of \$274,958.

The public involvement coordinator is responsible for the development, coordination and maintenance of the volunteer program. The Reserve has a Volunteer Resource Handbook, which includes information related to the Reserve's mission, resources, programs, and operations. Each volunteer is provided with this handbook, along with general training about the Reserve and specialized training for projects, if applicable. The FOSS, youth work crews, AmeriCorps, local service programs, and individuals from the community all provide volunteer services for the Reserve. Volunteers' contributions of time and skill greatly enhance the programs and operations of the Reserve.

Volunteers assist with visitor services, education programs, trail improvements, habitat restoration, monitoring, and research projects. By sharing their enthusiasm for and knowledge of South Slough, volunteers enhance visitors' experiences and foster interest and awareness of the Reserve throughout the local region. The Reserve recognizes an obligation to provide interested volunteers with rewarding and enriching opportunities in exchange for their efforts.

Internship Program

The Southern Oregon coast community has a need for those entering the workforce to develop specialized skills through exposure to a variety of work experiences, particularly in natural resource-related science and education careers. The Reserve plan for addressing this need began with a two-year AmeriCorps VISTA position funded through the Friends of South Slough Reserve to assist the Reserve in developing an internship program. Since



Figure 4.22: Friends of South Slough intern Joe Shapira collecting surface elevation data at Hidden Creek marsh as part of her Sentinel Site internship.

the program's implementation in 2012, 53 individuals have participated. The goal of the program is to provide valuable training and job specific skills in the science, education, and natural resource fields while instilling the importance of estuaries and fostering stewardship for them (Figure 4.22).

The internship program also helps extend Reserve capacity to develop and implement programs and deliver community services. Some specific activities supported by the internship program include; monitoring reserve vegetation and habitats, inventory of plant and animal species, aquarium husbandry, mapping, environmental education, forestry, and trails maintenance, interpretive and administrative services. The Public Involvement Coordinator works with staff to develop internship job descriptions and to appropriately match program participants to operational needs at the Reserve.

Information Outreach

The profile of the Reserve has been raised by the public involvement coordinator's active role on a variety of local organizations' boards and committees. Along with outreach at a variety of local events, this has helped to build community awareness of the Reserve and the work done by the Reserve. Having a bi-weekly booth at the seasonal Coos Bay Farmers Market for example, increases awareness of the Reserve. Information outreach also includes: advertising programs with a bimonthly calendar delivered electronically to subscribers, local visitor centers and libraries; Public Service Announcements; fliers posted at community establishments; and managing Reserve social media accounts.

Public Involvement Program Goals 2017-2022

Generally, program delivery for all Reserve sectors, including Public Involvement, will be guided by the three priority issues in the Reserve's Strategic Plan (see Chapter 3): *climate change, habitat protection, and invasive species*. For each priority issue, details are provided below on how Public Involvement program delivery actions will address the strategic goals:

Climate Change Goal 4: Increase communications about actual and potential climate change impacts to diverse audiences.

Public outreach staff will contribute to achieving this climate change goal by emphasizing Reserve science research (including Sentinel Sites) and community level solutions at public outreach events. For example, the bi-monthly newsletter will

continue to track the Sentinel Site Research as well as other Reserve projects tied to climate change. Volunteer training will include methods for addressing climate change with the general public. Volunteers will then use that training as they provide outreach at tabling events and festival booths highlighting Reserve projects (Figure 4.23).



Figure 4.23: Attendees of the Stand Up for the Bay event learning about slough creatures.

Habitat Protection Goal 1: Help with assessing and monitoring habitats in the Coos estuary in order to characterize conditions and changes in habitat use and availability.

Public outreach staff will contribute to this goal by engaging interns to assist science staff with mapping and ground-truthing as part of their job-training experience.

Habitat Protection Goal 3: Increase public awareness of Reserve stewardship practices, habitat-related research, and habitat protection.

The Public Involvement Program will help develop educational tools that build public awareness and engagement in stewardship practices at the Reserve. For example, the program works with the Friends of South Slough to sponsor stewardship activities, like invasive species pulls. Public Involvement

will also identify best practices that help staff reduce ecological impacts from special events and programs. For example, at events where there is food consumption, Public Involvement staff will encourage participants to bring their own beverage containers and recycle compost remaining waste.

Carpooling is recommended for all travel and teleconferencing is used when possible. For the general public using the Reserve trail system, staff will promote “Pack it in Pack it Out”.

Invasive Species Goal 1: Help characterize and monitor the extent of invasive species affecting the Reserve.

Public Involvement will recruit and engage interns to assist science staff with mapping and ground-truthing as part of their job-training experience. Public Involvement will also identify and develop opportunities to engage the public, including volunteers, in the monitoring of invasive species. This could be done through a citizen science program.

Invasive Species Goal 3: Reduce the impact of invasive species negatively affecting or threatening the Reserve.

Public involvement staff will assist with conducting at least six annual events for the control of invasive species in the Reserve. Staff will help secure interested community groups for control events and assist with providing training for staff, volunteers, interns, and students that help them identify and properly remove invasive species.

Over the term of this management plan, the public involvement program strives to:

Expand the internship program by increasing funds available to interns as well as building more support for mentors

Train volunteers to speak with a range of audiences about climate change impacts, stewardship practices, habitat protection, and invasive species impacts
Develop new outreach materials (print and electronic) to address priority areas such as climate change.

Streamline record keeping methods for recording volunteer and intern hours through a web based system

Recruit a marketing intern to assist with the expansion of social media outreach and community group participation

Liaise with the Friends of South Slough Reserve as they develop their strategic plan providing input and direction that coincides with the Reserve plan

Invasive Species Goal 4: Increase distribution of information about the status and impacts of invasive species to diverse audiences.

The Public Involvement Program will support internships and volunteer coordination for invasive species projects and outreach. Staff will utilize opportunities to post current findings related to invasive species on the Reserve social media pages. Staff will also partner on events with other community organizations that focus on control and education regarding invasive species.

Program Integration

The Public Involvement program supports Reserve programs by providing skilled volunteer and intern support to expand the work of paid staff. Additionally, Public Involvement provides marketing for programs and informational content via the website, newsletter, and social media for all Reserve programs. Through a presence at community events and in community organizations, the Public Involvement program builds awareness for all Reserve programs, increasing community support and knowledge even outside the Reserve boundaries.

Other programs at the Reserve provide support for Public Involvement as well. Administration oversees the Public Involvement Coordinator's work, record keeping, and reporting and provides guidance in the management of volunteers and interns as well as editorial support for media releases. Staff from all Reserve programs act as mentors for interns, assist with volunteer training, support, and collaborate on community wide events such as fairs and public speaking events.

Public Involvement Needs and Opportunities

Needs and Capacity

Since the establishment of the public involvement coordinator position in 2001, the program has grown immensely. The Reserve is networked into several community organizations and events. Consequently, public involvement staff are operating at capacity. Over the five year term of this plan, Public Involvement Program needs include:

Continued funding for a Public Involvement Coordinator position at the Reserve
Continued collaboration with other Reserve programs to provide volunteer intern training

Funding to install web based software that can be used for on-line program registration, volunteer tracking, web based outreach, and record keeping

The addition of an intern and or volunteer to specifically work alongside the public involvement coordinator to implement the activities planned over the next five years (see Reserve Strategic Plan, Chapter 3).

Limitations and Opportunities

Opportunities of the Public Involvement Program include: expanding the volunteer and intern program capacity through FOSS support, building the capacity of FOSS to expand their support of Reserve programs, and marketing and sharing information in ways that coincide with the pace of modern technology.

Limitations of the Public Involvement Program include: funding for marketing, capacity of the single public involvement staff member, and volunteer and internship work limitations. While many volunteers and interns are highly skilled and dedicated individuals, they do not serve as paid staff, which limits the amount of time and the degree in which they can contribute to a program or project. The remote setting of the Reserve also makes it difficult to attract volunteers and interns who do not have their own transportation or who do not like to travel outside of nearby city limits.

References

Dello, K.D. and Mote, P.W. (Eds). (2010).
Oregon Climate Assessment Report. Oregon
Climate Change Research Institute. College of
Oceanic and Atmospheric Sciences, Oregon
State University, Corvallis, OR

Department of Land Conservation and
Development (DLCD). (2010). Oregon Climate
Change Adaptation Framework. Available
on-line at http://www.oregon.gov/ENERGY/GBLWRM/docs/Framework_Final_DLCD.pdf

Gaskill T., Kulluson ., and Calvert D. (2012).
Oregon Coastal Education Market Analysis
and Needs Assessment Study. South Slough
National Estuarine Research Reserve.
Charleston, OR.

Pendleton, L.H., Sutton-Grier, A.E.,
Gordon, D.R., Murray, B.C., Victor, B.E.,
Griffis, R. B., Lechuga, .A.V., and Giri, C.
(2013). Considering “Coastal Carbon” in
Existing U.S. Federal Statutes and Policies,
Coastal Management, 41:5, 439-456, DOI:
10.1080/08920753.2013.822294. Available
on-line at <http://dx.doi.org/10.1080/08920753.2013.822294>.

