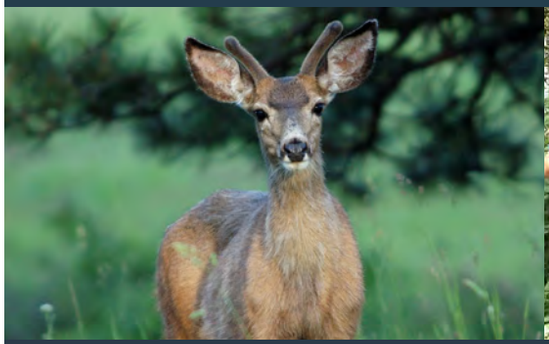
2020 STATE OF THE BAYS

TILLAMOOK ESTUARIES PARTNERSHIP
A NATIONAL ESTUARY PROJECT
WWW.TBNEP.ORG



Gregory Slobirder Smith

Why

WE BELIEVE in the intrinsic value of nature. Our goal is to conserve and enhance the estuaries and watersheds of Tillamook County by creating productive dialogues around the natural resources at the social, cultural, and economic core of our community while providing active and adaptable environmental leadership that honors the community's principles and values and sustains our partners.

How

MISSION

Tillamook Estuaries Partnership is a nonprofit organization dedicated to the conservation and restoration of Tillamook County's watersheds through active stewardship, scientific inquiry, community engagement, and education.

Table of Contents

Report design by Elise Wahl | Timberdoodle Studio
Salmon photo on cover by US Forest Service. Non-attributed photos throughout this report are by TEP staff or open source.

Where

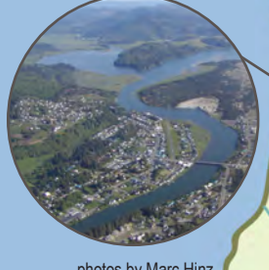
Nehalem Bay

Tillamook Bay

Netarts Bay

Sand Lake

Nestucca Bay



photos by Marc Hinz

Washington

Oregon

101

Manzanita

North Fork Nehalem

Nehalem River

TEP Study Area

Miami River

Kilchis River

Wilson River

Watershed Boundaries

Tillamook

Trask River

Tillamook River

101

Nestucca River

Tillamook County

OREGON

Little Nestucca

Neskowin

Neskowin Creek

What

SUMMARY OF STUDY-AREA PROJECTS (2015–2019)

205
Number of projects

8 Land acquisitions

1,100 acres
127 linear miles
Total project areas

ROAD CLOSED

6 Restorations

Road decommissioning and realignment

76 Enhancements

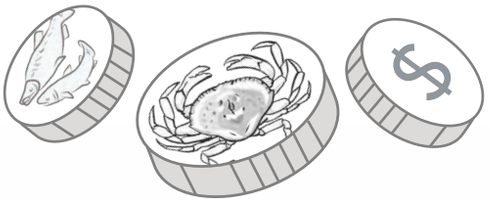
Large woody debris, plantings, culvert modification or replacement, weed control