Chapter : Administration Plan

Organizational Framework and Management Authorities

The Reserve is a cooperative federal-state partnership between the National Oceanic and Atmospheric Administration (NOAA) and the Oregon Department of State Lands (DSL). NOAA provides funding, national guidance, and technical assistance to the Reserve; DSL contributes match funding, leadership, and administrative oversight. A memorandum of understanding outlining the agreement between NOAA and the State of Oregon is presented as Appendix D. The Reserve is also subject to oversight from the Reserve Management Commission.

The Reserve's administrative services program supports human resources, facilities and the research, education, and stewardship programs. Grant monitoring, fiscal reconciliation with DSL, and guidance for general operations are provided through administrative staff and processes. Administrative services are closely aligned with facilities operations since both support all program areas of the Reserve.

Role and Responsibility of NOAA

NOAA's Office for Coastal Management (OCM) administers the overall National Estuarine Research Reserve System (Reserve System). The OCM disburses and oversees expenditures of federal funds. The OCM also coordinates the design and implementation of system-wide programs, provides guidance for the development of Reserve System policies, and is responsible for ensuring that the Reserve is managed according to Reserve System's

regulations. The Reserve applies annually for funds from NOAA that are used to support research, education, stewardship programs, and Reserve operations.

NOAA funds may also be requested for special projects, facilities construction, and land acquisition. NOAA guidelines require a 30 non-federal cost share for operation and construction awards and a 50 cost share for acquisition. The Reserve also applies for and is dependent on grants and contracts from outside of NOAA, to support many of the projects undertaken by the Reserve's programs.

As required by federal regulations (15 C.F.R.

921.40), NOAA periodically evaluates the performance of each Reserve for compliance with federal requirements and with the Reserve's federally-approved management plan. The last performance review (312 Evaluation) of South Slough programs and operations was conducted in 2015.

Role and Responsibility of DSL

Since the Reserve's creation in 1974, it has been partnered with the Oregon Department of State Lands. DSL is a state agency under jurisdiction of the State Land Board, which is composed of the Governor of Oregon, the Oregon Secretary of State, and the Oregon State Treasurer (Figure 5.1). The responsibilities of DSL include stewardship of wetlands, waterways, and other state managed lands; this mission aligns well with the Reserve's goal to improve the stewardship and understanding of Pacific Northwest estuaries, which makes the agency a good fit.



Figure 5.1: Organizational chart for the Department of State Lands

DSL provides leadership and administrative oversight for the Reserve. DSL also provides the Reserve with fiscal record keeping, technological support, and assistance with human resources, as well as administrative support for the Reserve's Management Commission (O.R.S. 273.554(1)(a)). Funding for the Reserve, from NOAA and other sources, is administered through DSL. Core Reserve staff are DSL employees. The role and responsibility of DSL in the management of the Reserve is specified in Oregon Law (see Appendix B: Oregon Revised Statutes and Appendix C: Oregon Administrative Rules).

The Reserve's Management Commission

Oregon statute (O.R.S. 273.554) created the Commission as the Reserve's sole governing body. The Commission is responsible for overseeing the general operation and management of the South Slough Reserve, including establishing operating policies and

administrative rules for the operation of the Reserve (O.R.S. 273.554 (a)). The Commission is empowered by statute to appoint a manager and other staff to carry out these responsibilities.

As per state statute, the nine members of the Commission are appointed by the Governor for four-year terms and serve as representatives of specific institutions, agencies, and other stakeholders (see sidebar on page 5-3). The Director of DSL (or a designee) serves as permanent chair of the Commission. The authority of the Commission must be consistent with the policies formulated by the State Land Board as well as state and federal laws.

The Commission may apply for, receive, and expend federal, state, and other funds for Reserve purposes. Commissioners review Reserve activities and proposed initiatives at public meetings held three times a year.

South Slough Management Commission Positions

1. Education
2. Public
3. Oregon International Port of Coos Bay
4. Director of Department of State Lands
(Chair)
5. Office of Coastal Management AA
non profit
6. University of Oregon Institute of Marine
Biology
7. Oregon State University
8. Coos County Commission
9. Local Government Relations

Federal and State Laws

The Reserve is managed in accordance with Reserve System Program Regulations (15 C.F.R. Part 921), which govern the administration of Reserve System programs, grants, and funding (see Appendix A). State statutes and administrative rules support the objectives of the Reserve System by establishing policy for the operation and public use of the Reserve (see Appendix B: Oregon Revised Statutes and Appendix C: Oregon Administrative Rules). These regulations and rules are used in combination with stewardship policies to manage and protect the resources and integrity of the Reserve.

Current staff

Adequate staffing is essential to the effective implementation of the Reserve's programs and operations. The Reserve currently meets human resource needs through a combination of 16 permanent full-time staff, along with

part-time positions, contractors, interns, and volunteers (Figures 5.2 and 5.3). Thus, total staff size fluctuates with the addition of temporary employees, students, interns, participants from social service training programs, and others. Extra staffing is supported by federal and private grants, inter-agency cooperative agreements, state operating funds, student scholarships, and donor contributions.

The need for some staff positions is identified by NOAA as a prerequisite for participation in certain programs. Participation in some national initiatives requires a program coordinator. The funding available for these programs generally supports the program and necessary staff. The Reserve must also apply for supplemental funds and agree to conduct the programming within the parameters laid out by NOAA.

New staff positions are identified and developed in a number of ways. With new projects and expanding programs, Reserve staff work with management to include tasks in grant proposals to support limited-duration, part-time, and full-time positions as well as volunteers, contractors, and interns. Positions are established based on responsibilities, work load, budget, and other parameters. NOAA may also recommend additional staffing needs via periodic evaluations.

At times it is possible to submit a policy option package (POP) to the state legislature during a biennium budget request to provide funding for additional permanent full time positions at the Reserve. Such positions were identified (but not approved in the 2017-19 cycle), and will be sought after in future cycles. The highest

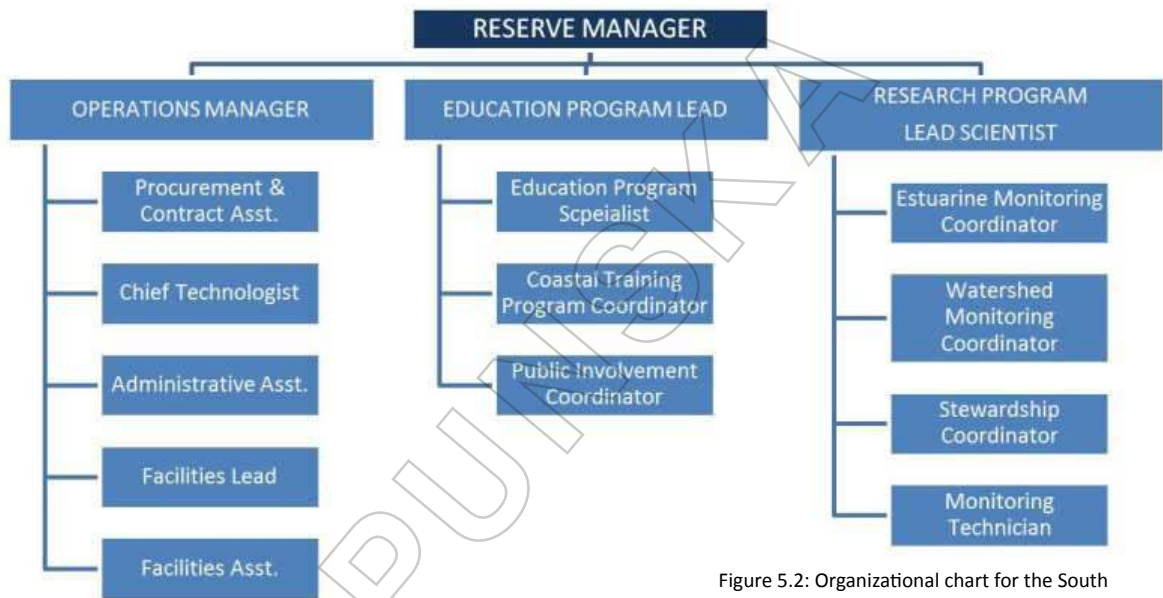


Figure 5.2: Organizational chart for the South Slough National Estuarine Research Reserve.

Category	Position	Office Location
Full-time Staff	Reserve Manager	Lab-OIMB
	Research Coordinator (Lead)	Lab-OIMB
	Estuarine Monitoring Coordinator	Lab-OIMB
	Watershed Monitoring Coordinator	Lab-OIMB
	Stewardship Coordinator	Lab-OIMB
	Monitoring Technician	Lab-OIMB
	Chief Technologist	Lab-OIMB
	Operations Manager	Interpretive Center
	Education Program Coordinator (Lead)	Interpretive Center
	Education Program Specialist	Interpretive Center
	Coastal Training Program Coordinator	Interpretive Center
	Public Involvement Coordinator	Interpretive Center
	Procurement & Contracts Assistant	Interpretive Center
	Administrative Assistant	Interpretive Center
	Facilities Supervisor (Lead)	Maintenance Bldg.
	Facilities Assistant	Maintenance Bldg.
Part-time Staff	Americorps, temporary employees, etc.	Lab-OIMB and Interpretive Center

Figure 5.3: Location of Reserve staff. OIMB Oregon Institute of Marine Biology

priority staff needs at this time are a geographic information systems (GIS) specialist to support geospatial data collection, organization, and analyzing, and to create map products for all sectors of the Reserve, and an education assistant to work with education staff to deliver educational and interpretive programs (see Administration Needs, below).

Information Technology

The Information Technology (IT) department's purpose is to maintain current systems and implement new technologies, programs, and upgrades as needed to support Reserve staff. IT staff provide administrative support for all Reserve user profiles, email, and on line work-flow programs. IT staff are essential

to the operations of the Reserve. The Chief Technologist serves as the head of the IT department and primary IT staff person. The Reserve's main facilities (the Visitors' Center and Science Laboratory) host a domain log-on server, storage server, backup servers, along with their entire network infrastructure. The Chief Technologist supports about 30 desktop workstations and five laptops for staff, interns, and volunteers.

The Chief Technologist is responsible for monitoring and maintaining:

- Computers, printers, and the network system support

- The solar project, which includes solar equipment at the Visitors' Center, designed to power the building and generate surplus power for the regional grid

- All interpretive exhibits with computers, monitors, and projectors

- Audio and visual equipment at the Visitors' Center and Science Laboratory

- Specialized weather and earthquake equipment monitoring

- The phone system

- Software installation, licensing, and updates, including GIS platforms for desktops and hand-held field devices

- The wireless communication project, which includes:

- o The solar powered communications tower located along the Ney Slough
- o Multi-band microwave equipment
- o A series of line-of-sight communication relay towers (installation in process)

Once the wireless project is complete, the entire Reserve, including the trails and waterways, will have wireless access to the

Internet. Wireless access will provide an immense resource to research and education activities that occur in isolated places, as well as being an important safety measure in remote areas.

Program Funding Support

Basic Reserve operations, including personnel expenses, are supported by a combination of federal funds and state funds. Federal funds come from NOAA through a grant-in-aid agreement for approximately \$1.6 million per biennium. State funds total approximately \$2 million each biennium, for a grand operating total of approximately \$3.6 million per biennium. State funds do not come from Oregon's General Fund, but from the Common School Fund.

Reserve staff routinely apply for other funds in the form of competitive grants (federal or private) to provide support for special projects and activities, and sometimes to supplement basic operating needs. The FOSS also assist with fundraising and administer some grants on behalf of the Reserve.

Partnering Agencies and Organizations

Administration oversees the Reserve's formal and, to an extent, informal partnerships.

Formal partnerships exist with a number of state, federal, and non-profit organizations to guide working relations. Informal partnerships with local groups help expand the capacity and reach of the Reserve's work. Reserve administrative staff recognizes that partnerships enhance the ability of each entity to be more efficient, effective, and productive.

The Reserve actively seeks partnerships in the community, regionally, and nationally to support joint projects and efforts guided by the Reserve's mission, vision, and strategic plan. Appendix F outlines the list of ongoing formal cooperative agreements. Some key community partnerships are described below.

Friends of the Coos Bay Estuary

Incorporated in 1989, FOSS is a non-profit organization that supports and assists Reserve activities, and obtains grants to support and expand the Reserve's programs and infrastructure. The FOSS also provides educational and interpretive services to the Reserve, helping visitors understand the function, flora, fauna, and cultural history of the estuary. The FOSS' mission is to improve people's understanding of and relationship to estuaries and coastal watersheds. Any individual or group supporting the mission of FOSS may become a member.

FOSS generates revenue for its operations by managing a gift shop at the Interpretive Center. FOSS also applies for grants on behalf of the Reserve. In the past, fundraising efforts by FOSS generated \$132,500 for renovations to the Interpretive Center and over \$20,000 for the development of new exhibits. In 2008, FOSS received \$11,000 for the development of an aquarium program, which has become a key exhibit at the Visitors' Center. In 2009, FOSS administered the Reserve's Upper Watershed Restoration Action Plan. In 2015, FOSS commenced administration of awards for over \$60,000, to support fish research, and \$20,000, to restore a historic cultural site on the Reserve. The FOSS provides significant support

Administrative Objectives for 2017-2022

While the overall goal of administration is to support the strategic priorities, goals, objectives, and actions of the Reserve (see Chapter 3), the following objectives have been developed to articulate how the administration will help support Reserve programs and operations.

Objectives:

1. Maintain public access to the Reserve through facilities and trails, using innovative design and construction methods that minimize ecological impacts.
2. Strengthen the Reserve's relationships with DSL, NOAA, and regional sovereign tribal nations.
3. Support capacity at the Reserve by sourcing and managing funding sufficient for addressing program objectives.
4. Improve budget oversight and communication at the Reserve.
5. Improve staff development through training and experiences that foster professional growth.
6. Work to ensure the community recognizes the Reserve and understands how it serves the residents and visitors of the Coos Bay area.

to K-12 and adult learning programs and has funded the growth of the internship program at the Reserve. In addition to fund-raising, FOSS members donate their time and talents as volunteers at the Reserve.

State legislation, effective January 2004, enabled DSL to more fully develop its relationship with FOSS. The management of the Reserve already works closely and collaboratively with FOSS. The Reserve Manager and Public Outreach Coordinator attend FOSS board meetings. Currently the FOSS president occupies the public-at-large representative's seat on the Reserve Management Commission.

The Reserve will continue to foster the partnership with FOSS and explore methods to enhance fundraising and resources utilization that serve both entities.

University of Oregon's Institute of Marine Biology OIMB

A partnership with the University of Oregon's Institute of Marine Biology (OIMB) facilitates the operations of the Science program at the Reserve. OIMB occupies a 107-acre site in Charleston, at the mouth of the South Slough watershed. All Reserve science staff (research, monitoring, and stewardship) are housed in office and laboratory space on the OIMB campus.

Through the University of Oregon, OIMB conducts research and offers courses in marine biology and related fields. The Reserve maintains a Memorandum of Understanding with OIMB to share administrative resources and laboratory facilities (Appendix E). In the past, the Reserve has collaborated with OIMB in the Reserve System's Graduate Research Fellowship program. The Reserve's Research Coordinator holds a courtesy faculty appointment at OIMB, and serves as an

advisor for graduate students. The Research Coordinator collaborates with other faculty members at the university and at OIMB to conduct and direct research. A representative of OIMB occupies a seat on the Management Commission.

Sovereign Tribal Relations

Since 2006, the Reserve has increased its collaboration with sovereign tribal nations in the Coos Bay area for a number of projects.

The Reserve works with the Confederated Tribes of the Coos, Lower Umpqua, and Siuslaw Indians, as well as staff from the Coquille Indian Tribe, to implement water quality monitoring throughout the Coos estuary. The Reserve also works with both tribes on habitat and cultural restoration projects, cultural resource protection, education and outreach. For example, the tribes have provided assistance with compliance to the National Historic Preservation Act Section 106 review process.

Cultural and natural resource team members also serve on project advisory groups and help shape educational programming when appropriate. A seat on the Reserve's Management Commission is jointly held Oregon's coastal tribal nations. Since 2015, MOUs have been in place with the Coquille Indian Tribe and the Confederated Tribes of Coos, Lower Umpqua and Siuslaw Indians.

Coos Watershed Association

The Coos Watershed Association represents a variety of land management interests in

the local community and is responsible for initiating many innovative practices in effective watershed management. The Reserve is a founding member of the watershed association, and the two groups have coordinated on a number of projects over the years, establishing an excellent working relationship. The watershed association has professional staff and the institutional capacity to solicit and administer grant funds on behalf of the Reserve.

The Reserve Manager has served on Coos Watershed Association Board of Directors since its formation. In 2015, a Memorandum of Understanding formalized the already successful working relationship between the two organizations.

Federal and State Partners

The Reserve renewed its MOU with the Coos Bay office of the Bureau of Land Management in 2015. A new MOU with the Oregon Department of Fish and Wildlife was also formalized in 2016. Similar to the MOUs with the Tribes, these agreements facilitate resource sharing, increase program effectiveness, and improve inter-agency communication. See Appendix F for the list of current formal cooperative agreements.

Advisory Committees

While the Reserve no longer maintains a Reserve-wide advisory committee, the practice of the Reserve has always been to develop project specific advisory groups compiled of specialists and community stakeholders. For example, the Winchester Tidelands Restoration Advisory Group was developed to design and implement tideland restoration and monitoring work along the Winchester arm of the South

Administrative Accomplishments since 2015

- Secured a full-time Chief Technologist position at the Reserve
- Secured a full-time Procurement & Contracts Specialist position
- Reinstated the position of Stewardship Coordinator position
- Research and Education Coordinator positions were upgraded to lead staff positions
- Updated the Reserve's phone system
- Developed and renewed various cooperative agreements with multiple partners
- Established an Internet link to the DSL's network and document management systems
- Adopted Fee Rules Fee Schedule for Reserve facilities
- Completed an Upland Habitat Restoration Plan (2008)
- Completed an Energy and Climate Plan (2011)
- Completed the NOAA-required C MA Section 312 Evaluation (2014-2015)
- Disaster Response Plan, completed 2015

Slough. Similarly, the Wasson Creek Watershed Restoration Advisory Committee evolved to target design and monitoring efforts for the upcoming ridge-top to estuary restoration project in the drainage. The Partnership for Coastal Watersheds is another example of a stakeholder driven advisory group, used by the Reserve to inform research and education programming to address community needs.