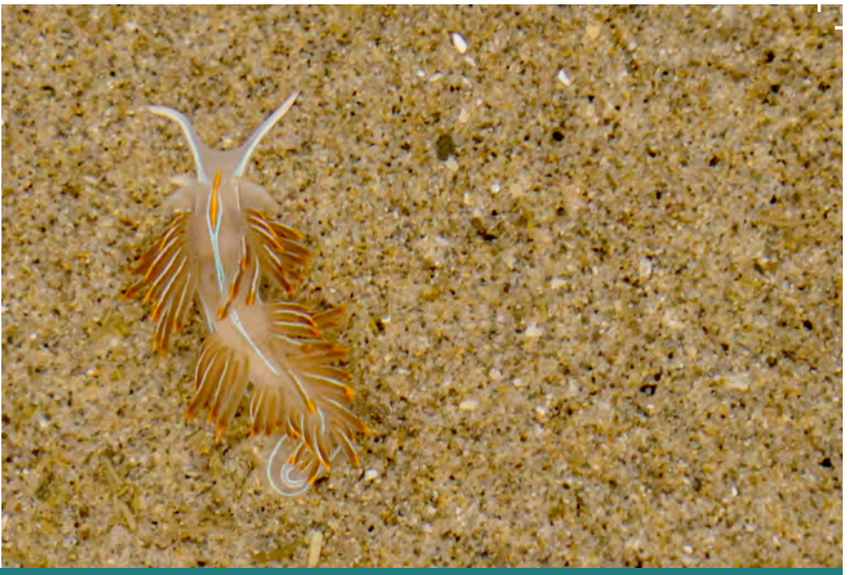
CCMP ACTIONS ADDRESSED

HAB-01	Assess and prioritize estuarine habitats
HAB-02	Assess and prioritize non-estuarine habitats
HAB-03	Assess and prioritize in-stream habitats
HAB-04	Assess and prioritize riparian habitats
HAB-05	Assess and prioritize upland habitats
HAB-06	Conserve and restore key habitats in the estuary
HAB-07	Conserve and restore key habitats in the lower watershed
HAB-08	Conserve and restore key habitats in the upper watershed
HAB-09	Maximize ecosystem connectivity to ensure a landscape array of ecosystem processes and ease of species movement
HAB-10	Provide genetically appropriate native vegetation and promote its use among habitat restoration and enhancement partners
HAB-11	Assess, prioritize, and enhance key native species populations, emphasizing contribution to ecological function
HAB-12	Assess, prioritize, and manage non-native species emphasizing those that have or are likely to have disproportionate negative effects

$31,539,844

Total amount spent





115 Re-establishments

Projects include tide gate modification or replacement; culvert removal, repair or replacement; fish screen, fishway, dam, and levee removal.

142 Partners (pg 24)

Agencies, organizations, and individuals

HAB-13	Assess and implement best management practices for key habitat conservation
WAQ-01	Improve farm management practices to address water quality
WAQ-02	Improve rural residential and urban infrastructure to address water quality
WAQ-03	Enhance riparian and instream areas throughout the watersheds to improve water quality
WAQ-04	Restore channel features and hillslope management to improve sediment storage and routing to address water quality
WAQ-05	Identify status and trends and quantify changing environmental conditions in water quality to inform adaptive management strategies impacting TEP's priority areas
CEE-01	Strengthen STEM literacy for K-12
CEE-02	Advance STEM-related career opportunities
CEE-03	Foster lifelong learning and environmental awareness
CEE-04	Cultivate community environmental stewardship
CEE-05	Build capacity for partner organizations

2019 CCMP

CLIMATE CHANGE VULNERABILITY ASSESSMENT AND CLIMATE CHANGE PREPAREDNESS STRATEGY

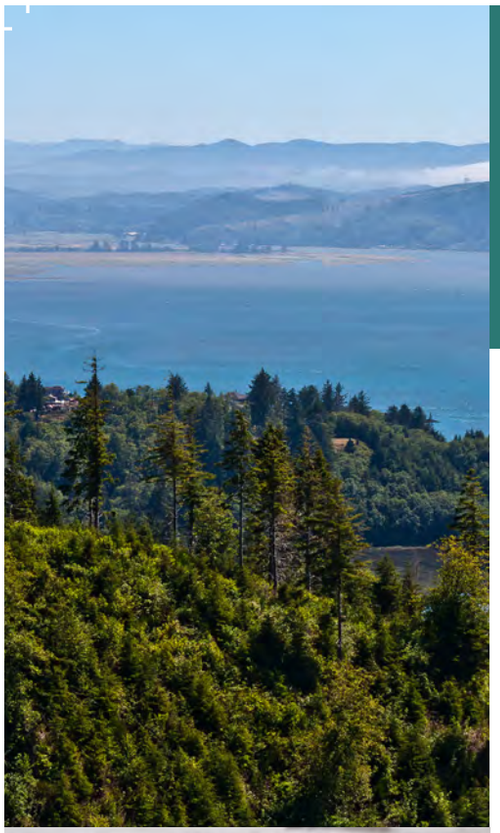
Ecosystems within TEP's focal area are expected to experience overall warming of 4°–7° F (3°–5° C) during the next 50 years. Likely to result in warmer, wetter winters and drier summers, overall climate extremes are anticipated to increase with higher incidents of extreme heat, precipitation, flooding, and drought. Climate change is anticipated to exacerbate resources and habitats already stressed by factors like pollution, sedimentation, and land conversion. Primary risks involve water quality and key habitat goals. These risks were used in development of adaptation strategies which were determined using the following variables: co-benefits, potential barriers or conflicts, partners, effectiveness, and relative cost. Thirty-five high-priority adaptation actions were identified among 23 general strategies and 78 specific actions. Many 2019 CCMP actions directly address climate change and are linked to the adaptation strategies.

CCMP REVISION

Informed by the climate analysis and incorporating assessments of completed and ongoing projects, emerging issues, and changing relevancies, TEP's 2019 CCMP utilizes the original 1999 CCMP as its foundation. Previous priorities related to erosion, sedimentation, and flooding were broadened to include a full suite of natural hazards and were integrated into both the water quality and habitat restoration action plans. Climate change stressors and vulnerabilities are emerging challenges in Tillamook County and are addressed throughout the new document.

This revision also considers evolving social, economic, and cultural values of the community. Public and partner input and review of the CCMP streamlined goals:

- Maintain and improve beneficial uses of estuaries and watersheds for humans and native aquatic and terrestrial species;
- Conserve and restore ecological functions of Tillamook County's estuaries and watersheds to benefit native aquatic and terrestrial species and the communities that depend on them; and
- Foster awareness of Tillamook County's estuaries and watersheds, engage in problem solving, and take action to conserve and enhance our natural resources.



Gregory Slobirder Smith

Conservation

(n. a careful preservation and protection of something)

& Restoration

(n. a bringing back to a former position or condition)

SITKA SEDGE

Sand Lake Estuary Watershed –NNSLWC, ORPD, TEP (HAB-01, -06, -07, -09, WAQ-04)

The 357-acre ecologically diverse Sitka Sedge Natural Area encompasses the southern end of the Sand Lake estuary. This Oregon state park supports a variety of habitat types and a range of important rare plants and wildlife.

Through a collaborative process with regional organizations and local residents, preliminary plans to breach Beltz Dike, an outdated tidal barrier, have been agreed upon, making this conservation success an impending restoration project. The breach and removal of a non-functioning tide gate are anticipated to restore tidal processes to 69 acres of tidal marsh while installation of a new setback levee at the estuary's southern boundary will provide the community of Tierra del Mar protection from flooding and sea-level rise.

Detailed site assessments conducted over the previous three years indicate reestablishing daily tidal patterns will regenerate nutrient cycling and food-web connections, improving foraging habitat for threatened juvenile coho salmon and other estuarine fish species. In a turn of economic fate, Oregon Parks and Recreation Department (OPRD) transferred responsibility for Sitka Sedge to TEP. The conservation and restoration project described above will continue as outlined and will be conducted by NNSLWC, TEP, and OPRD.

South Marsh, south of Beltz Dike, in Sand Lake estuary

SOUTHERN FLOW CORRIDOR – LANDOWNER PREFERRED ALTERNATIVE (SFC)

Tillamook Bay – SFC Corridor Team (HAB-01, -06, -09, -10, -11, -12, WAQ-02, -04)

At the head of Tillamook Bay, SFC encompasses 642 acres at the confluence of the Tillamook, Trask, and Wilson Rivers. This collaborative project brought together federal, state, and local partners and was designed to reduce flooding, provide economic benefits to the community, and restore habitat for native fish and wildlife. Eventually, 521 acres of habitat will be restored to full tidal inundation.

Designed to help alleviate flooding in the town of Tillamook and enhance ecosystem services in the estuary, SFC is one of the largest tidal wetland restoration projects in the Pacific Northwest. In 2016, the tide gates and dikes restricting tidal inundation were removed, restoring natural hydrology to channels and emergent wetlands; engineering crews also excavated remnant and new tidal channels.