Administrative Needs

Currently, two additional full-time positions have been identified as high need at the Reserve, when funding support becomes available:

GIS & Data Management: An Information Systems Specialist position, focusing on geographic information systems (GIS) and data management, was identified as a program suggestion in the 2008 NOAA's 312 evaluation and continues to be a priority identified by staff. This position would be responsible for capturing, integrating, storing, manipulating, analyzing, managing, and presenting all types of spatial and geographical data for research, education and restoration programs on a local, regional and national level. Establishing and supporting a GIS position will provide the human resources necessary to implement the priorities at the Reserve (See Chapter 3), including continued support for the Partnership for Coastal Watersheds initiative, a bottom up stakeholder process concerning the management of the Coos Watershed.

Education Program Assistant: An additional education program specialist has also been identified as a high need by staff and management alike. The Reserve receives more education requests than current capacity can accommodate. Consequently, the Reserve is in the process of exploring how to obtain support for this position, in order to achieve strategic priorities.

Chapter 6: Facilities Development and Improvement Plan

Goal of Facilities and Construction Philosophies

The South Slough Reserve is proud of the high quality facilities it provides to visitors and staff. The facilities team at the Reserve does an impeccable job maintaining the grounds and infrastructure and as such, the philosophy of the Reserve can be described as one where safety and consideration are emphasized in building plans and operations.

Facilities have a wide range of purposes

There are science labs that serve as a base for research, monitoring and stewardship in the Reserve. There are administrative offices that oversee the technical aspects of the Reserve, from finance to information technology. There are public facilities that provide educational exhibits and local meeting areas and there are trails that provide visitor and staff access to recreational, research, and educational opportunities. Overall, these facilities exist to serve the Reserve's conservation, scientific, and educational goals.

Along with the State of Oregon, the Reserve is also committed to using sustainable building technologies. As part of a state agency, the Reserve is required to spend 1.5% of future total construction or renovation contract prices on green energy technology (ORS 279C.527 through 279C.528 and Oregon Laws 2013 ch. 612 (HB 3169)).

Utilizing innovative sustainable technologies in new or retrofitting construction is important to the Reserve, which is why solar power technologies have been incorporated into the

Reserve over the last several years. In order to maintain high quality facilities, and a philosophy of considerate and informed facilities management, the Reserve will continue to seek innovative building technologies as opportunities arise.

Facility descriptions

The Reserve comprises several facilities. Buildings include:

Visitors Center

Built in the mid-1980s, the Visitors' Center (Center) was remodeled in 2002 (Figure 6.1). The Center is the Reserve's primary public building and is located four miles south of Charleston on Seven Devils Road. The Center houses exhibits, a reception area, a gift shop, several Reserve staff offices, a classroom and an auditorium. The Center is the point of departure for most of the Reserve's trails.

The 1,500 square-foot auditorium accommodates up to 70 people for lectures and about 30-40 for workshops. There are 16 work stations for staff.



Figure 6.1: Aerial image of the Reserve's Interpretive Center.

Other resources include a common room, copy room, kitchen, bathroom, utility room, classroom, storage area, deck, and public restrooms.

There have been several advances to improve sustainability in the Center. With energy-efficient lighting throughout the building, as well as 52 solar panels on the auditorium roof, energy is returned to the grid and applied as credit to the power bill (Figure 6.2). A display inside the exhibit hall informs visitors of the total energy savings since installation, the daily savings, and the amount of CO₂ reduced by using green energy. There are also new solar-powered water pumps for the well, and an energy-efficient, wood burning insert installed in the fireplace. Though there are no current plans to improve this building, all future restorations will incorporate sustainability into their plans.



Figure 6.2: Solar panels that are mounted to the roof of the Interpretive Center auditorium.

Exhibits

The majority of the Reserve's exhibits are located in the Center. Live exhibits welcome visitors to the Center with displays of fish, marine invertebrates and amphibians, and

with a mural depicting the Reserve's principal habitat types. The foyer also accommodates an introduction to the Reserve, including history, wildlife, and a map.

Immediately inside the front door is the kid's center. This area includes a table with shells, petrified wood, feathers, and animal hides that children are encouraged to play with, as well as a coloring station.

The structure of the main exhibits mimics the boardwalk of the marsh trail system. The boardwalk winds around the exhibits and periodically features habitat exhibits, with field guides explaining the common species in that area. Habitat types include the tidal mudflats featuring rock weeds, raccoons, and butter clams; freshwater marshes featuring river otters, skunk cabbage, and marsh wrens; and salt marshes featuring long-tailed weasels, tufted hair grass, and salt grass. There is also an earthquake monitor in the exhibit area that highlights past earthquakes and speaks to increasing awareness about future ones that might affect the estuary.

While viewing the exhibits, visitors can hear the sounds of the estuary in the form of running water and frog and bird calls. The following exhibits encompass themes that are central to the Reserve's mission by accentuating the inter-tidal environment, cultural heritage, and current scientific understanding of the Coos estuary and Oregon's dynamic, tectonically active coastal margin:

o a t p: This exhibit explains water flow throughout the Reserve, restoration efforts, and some of the aquatic species in the Reserve. It includes an interactive display

to explain water-filtering through sediment, as well as fish specimens that visitors can study under a magnifying glass and a historic lamprey trap.

Surviving Salinity: In this exhibit, visitors can learn about the changes in salinity throughout the Reserve and how plants and animals adapt to the change. It includes casts of different bird skulls, a mounted great blue heron, and Dungeness crab molts under a magnifying glass.



Figure 6.3: Reserve staffers Hannah Schrager and Tally interpret an exhibit for an education program.

Life in the Muddy Hallows: This exhibit describes the mudflat habitats in the Reserve and the animals found there.

Ocean Influences: This exhibit details the many ways that the ocean affects the Reserve. It includes an interactive “estuary soup,” in which visitors can turn a wheel to see different microscopic species within the estuary or can watch a video of zooplankton in the Reserve. The exhibit also explains oceanic weather influences and provides current weather conditions.

Life on the Landscape: In this exhibit, visitors can learn the varied ways that nature can be used to understand history. It includes a sediment sample with explanations for what each layer means as well as a local tree trunk with explanations for what was happening in the area during each set of rings.

Of Forests and Lowing Water: This exhibit explains the importance of uplands and riparian habitats in the Reserve. It includes a bear hide with a description of local black bear populations and a “stand” of old growth trees with a small human figure to give the scale of the size of old growth forests.

People of the Estuary: This exhibit provides a historic background of the people in the South Slough and Coos estuary. It includes a slide show of historic pictures; a twelve minute video titled “Tide of the Heron: The story of South Slough”; a post box with copies of historic letters and articles; and a recording from a citizen of the Slough telling stories from her childhood.

The Naturalist's Desk: This desk, situated in the corner of the exhibit hall, provides visitors with a hands-on chance to explore the Reserve. In various hidey-holes and drawers are magnifying glasses, shells, bones, feathers, and rocks. A computer monitor plays a slide show to help inform visitors about what they are studying. There are also maps and handouts for visitors to take with local information, such as tsunami hazards.

Exhibits continue into the William A. Wick Auditorium. In the back of the hall there are hangings informing visitors about tide cycles, eelgrass meadows, and forested habitats. There are also drawers containing various interactive activities, such as comparing sediment types and samples of different wood species. Exhibits extend to include the works of local artists that are periodically displayed in the auditorium.

The deck surrounding the Center has informative panels on the side rails describing

the Reserve's migratory bird populations, trail system, and upland habitats. Attached to the rail is a spotting scope that affords a view of the South Slough. The Reserve also has exhibits beyond the Center. Signs along the trails inform visitors about local plant life and habitats.

Science Laboratory

The Science laboratory (4,000 sq. ft.) was built in 1999. It serves both administrative and research purposes and is housed in a two-story wing of the Terwilliger Building at the southern end of the OIMB campus in Charleston (Figure 6.5). It includes nine offices and 13 work stations, storage servers and backup servers along with a battery backup unit to cope with power interruptions and surges. Additionally, there is a wet-dry laboratory, seawater table room, staging and storage areas, kitchen, a shower, and a garage.

Improvements to sustainability have included expansion and reorganization of the facility to enhance efficiency. Future structural modifications will seek to reduce the building's energy consumption and expand work space (see Facility Upgrades section).



Figure 6.4: The Reserve Science Center building located at the Oregon Institute of Marine Biology in Charleston, Oregon.

Maintenance shop

The maintenance shop (3,888 sq. ft.) was built in 1997 on Seven Devils Road a mile south of the Visitors' Center (Figure 6.5). The shop provides shelter for vehicles and paddle craft, storage, a woodworking shop, and one office with two work stations. A pole barn provides protection from weather for additional equipment. The shop, barn, and yard are protected by a security fence, alarm system, and remotely-operated gate. This building has no public access and no current plans for improvement, though any future plans would consider sustainability. The facility gets network connectivity through a wireless bridge.