Since 2013, a team of researchers monitored fish populations, hydrology, soils, vegetation, and soil carbon at SFC and nearby reference wetlands. Preliminary results, some of which are presented here, will inform monitoring strategies that recognize a more natural timeline as adult salmon returns increase and marsh soil accretion occurs over coming years and decades. Additionally, the partners agreed to a 10-year management plan.

SFC A monitoring crew member establishes a feldspar marker horizon plot for measuring soil accretion.

SFC tidegate

SALMONID ABUNDANCE

Before restoration, chum salmon were absent, and Chinook salmon were nearly absent from SFC channels. After the first two years of project implementation, six times as many chum salmon and approximately twice as many juvenile Chinook were found in SFC channels compared to reference areas. While ESA-listed young-of-the-year coho salmon catches were highly variable, they used SFC habitat before and after restoration; no restoration response has yet been detected. It is anticipated that salmonid use of this new estuarine habitat will continue as SFC channels and vegetated wetlands develop and provide improved rearing habitat, benefiting populations regionally.

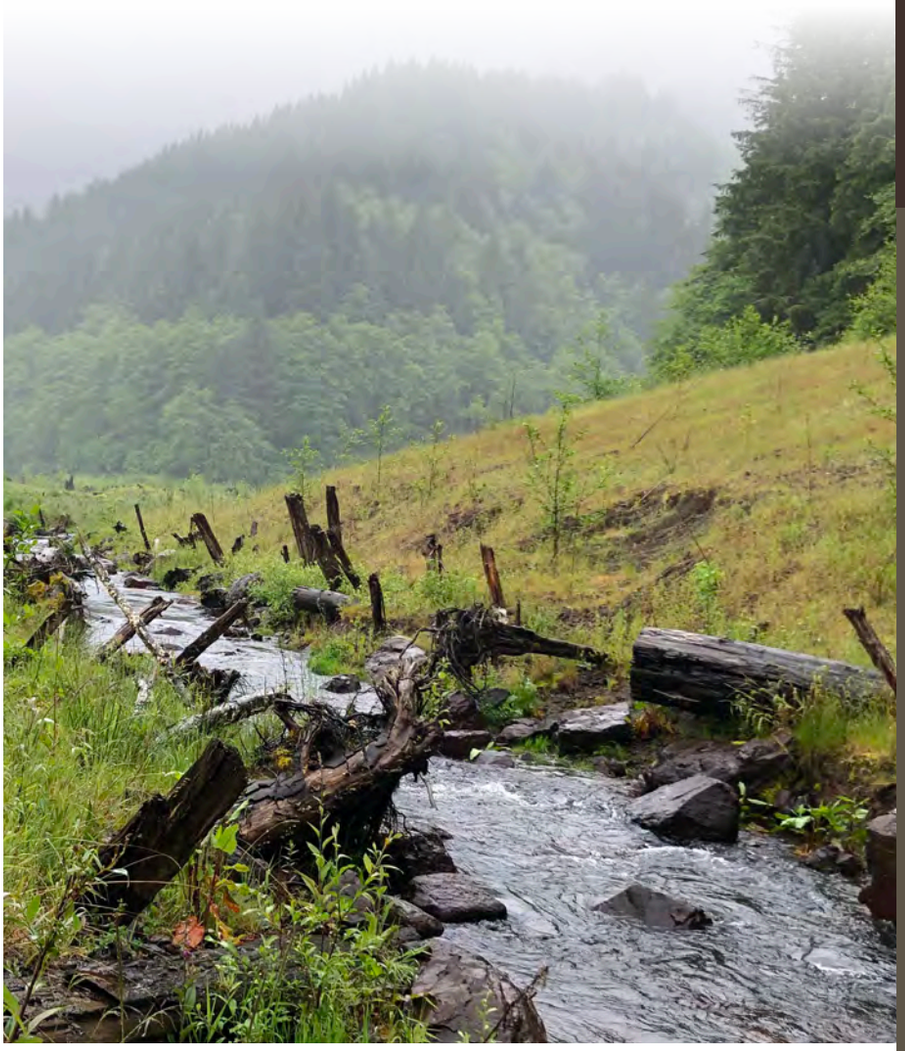
DEVELOPMENT OF WETLAND SOILS AND VEGETATION.

Invasive reed canary grass and other freshwater and non-native plant species dominated SFC before restoration. In the three years since project implementation, much of this vegetation died back and brackish wetland species established. Regular tidal inundation at SFC caused changes in surface soils and groundwater, with higher water tables, and saltier and less acidic soils. High soil deposition rates in many areas of SFC after restoration suggest the site's wetlands may return to the mature high marsh habitat historically found here.

CARBON SEQUESTRATION–the uptake and storage of carbon in soil which prevents it from entering the atmosphere where it can contribute to global warming– is an important function of tidal wetlands. Similar to nearby reference wetlands, SFC soils store large amounts of carbon, implying the restoration site will potentially increase carbon storage over the coming decades. To better understand SFC's potential net climate effects, we measured uptake and emissions of greenhouse gases (GHG) at SFC and nearby reference wetlands and farmlands. Nitrous oxide emissions were low in all land uses. Methane emissions were low in farmed areas and reference marshes, and higher at SFC because it tends to be wetter. As tidal channels develop and allow water to move off-site more rapidly, and as soil accretion shifts the site higher in the tidal frame, we anticipate SFC wetlands will have lower methane emissions than they do currently.

SFC Researchers measure the elevation of a tide gauge installation in a reference wetland for the SFC project.

JETTY CREEK – Nehalem River Watershed – LNWC (HAB-07, -09, WAQ-02, -03, -04) Moving Rockaway Beach's on-channel water impoundment (center right) off of Jetty Creek and restoring the channel now allows anadromous fish access to the length of Jetty Creek (~2 miles), a tributary of the Nehalem River.



Fawcett Creek channel through breached dam site.

SKOOKUM DAM REMOVAL

Tillamook River Watershed – USFS, City of Tillamook, TBWC (HAB-08, -09, -10, WAQ-03, -04)

Built of unconsolidated landslide material in 1965, Skookum Dam impounded Fawcett Creek and Skookum Lake creating a reservoir for the City of Tillamook. At risk of catastrophic failure, the dam was intentionally breached in 2018 by a collaborative group of government and non-profit entities. Excavating a pilot channel reconnected the upstream floodplain and two miles of fish passage. Planting native wetland species augmented natural recolonization to restore food web connections for migratory songbirds, elk, and other species using the corridor. The restored system has dual conservation and public safety benefits: increased resilience, catastrophic threat removal, restored natural processes, and access to fish spawning and rearing habitat.

BACKYARD PLANTING PROGRAM

Tillamook County – TEP (HAB-10, WAQ-02, -03)

2015–2019

10.2 total miles restored

64.3 total acres restored

32 landowners involved

17,442 trees planted

6,294 shrubs planted

19,350 cuttings planted

To encourage healthy riparian zones, the Backyard Planting Program provides free assistance to willing landowners with the aim of enhancing stream health by removing invasive vegetation and planting native trees and shrubs in riparian zones. Site-specific plans include site preparation, tree and shrub plantings, labor, and livestock fencing and off-stream watering. Healthy riparian zones stabilize stream banks, provide shade, which maintains cooler water temperatures, and consistent ground water storage and release. Additionally, they filter sediments, nutrients, and pollutants while also contributing organic matter that supports the aquatic food chain and large woody debris that creates streambed complexity and fish habitat.

EAST BEAVER CREEK

Nestucca River Watershed – TEP (HAB-08, -10, WAQ-03, -04)

Fall Chinook, Oregon coast coho, winter steelhead, and coastal cutthroat trout are found in East Beaver Creek, a Nestucca River tributary. The product of a private-public partnership, this enhancement and restoration project recreated necessary habitat components and increased instream structural diversity. Placing large woody debris and scattered individual trees encouraged pools, side channels, and better gravel sorting, all important features of fish habitat and a healthy river. Additionally, an 800-foot section of E. Beaver Creek Rd. was relocated to allow the river to regain its natural meanders and almost 1,300 native trees and shrubs were planted in the riparian corridor.