Spruce Ranch

Spruce Ranch (1,680 sq. ft.) was purchased in 1997 and remodeled in 2002 to accommodate guests or temporary workers. Its location is adjacent to the maintenance shop (Figure 6.5). Two 24-foot diameter yurts added to the property in 2004 provide additional temporary housing. There is no public access to this facility and no current plans for improvement, though any future plans would consider sustainability.

The house is also connected to the Internet infrastructure via a wireless relay station link, and the entire complex, including the yurts, have wireless coverage for researchers and visiting guests.

Education shed

Built in 1997 at the lower end of the Estuary Study Trail, this shed provides storage for teaching materials. It has minimal public access and no plans for improvement.

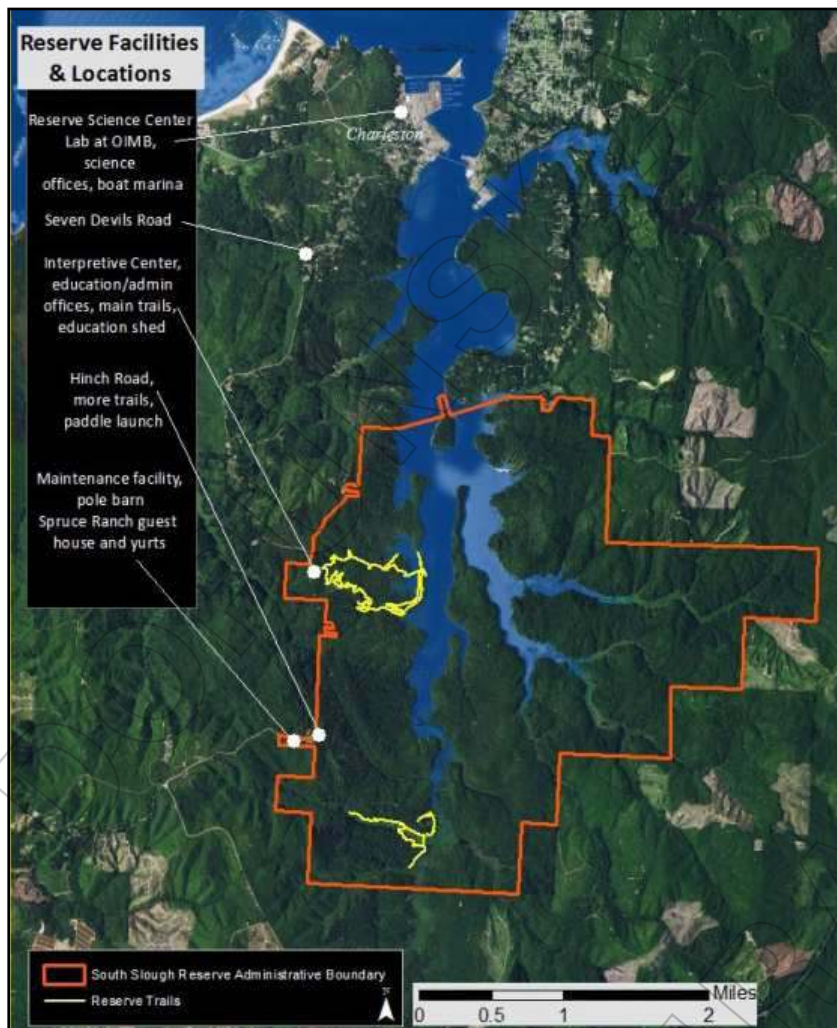


Figure 6.5: Map of Reserve facilities and locations.

Trail restrooms are located at the lower end of the trail system near the education shed. The self-contained composting toilets in these restrooms minimize environmental impacts.

Other facilities

Boats

- Two boats w outboard motors and trailers
- One Native American-styled 24 foot, 8-passenger canoe
- Six kayaks

ehicles

- One tractor
- One 7-passenger van
- Three pickup trucks
- One flatbed truck for maintenance use
- One fuel efficient car for out of town travel

Science stations

- System-wide Monitoring Program (SWMP)
- water quality stations
- Meteorological stations
- Sentinel Site stations

For a full list of facilities refer to Table 6.1.

Category	Description
Primary Structures	<p>Interpretive Center (IC): offices, restrooms, public exhibits (including aquaria), auditorium, classroom, storage closets, bookstore, copier/library room</p> <p>Maintenance shop: office space, restroom, 3-bay garage (tools, vehicle, watercraft storage)</p> <p>Spruce Ranch: living area, kitchen, bathrooms, deck, queen bed, bunk beds, heating fuel tank, well pump</p> <p>Spruce Ranch yurts (2): Bunk beds, tables, chairs, futon, armoire, heaters</p> <p>Office spaces at OIMB: offices for science staff, wet lab, field gear storage, and garage</p>
Support Structures	<p>Pole barn (at maintenance shop): boat, trailer, landscape equipment, and firewood storage</p> <p>Hinch Road Paddle Launch: gravel paddle launch for water based programs</p> <p>Pump house (at IC): water tank, solar water pumping equipment, office tables/chair storage</p> <p>Hidden Creek boardwalk and Overlook infrastructure</p> <p>Trail bridges (North Creek, Hidden Creek, 10-Minute Trail, etc.)</p> <p>Education storage shed (located at the lower portion of the main trail system)</p> <p>Vault toilet (located in the lower part of the main trail system)</p> <p>Wireless tower and building at Joe Ney Landfill</p> <p>Wireless tower at south end of Reserve property off of Seven Devils Rd.</p>
Utilities	<p>Electric (IC): Pacific Power (888) 221-7070, 52 panel solar system on auditorium roof that feeds back to the grid</p> <p>Electric (Maintenance, Spruce Ranch): Coos Curry Electric, (541) 396-3118 or (866) 352-9044</p> <p>Internet: Connected to OIMB internet at OIMB; a wireless system connects OIMB to the IC, Maintenance and Spruce Ranch</p> <p>Propane: IC and ECOS Ferrellgas, (541) 888-2636</p> <p>Phone: Frontier, (800) 921-8104</p> <p>Heating Fuel: Carson Oil, (541) 756-3426</p>
Support Equipment	<p>Flatbed 1-ton truck; Chevrolet ½ ton; Ford F-150; Dodge Caravan; Ford Fusion, Ford F-250</p> <p>6 Kayaks, 2 boats, 3 trailers, 1 tractor, 2 boat motors, 1 riding lawn mower, maintenance tractor, weed eaters, chain saws, misc. garden/lawn tools, 1 Solar Panel boat Battery</p> <p>Communications: cell phones (4), Motorola base radios (2), hand held radios (3), walkie-talkie, NOAA midland radio, ONSET USB base station (Water Logger), SATLINK2 Remote Satellite</p> <p>Other: 2 Pumps, 1 Portable Water Pump, 6 Solar Panels – in field (SWMP), 6 SATLINK2 Remote Satellites – in field (SWMP), Solar powered generator (IC), emergency battery</p>
Long Term / Permanent Monitoring Stations	<p>NOAA climate Reference Network weather station (2 structures) on steel tower and concrete posts/wood fence (Frederickson Marsh)</p> <p>SWMP real-time weather station on 30 ft. steel tower (Tom's Creek marsh)</p> <p>SWMP real-time water quality station on: wood piling dock (Charleston Bridge), wood piling (Valino Island), steel tripod towers (Elliot Creek, Winchester Creek)</p> <p>SWMP secondary water quality station on: steel piles (Catching Slough, Coos River), wood/concrete piling (Isthmus Slough), wood dolphin McCullough Bridge (North Point)</p>

Table 6.1: Detailed list of Reserve facilities, including structures, utilities, support equipment and permanent monitoring stations.

Building	Age (years)	Years since last remodel
IC	~30	13
Science Lab	25	15
Maintenance Shop	18	N/A
Spruce Ranch	18	13
Education Shed	18	N/A

Table 6.2: Age of major Reserve facilities, including remodel information if applicable.

Facility challenges

None of the Reserve's buildings are less than 10 years old (see Table 6.2). Though age can cause stress to some buildings, regular updates to the main buildings have prevented it from being a debilitating problem. The systems within the buildings (such as the new pump system in the Center) are also up-to-date and sustainable.

To mitigate the Reserve's climate impact, staff have reduced the Reserve's carbon footprint through changes in facilities, including installation of photovoltaic panels on the roof of the Center and pump house; replacing incandescent lighting with high intensity light-emitting diode lamps and directed fixtures; installing a fireplace insert and on-demand low-energy water heaters at the Center; using solar panels to power science stations; and making other improvements to save energy. Similar improvements for the science laboratory have been included in the plans for the lab expansion.

Both natural and anthropogenic stressors affect Reserve facilities (see sidebar). Future stressors revolve around climate change. Sea level rise

Natural and anthropogenic stressors that affect facilities

Natural

Heavy rain, humidity and cool temperatures; general coastal weather patterns
Ground settling, causing some building separation from the main structure (e.g., Interpretive Center offices)
General wear on the trail systems, such as erosion, boardwalk deterioration and damage from wildlife, vegetation overgrowth, and winter storm damage

Anthropogenic

Littering within the Reserve
Vandalism
Theft of property and forest products

would flood some of the trails in the system. An increase in winter storm intensity would increase wear on both trails and buildings, and may cause an increase in flooding or facility damage. Though the Reserve has currently planned for these changes, they still have the potential to cause damage to the facilities.