MCDONALD SLOUGH

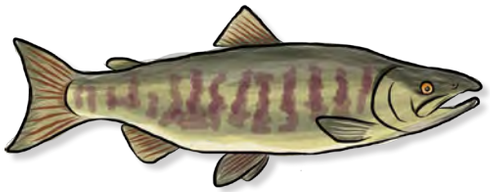
Nehalem River Watershed – LNWC (HAB-07, -09)

LNWC installed a Muted Tidal Regulator (MTR) gate (right, below) in place of an existing top-hinged tide gate between McDonald Slough and Nehalem Bay. The new gate, which is open approximately half of the time, allows juvenile fish to access 1.5 miles of critical estuary habitat.

NESKOWIN EMERGENCY EGRESS/ FISH PASSAGE IMPROVEMENT PROJECT

Neskowin River Watershed – NNSLWC (HAB-06, -09, WAQ-02, -03, -04)

Neskowin village's only access route floods during storm events making Hawk Street the only reliable exit and an essential emergency egress route. A private footpath running north from OPRD's Neskowin Beach Wayside, Hawk Street crosses several culverts, including two tide gates, on Butte and Hawk Creeks. These under-sized and failing culverts limit natural stream function and create velocity barriers during high flows, limiting access



to critical fish rearing habitat and aquatic species refugia. Wetlands on both sides of Hawk Street reduce flood risk and improve water quality and habitat on Hawk and Butte Creeks by lowering flood peaks, reducing water velocities, trapping sediments, and filtering pollutants and nutrients. Seven years of planning will culminate in replacing the failing culverts and tide gates with bridges improving hydraulic connectivity, reducing flood risk, and increasing habitat resiliency, fish passage, and habitat access while also providing a necessary and reliable egress route for the village. Construction is planned for 2020–2021.

Neskowin Marsh (bottom center). Highway 101 borders the marsh to the right and Salem Street is visible at lower left. Neskowin Golf Course (top-center, north in this view) is regularly flooded, as seen here. Between Neskowin Marsh and Hwy 101, Hawk Street parallels Salem Street

RAPID BIOASSESSMENT (RBA)

Nehalem River Watershed – LNWC (HAB-01, -02, -03, -11, -13)

To prioritize habitat enhancement opportunities in LNWC's coverage area, snorkel surveys were conducted on all 202 stream-miles of the Lower Nehalem River accessible to anadromous fish. Additionally, a simultaneous Limiting Factors Analysis (LFA) identified those reaches of the river that provide anchor habitat – i.e., all of the necessary seasonal elements required for coho salmon from incubation through winter rearing. The combined RBA and LFA give insight to future conservation and restoration needs. Two Large Woody Debris (LWD) placement projects designed with this work in mind are slated for 2020.

EAST BEAVER CREEK BRIDGE

Nestucca River Watershed – NNSLWC (HAB-08, -09, -10, WAQ-02, -03, -04)

East of Hemlock, the NNSLWC replaced Bear Creek's last remaining fish passage barrier on East Beaver Creek Road. Bear Creek enters East Beaver Creek near its confluence with West Beaver Creek, a tributary of Nestucca River. From its headwaters on USFS land and draining a 1,600-acre watershed with roughly three miles of anadromous fish habitat, Bear Creek flows through private timber and pastureland. The old culvert, undersized and approaching failure, was replaced with a 43' bridge that meets Aquatic Organism Passage Standards.

SALMON SUPERHIGHWAY

Tillamook County – Multiple Partners (HAB-04, -07, -08, -09, WAQ-02, -03, -04)

Between 2014 and 2019, the Salmon SuperHwy team removed 29 of 93 priority barriers, reconnecting 80 miles of spawning and rearing habitat for native migratory fish. Partners leveraged almost $8.7 million in funding and created 129 jobs. Local project support continues to flow.

Roger Ross Photography

Stewardship

(n. the careful and responsible management of something entrusted to one's care)

FRIENDS OF NETARTS BAY WATERSHED, ESTUARY, BEACH, AND SEA

Netarts Bay Watershed – (CEE-01, -02, -03, -04, -05)

WEBS strives to build a community of excellent stewards around the Netarts Bay watershed nestled between Cape Lookout and Cape Meares. Providing extensive pre-K–12 school programs and community learning opportunities, as well as supporting various community efforts, WEBS' goal is to create community pride and contribute to the long-term vitality of the natural and cultural resources of this place, our place. In 2019, 70+ volunteers contributed to 35+ community education programs and 25 school trips.

Currently, with support from private nurseries and the Bureau of Land Management (BLM), NORP grows

5 conifer species

6 hardwood tree species

20 varieties of riparian and wetland shrubs

5 forb species

In 2019

19 partners implemented

46 restoration projects

43,000 NORP nursery plants to restore

11 miles of riparian habitat

550 acres across riparian, wetland, and other habitats

NORTHWEST OREGON RESTORATION PARTNERSHIP

TEP (HAB-10, CEE-03, -04)

NORP's primary objective is to collect and propagate locally adapted, genetically appropriate native plant material creating robust stock that is better able to withstand competition and depredation while meeting management plan and restoration requirements. With roughly 100,000 native plants in production at the TEP nursery, NORP distributes approximately 50,000 plants to 40 partner projects annually.

Additionally, in a different form of stewardship, NORP coordinates with the Oregon Youth Authority (OYA) to have incarcerated youths work at the nursery. Providing the nursery's primary work force, the OYA crew supports daily essential operations in exchange for work skills and experience, and an hourly wage.

Scientific Inquiry

Informs restoration and conservation work

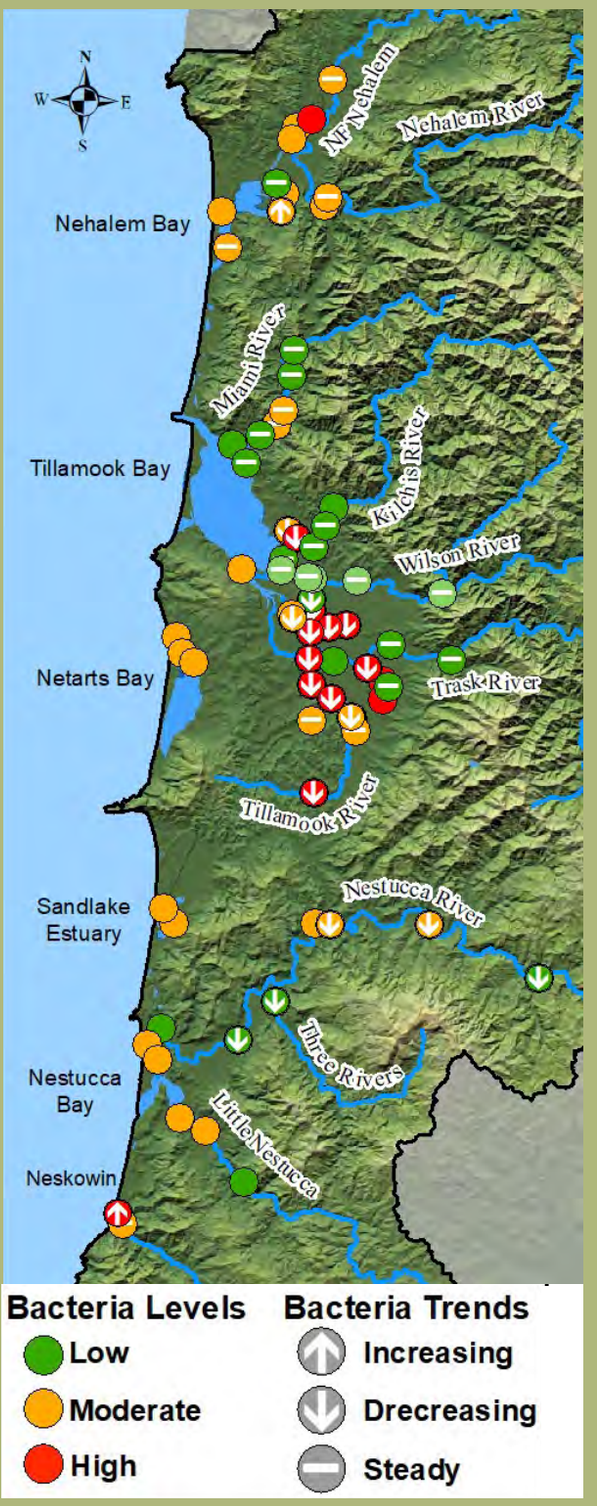
TRACKING LAND-BASED NUTRIENT AND BACTERIA INPUTS TO TILLAMOOK ESTUARY**

Tillamook River Watershed – EPA (WAQ-01, -05)