Planning for facilities

When new facilities are needed they will be planned and constructed to comply with the Americans with Disabilities Act. New construction will be planned so as to have minimal visual impact and not obstruct views, either within or beyond the Reserve's boundary. Building exteriors will be finished using rough-textured, natural or natural-appearing materials with neutral, natural colors. Where practical, preference may be given to artificial, sustainably produced

building materials that mimic natural materials. To the greatest extent possible, new buildings will be designed and located to support multiple Reserve goals. In locating buildings, the Reserve will consider the potential impact of increased human activity on natural areas and resources. Construction methods will be chosen to have minimal environmental impact, with particular attention paid to reducing the impacts of runoff, pollution, and soil compaction.

Where applicable, construction will occur in the dry season to minimize ground compaction and sediment loading of water bodies. Runoff from roads and parking lots will be directed whenever possible through vegetative filters prior to entering any water body. Non-motorized conveyances will be used whenever feasible to transport construction materials to and from sensitive sites.

In planning, locating, and constructing new facilities, and when upgrading existing facilities, the Reserve will plan for energy efficiency, reduced production of carbon dioxide, and the use of sustainably produced and designed building materials. All construction will be consistent with the Reserve's stewardship policies and Oregon's statewide land use planning goals.

Only native plants already found within the Reserve will be used as decorative plantings around buildings and facilities.

Trail development is guided by the 1990 Watershed Walkway Plan, although this plan is in need of an update. Public trails are planned to avoid crossing tidally-influenced areas

and wetlands as much as possible. They are designed to discourage shortcuts or off-trail excursions, and are predominantly earthen but may be surfaced with wood chips or gravel for safety or to minimize erosion. In areas where boardwalks can become slippery, the planks have been surfaced with wire mesh to provide traction. As trails are updated and added, accessibility in emergencies will be addressed.

The Reserve maintains roads and parking to provide public access and facilitate the Reserve's programs and operations. All of the Reserve's roads are legacies of the age of logging. Many have been modified to improve drainage and reduce erosion. Roads and parking areas are associated with compacted soils, storm water runoff, and erosion, and may disrupt animal habitat and visitors' trail experiences. Vehicles are allowed only on the Entrance Road, Winchester Road, and Hinch Lane.

The Reserve's policy is to construct and maintain roads and trails only to the extent necessary to do work. If needed, temporary roads may be constructed to provide access for work crews. Staff do not maintain the many miles of abandoned logging roads that remain within the Reserve's boundaries. These roads despite being covered by forest duff and grown over by small trees remain usable. Some are likely to be re-activated as the Reserve begins to implement habitat restoration in the upper watershed.

Facility Upgrades

The primary facility upgrade that the Reserve is currently planning is for its Science Lab. The Reserve will upgrade both the laboratory and

offices to improve the working environment.

The Science Lab facility is currently operating at capacity. All work stations are occupied and the laboratory space is fully utilized to support multiple research and monitoring projects as well as field-based projects led by visiting researchers.

In 2011 a NOAA construction grant provided funds to:

1. Complete interior renovations to office space on the first floor where the Lead Scientist and Estuarine Coordinator currently have their offices.
2. Contract with an architect for the design and plans of the expansion of Science Lab as well as the reorientation of the garage.
3. Complete architectural drawings and plans for the new additions (completed March 14, 2014). Cost estimates for the remodel were completed May 1, 2015, which

Current Facility Needs

Install vault toilet(s) at the Wasson trailhead and or the paddle launch

Improve the observation platform deck and upper overlook

Address the safety issues surrounding the Fredrickson House; a cultural landmark within the Reserve that has not been up kept. The walls and the foundation are starting to crumble and pose a safety risk to the public.

Restore the Fredrickson Shed; a 2016 Coquille Tribal Community funded project that involves the restoration of a culturally and historically significant structure located on the South Slough Reserve. This project is currently underway.

Update the Reserve's Facilities Master Plan, which has not been updated since 1991.

Maintain and improve Spruce Ranch facilities to keep housing available to visiting researchers and interns.

Complete the wireless communication project: part of this project that been completed but will need additional Multiband microwave equipment and an additional series of line-of-sight relay towers. This will complete the installation of five new wireless relays for internet connectivity through the entire estuary.

Update and improve interpretive and directional signage on the trail system.

Update and or replace watercraft and motor vehicles as needed; research boats are used almost daily and updates will need to be completed to keep staff safe. The fleet of kayaks is also aging; most are at least 15 years old. New and improved kayaks are lighter and come with up-to-date safety features. The Reserve's motor pool, in particular the Dodge Caravan, is in need of constant service and may need replaced soon.

Utility Terrain Vehicle for maintenance and emergency access to trail systems: it has become increasingly necessary to look at accessibility for emergency needs on the trail system. With the multiple miles of trails, maintenance accessibility is also a problem. The use of a Utility Terrain Vehicle will allow evacuation of hikers with injuries and could lesson injuries to all staff by transporting heavy or awkward equipment.

allowed the Reserve to apply for a construction grant from NOAA in the Fall and Winter of 2015 2016.

The new renovations will entail the following:

Renovation to enlarge and re-orient an existing garage on the southeast portion of the Science Lab.

A parking area that will allow for vehicle access on the Seafoam Lane property.

Reroute a drainage ditch on the Seafoam Lane property.

Build out additional wet lab space adjacent to seawater tanks.

The second floor will be built out above the garage and where the current deck and stairs are, adding approximately 1100 square feet of additional office space on the second floor.

The Reserve will also be installing five new wireless relays for Internet connectivity through the entire estuary.

Though other construction is not currently planned, some building projects may develop in the future. As time and budget allows, staff will remove or arrest decay on deteriorating or unsafe structures within Reserve-managed lands. Planning has not yet begun for these projects; depending on the need, the Reserve may seek funds from NOAA for demolition, construction, and clean up. The Reserve needs to update its facilities master plan, which has not been updated since 1991 (see *Current Facility Needs* sidebar).

All facility upgrades will comply with the same philosophies mentioned in the Planning for Facilities section above.

Facilities Accomplishments since 2006

Energy efficiency upgrades to Reserve buildings (see Interpretive Center above)

Replacement of Interpretive Center Roof

An update of trail signs to include interpretive kiosks

Addition of a new wireless tower

Installed a second bathroom added to Spruce Ranch to accommodate larger groups.

Updated the boardwalk on the Hidden Creek trail system

Exhibit redesigns and installation in Center (see exhibits section under Visitors' Center, above). Portions of the exhibits are electronic and can be updated easily.

Building leveling, summer 2015, at the Visitors' Center, where settling ground compromised the building's foundation.

The Reserve contracted a building lift and stabilization to repair the foundation

Developed a paddle launch at Hinch Road Bridge and a water trail within the Reserve. This project included several organizations including the Port of Coos Bay, Coos County Parks and local merchants.

Completed the North Creek Trail. The North Creek trail is a 1.5 mile trail (longest in Reserve) and one of the largest accomplishments during the last 10 years. Completion included several organizations and groups including inmate crews, volunteers from AmeriCorps, Oregon Youth Conservation Corp, and the Belloni Boys Ranch. The upland trail route was completed in early 2008 with staff directing the work of these work crews as well as adjusting the trail plan as necessary

to conform to the terrain and optimize interpretive opportunities.

Upon completing the upland portion of the trail route, the Reserve contracted an experienced engineer familiar with trail design and construction to design and engineer a bridge to link the lower portion of the North Creek trail with existing portions of the Estuary Study trail system. The final bridge design was a 70 foot aluminum box girder foot bridge with cedar log abutments, wood decking and safety netting. The bridge was constructed by a local contractor, transported by truck to a trailhead on the Reserve then moved by small excavator down the Railroad Trail where it was placed over the estuary to its final resting location.

Chapter : Resource Protection Plan

All programs at the Reserve are dedicated to protecting the Reserve's function as an area to be used for coastal ecosystem research and education. The Reserve operates with input from a variety of partners to maintain ecological integrity and to foster better informed management of Pacific Northwest estuaries and coastal watersheds. The legal framework in place to protect Reserve lands, waters, and resources includes the following federal, state, and local regulatory authorities:

Management Authorities

Federal:

Section 315 of the U.S. Coastal Zone Management Act of 1972, as amended (16 U.S.C., 1461): Section 316 provides for the establishment of a National Estuarine Research Reserve System and the basis for identifying suitable lands and waters for designating National Estuarine Research Reserves. It also provides for financial assistance to support reserves and evaluation and reporting requirements.

National Estuarine Research Reserve System Regulations (15 C.F.R. Part 921): The NERRS Regulations specifies, among other things, the mission of the NERR Program, the site selection and management plan development process, designation requirements, ongoing oversight and performance evaluation, and financial assistance provisions. The mission of the Reserve Program is to establish and manage a place-based system of estuarine research reserves "for long-term research, education, and interpretation.

Federal Grant in Aid No. 04-4-158-12001, as amended: This is the original 1974 grant that created the partnership between NOAA and the state agencies (in Oregon, the Department of State Lands), and provided funds for the initial purchase of lands for National Estuarine Research Reserves. Oregon State agreed to acquire the specified lands to create the Reserve, and enact state statutes to keep the ecosystems on those lands intact.

State:

Oregon Revised Statutes and Administrative Rules:

- o Oregon Revised Statutes, Section 273.533 et seq. These statutes establish the management policy for the Reserve, which is to "maintain the integrity of the estuary; protect the estuary from uses and activities, both within and beyond boundaries that may alter or affect the ecosystem and its natural dynamic properties, and preserve the area for long-term scientific and educational uses, (Appendix B). These statutes also establish the Reserve's Management Commission (Commission).
- o Oregon Administrative Rules, Chapter 142. These state rules specify allowable and non-allowable public uses of the Reserve and its resources. These rules are designed to complement the primary management objectives and the primary scientific objectives of the Reserve by regulating use, in keeping with Oregon's management policy (O.R.S. 273.533) (Appendix C).

Statewide Land Use Planning Goals; Goal 16 Estuarine Resources: Oregon's statewide land use planning law (O.R.S. 197) authorized the state's Land Conservation and Development Commission to adopt 19 goals containing procedures and guidelines to direct local governments in preparing comprehensive land use plans. Planning Goal 16, for estuarine resources, provides specific plans to coastal counties for conserving the ecological values of estuaries. Oregon Coastal Management Program: To be approved, the Reserve management plan must comply with the Oregon Coastal Management Program's rules, regulations, and relevant enforceable policies for protecting estuarine resources. For the Reserve, this includes consistency with the Coos Bay Estuary Management Plan.

Local:

Coos Bay Estuary Management Plan: This plan is an element of the Coos County Comprehensive Plan. When the Coos Bay Estuary Management Plan was first approved in 1974, the Coos County Commission established de facto protection from development for what was then known as the South Slough Sanctuary, as a special natural area of the Coos estuary. The Commission withdrew the area of the Reserve from the plan and declared it would be managed by the State in accordance with state and federal laws. In regards to the Reserve, the plan states: *"As this is an area set aside for its natural values and for research, it is ideally suited for litigation or restoration actions. The knowledge gained from a restoration enhance ment and monitoring*

progra , together with the advantage of state ownership of most of the sites could greatly facilitate development elsewhere in the bay, particularly in the Charleston area. Though several of the actions are small and may have relatively minor effects, the cumulative effect on the system is likely to be substantial. Therefore, these sites are accorded a higher priority than they would otherwise have. (Coos County, 1986).

South Slough National Estuarine Research Reserve Management Plan: The management plan details additional guidelines, policies, and actions deemed necessary by the Reserve manager to protect the natural, cultural, institutional, and other resources of the Reserve.

Additional sources: Other laws, such as those intended to protect historic, archaeological, or cultural resources or Native American sites, provide additional protection for Reserve resources. Furthermore, the Reserve manager, with the Commission's direction, may approve additional stewardship policies and actions as appropriate.

Partnerships for Maintaining Regulations

Partnerships between the State of Oregon, NOAA, the Reserve Management Commission, Reserve staff, Coos County, and other natural resource management organizations, maintain the regulations that protect the Reserve. Day to day oversight is provided by Reserve staff, while the creation and shaping of laws and rules is informed by Reserve staff, but overseen by the Commission, the State of Oregon, and the federal government. Law enforcement is provided by the Coos County sheriff and local regulatory

organizations, such as the Oregon Department of Fish and Wildlife, while compliance with rules is generally overseen by Reserve staff.

Allowable and Unallowable Uses

The above mentioned management authorities guide the allowable and unallowable uses of the Reserve. Federal law (15 C.F.R. 921.1) asserts that the Reserve shall be open to the public to the extent allowed by state and federal law, and it states that the multiple uses of the

Reserve must be compatible with the Reserve's primary purpose: to serve research, educational, and stewardship needs. Oregon state statutes and administrative rules were created in alignment with the primary uses of the Reserve, and in alignment with the mission to improve the understanding and stewardship of Pacific Northwest estuaries and coastal watersheds (Table 7.1). With that said, the pressures on and needs of the Reserve are ever evolving, so stewardship policies and administrative rules need revisiting from time to time.

Activity	Designation
Aesthetic appreciation	Allowed
Canoeing and paddle-craft	Allowed
Chemical fertilizer, herbicide, or pesticide	Restricted – permission required (Management Commission)
Commercial bait gathering	Prohibited
Commercial forest product gathering (greenery, bark, mushrooms)	Prohibited
Commercial mineral removal	Prohibited
Commercial timber harvest	Prohibited
Digging for artifacts	Restricted – permission required (Management Commission)
Dredging, filling, or altering	Restricted – permission required (Management Commission)
Firewood cutting	Restricted – permission required (Manager)
Hiking	Allowed
Horseback riding	Restricted – no current designated areas
Hunting	Restricted to certain areas - Oregon regulations apply
Hunting and observation blinds	Restricted - must be removed by sundown
Introduction of non-native species	Restricted – permission required (Management Commission)
Motorized boating	Restricted – wake must remain below one foot
Motorized/off-road vehicles, biking	Prohibited, except on county roads or with Manager's permission
Open fires	Restricted – permission required (Manager)
Overnight camping or use	Restricted – permission required (Manager)
Oyster cultivation	Restricted – permission required (Management Commission)
Pets	Allowed, on leash and under direct control of the owner
Picking forest greenery	Restricted – permission required (Manager)
Picnicking	Allowed, except where prohibited by signage
Recreational bait gathering	Allowed, except where prohibited by signage - Oregon regulations apply
Recreational berry picking	Allowed, except where prohibited by signage
Recreational clamming	Allowed, except where prohibited by signage - Oregon regulations apply
Recreational fishing	Allowed, Oregon fishing regulations apply
Recreational mineral gathering	Restricted – permission required (Manager)
Recreational mushroom gathering	Allowed, up to one gallon per person per day
Research & research/education	Restricted – permission required (Manager)
Road construction	Restricted – permission required (Management Commission)
Target/pleasure shooting	Prohibited
Trapping	Restricted – permission required (Manager)
Tree removal	Restricted – permission required (Management Commission)
Wildlife observation	Allowed

Table 7.1: A breakdown of activities that are permissible and prohibited as outlined in the Oregon Administrative Rules relating to the Reserve. Data: http://arcweb.sos.state.or.us/pages/rules/oars_100_oar_142_142_010.html

Restricted Activities Rationale & Pre-Reserve Uses

While the Reserve is open to the public, certain activities must be limited or restricted to maintain the mission and purpose of the Reserve. For example, the removal of natural resources (including minerals, forest products, and wildlife) is either entirely limited or limited by volume, to reduce the human impact on natural processes and the research and educational programming that is based thereon. The commercial extraction of natural resources is prohibited entirely since it does not align with the goals or objectives of the Reserve. One poten-

tial exception to this limitation is the removal of natural resources for the purposes of ecological restoration, in which case commercial revenue is not generated but directly invested back into the mission-driven project and programming itself.

Other uses that are restricted due to their potential adverse impacts on ecological processes, human safety, research, or education programming include off-road vehicle use, target and pleasure shooting, horseback riding, and hunting in certain areas of the Reserve (Figure 7.1). In addition to potential adverse impacts from these activities on programs,

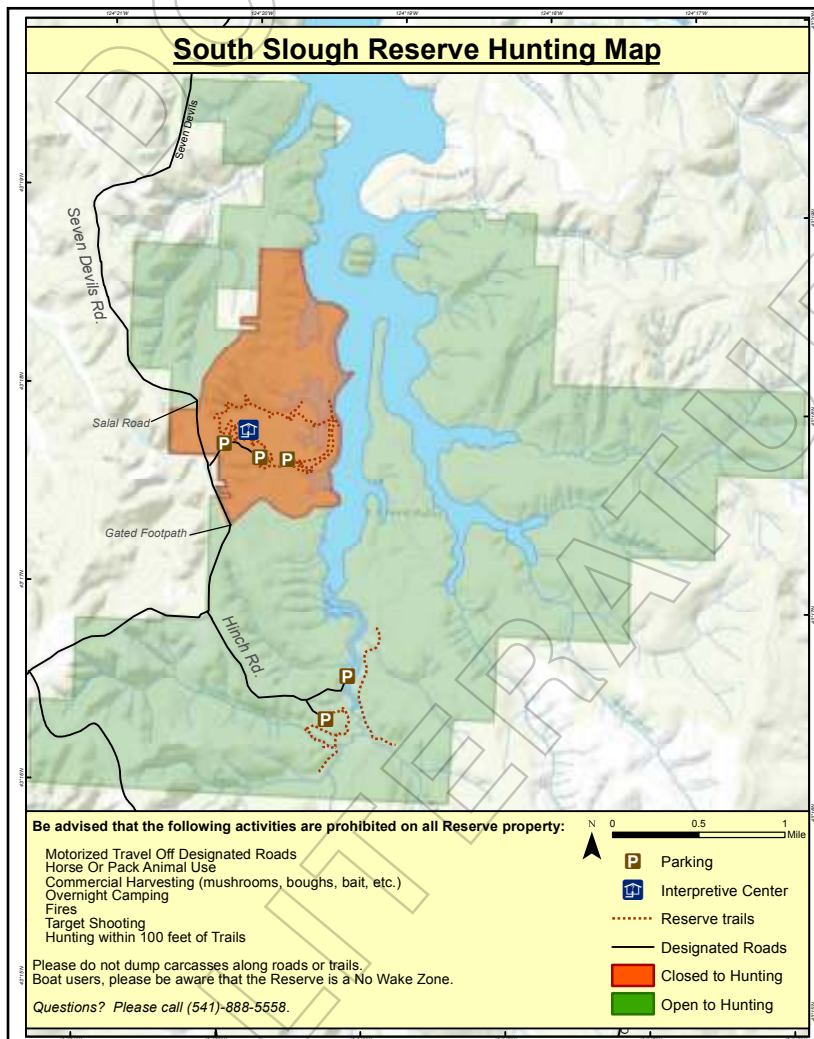


Figure 7.1: Hunting map, showing locations where hunting is allowed, prohibited, or restricted.

processes, and visitor safety, the Reserve often lacks the resources and staff to manage these restricted activities. For example, permitting camping requires staff and resources to manage waste, visitor safety, and infrastructure. Similarly, the permission of firewood collection and trapping require safety measures and monitoring that the Reserve is not equipped to provide.

The manager is authorized to take additional actions to protect public health, safety, and welfare, consistent with the primary objectives of the Reserve. Any activity may be suspended or any area closed if necessary for the conduct of appropriate scientific research, stewardship and education. Furthermore, if research suggests that certain uses have a detrimental impact on the ecosystem or resources thereof, or if these uses may have an adverse impact in the future, appropriate agencies of the State of Oregon shall take immediate action to control these uses so as to remove or negate their effects and restore the system to its prior natural state.

Oyster farming

Commercial oyster cultivation has occurred in the South Slough since before the creation of the Reserve. Although new oyster leases have not been permitted, the pre-existing uses continue (Figure 7.2). Oyster cultivation is a private commercial activity, and the number of oysters and their value is not publicly-shared information. Previously, the Commission has fielded requests by commercial oyster growers operating in the South Slough to grow additional species, such as non-native Manila clams. The Commission has denied these requests in order to provide maximum protection to native spe-

cies and resources, while grandfathered oyster cultivation practices persist.

Surveillance and enforcement

Partnerships between the Reserve and local law enforcement are fundamental to the protection of the Reserve. However, due to the remote location of the Reserve and its facilities, surveillance and enforcement can be problematic. Furthermore, Coos county law enforcement organizations are frequently underfunded and spread very thin, so regular patrol of the Reserve is challenging.

Reserve grounds are occasionally patrolled by the Coos County Sheriff's department, a partnership the Reserve is actively trying to mature. Fire protection in the Reserve vicinity is provided by the Charleston Fire Department and the Coos Forest Protective Association. Hunting and fishing regulations are enforced by Oregon State Police and protection within waterways is provided by the U.S. Coast Guard, stationed in downtown Charleston.



Figure 7.2 Commercial oysters inside the Reserve, adjacent to Long Island Point.



Figure 7.3: Hinch Bridge, located in the relatively remote southern end of the Reserve, is a hot-spot for vandalism. This is in part due to its accessibility.

Ultimately, Reserve staff monitor roads, trails and waterways daily for signs of illegal, prohibited, or restricted activities, and contact law enforcement to report vandalism or other violations. At the science laboratory and the interpretive center, 24-hour video cameras have been installed to provide additional security for publicly owned vehicles, boats, trailers, and other equipment routinely parked outdoors where it may be subject to vandalism and theft.

Resource protection challenges

Water Pollution

The South Slough estuary receives a variety of direct point source pollutant discharges, ranging from those generated by waterside businesses in Charleston (i.e. fish processing plants) to effluent from municipal water treatment outfalls. Non-point source pollutants enter the estuary indirectly as components of road runoff

and runoff from rural and urban activities, as well as occasional actions by private individuals along the shoreline or aboard boats. The Reserve is focusing efforts on developing a better understanding of the sources and movements of nutrients and bacteria in estuarine waters. Through the Partnership for Coastal Watersheds, the science staff is working with universities to develop a hydrodynamic model. The Reserve will continue to work with community organizations, such as water boards, to address water pollution in the South Slough and Coos Estuary.

vandalism

Vandalism is a chronic problem in remote locations of the Reserve (Figure 7.3). Hot spots for vandalism are those areas that can be reached relatively easily, by road or foot, but do not have a constant staff presence. The Frederickson homestead, Hinch bridge, and Reserve restrooms often experience tagging or other damage. Signage around the Reserve is sometimes the target of pleasure shooting and dumping occurs in areas adjacent to roadways. Reserve staff works with the Coos County Sheriff to deal with illegal activities. In 2015, the Reserve also installed new signage that will hopefully help communicate regulations in high use and problem areas (Figure 7.4).

Harvesting Forest Products

Brush picking, bark gathering, and mushroom collecting for commercial purposes is prohibited in the Reserve. However, each of these practices are chronic occurrences. Commercial endeavors do not align to the primary objectives of the Reserve and the commercial gathering of forest greenery can be downright harmful to Reserve ecological systems. When people illegally collect



Figure 7.4: Example of signs used to communicate uses that are allowed or prohibited within the Reserve.

Port Orford cedar boughs or salal brush, both valuable floral commodities, the foot traffic has the potential to exacerbate the spread of Port Orford cedar root rot (*Phytophthora lateralis*). The stripping of young plants may also damage the survival and resiliency of the vegetation. While the Reserve does allow limited harvesting of forest greenery for noncommercial purposes, these activities are individually approved by the Reserve manager and are mostly for cultural or interpretive reasons. Staff work with the Coos County Sheriff and the local tribes to monitor forest product harvesting in Reserve managed lands.

Timber Harvest on Adjacent Lands

Most of the lands surrounding the Reserve are used for commercial timber harvest. Practices on these lands expose the Reserve to some resource protection challenges, including increased wildfire risk, pollution from chemical treatments, increased sedimentation, and

habitat fragmentation. The Reserve does not manage the practices on these adjacent lands, but staff subscribe to a broad area surrounding the Reserve for all Notifications of Operation regarding timber related activities. Notifications come through the Oregon Department of Forestry and are reviewed by Reserve staff. The Reserve works with Coos County Forestry, the Oregon Department of Forestry, and other stakeholders to mitigate potential conflicts with diverse resource management.



Figure 7.5: Picture of a harvester harvesting timber. Industrial timber harvest is the most common type of land use surrounding the Reserve.

Off-highway vehicles

Off-highway vehicle (OHV) use mostly occurs on the east side of the Reserve and is likely due to unclear boundary markings. Preventing OHV use in the remote reaches of the Reserve is challenging due to limited accessibility and limited resources for enforcement. OHV use increases wildlife risk in the Reserve, may cause habitat destruction (including noise disturbance), and may lead to increased litter and dumping in the Reserve. The Reserve is not able to oversee responsible OHV trail creation or use and OHV activities do not meet the primary obligations of the Reserve.

Due to the historically unmanaged nature of Reserve uplands, many forest stands remain overcrowded and pose a catastrophic wildfire risk. The threat of wildfire may be increased by surrounding land management practices or when visitors have illegal campfires and or access areas via OHV. The Reserve works with local law enforcement to minimize illegal fires and wildfire risk activities in the Reserve. The Reserve also relies on the Coos Forest Protective Association and the Charleston Fire Department to enforce fire restrictions when appropriate.

Disaster Prevention and Response

Unexpected natural or human-caused disasters in any part of the Coos estuary can affect or threaten habitat throughout the ecosystem. The most potentially devastating disasters include oil or chemical spills, and accidents involving hazardous materials shipped to or from the Oregon International Port of Coos Bay. Strong tidal currents render South Slough particularly vulnerable to any water-borne spills during flood tide. The Reserve has participated in the development of spill prevention and contingency response plans by the Coos estuary subcommittee of Oregon Coast Oil Spill and Marine Safety Committee. Spill prevention planning addresses fuel hauling and handling practices; vessel routes, control, and communication procedures; tugboat equipment standards; and recreational boat licensing. The Reserve also completed their Disaster Response and Resiliency plan in early 2015, which addresses response to these threats (see References for the link to the plan).

Reserve Strategic Plan: Goals & Objectives Related to Resource Protection

Each of the goals, objectives, and actions in the 2017-2022 Reserve strategic plan are guided by or in response to resource protection in the Reserve and in the biogeographic region. The goals, objectives, and actions under all three of the priority issues (climate change, habitat protection, and invasive species) relate to resource protection. See Chapter 3 for the full 2017-2022 Reserve Strategic Plan.

References:

Coos County. (1986). Coos Bay Estuary Management Plan. Coquille, OR.

South Slough National Estuarine Research Reserve. Oregon Department of State Lands. (2015). Disaster Response Plan. http://www.oregon.gov/dsl/SS/Documents/SSNERR_DRP_FINAL2015.pdf