Addressing water quality issues in the Tillamook River watershed (such as low dissolved oxygen and elevated fecal bacteria) is challenging due to multiple nutrient and bacteria sources including run-off from dairy operations and human waste associated with wastewater treatment facilities and septic systems; hence, methods are needed to track fecal and nutrient inputs to the original source. Water samples were collected monthly (July 2016–May 2017) at 16 tributary sites, above and below potential anthropogenic pollution sources. Paired measurements were recorded for host-associated genetic markers targeting human, ruminant, cattle, canine, and avian fecal pollution sources. Samples were also analyzed for nutrients, E. coli, and nitrate isotope. Elevated nitrate isotope ratios in water suggest anthropogenic sourcing of nitrate, but do not discriminate between human and other animal pollution sources. In three rivers (Kilchis, Wilson, and Trask), nitrate and E. coli levels increased with downstream distance as the watershed transitioned from forested to agricultural/developed land use; while in the Tillamook River nitrate and E. coli were elevated at all sampling locations.

During the wet season, ruminant marker counts were highly correlated with *E. coli* and nitrate isotope. Nitrogen load contributions, from the SPAtially Referenced Regressions On Watershed attributes (SPARROW) model developed by USGS, demonstrate that manure and fertilizer explain greater than 80% of ruminant marker variation, *E. coli*, and nitrate isotope; while human inputs increased in importance downstream of a wastewater treatment facility. EPA research demonstrates that additional discrimination of sources can be obtained by combining microbial source tracking, stable isotopes, and watershed models.

BACTERIA LEVELS



**** EPA PROJECT COLLABORATORS/CONTRIBUTORS**

EPA - Pat Clinton (retired), Christina Folger, Darryl Marois (now with South FL Water Management District), T. Chris Mochon-Collura, Bill Rugh, Jody Stecher (retired), David Young (retired), Amy Zimmer-Faust (now with South CA Water Resource Research Program)
Oak Ridge Institute for Science and Education - Nate Lewis, Chanda Littles, Beth Rutila
DEQ/TEP - York Johnson
Oregon Department of Agriculture - Alex Manderson
USGS - Dan Wise

MAPPING THE DISTRIBUTION OF BAY CLAMS IN TILLAMOOK BAY**

Tillamook River Watershed – EPA (HAB-11)

Shellfish are important for the economy and well-being of Tillamook Bay residents and visitors. A valuable ecosystem service of the estuary, bay clams and Dungeness crabs are harvested both recreationally and commercially near the ocean in the lower estuary. To sustain shellfish production, estuary and resource managers need to map shellfish locations and habitat features that are important to the survival and growth of shellfish species. Obtaining these data is labor-intensive and, thus, expensive. EPA researchers from Newport are exploring alternative methods for mapping shellfish by developing ecological models using readily obtained environmental data to accurately generate habitat suitability maps useful for locating populations of harvestable bivalve shellfish within Pacific Northwest estuaries.

Habitat suitability is the capacity of a location to support a selected species based on that species' association with the location's biophysical habitat features. Researchers determined that just four variables (i.e., wet season mean salinity, sediment silt-clay percentage, presence of burrowing shrimp, and water depth) were needed to produce accurate bay clam habitat suitability maps. The maps were validated for Tillamook Bay using presence-absence data for each species obtained from independent scientific surveys of benthic invertebrates conducted between 1999 and 2011. These maps may be useful for estuarine land-use management and planning. While they do not have the spatial or temporal resolution needed for shellfish stock assessments, they may be useful for planning shellfish surveys. The principle advantage of the new modeling approach is that disparate, independent sets of existing data were sufficient to produce and validate maps of habitat suitability for five species of bay clams.

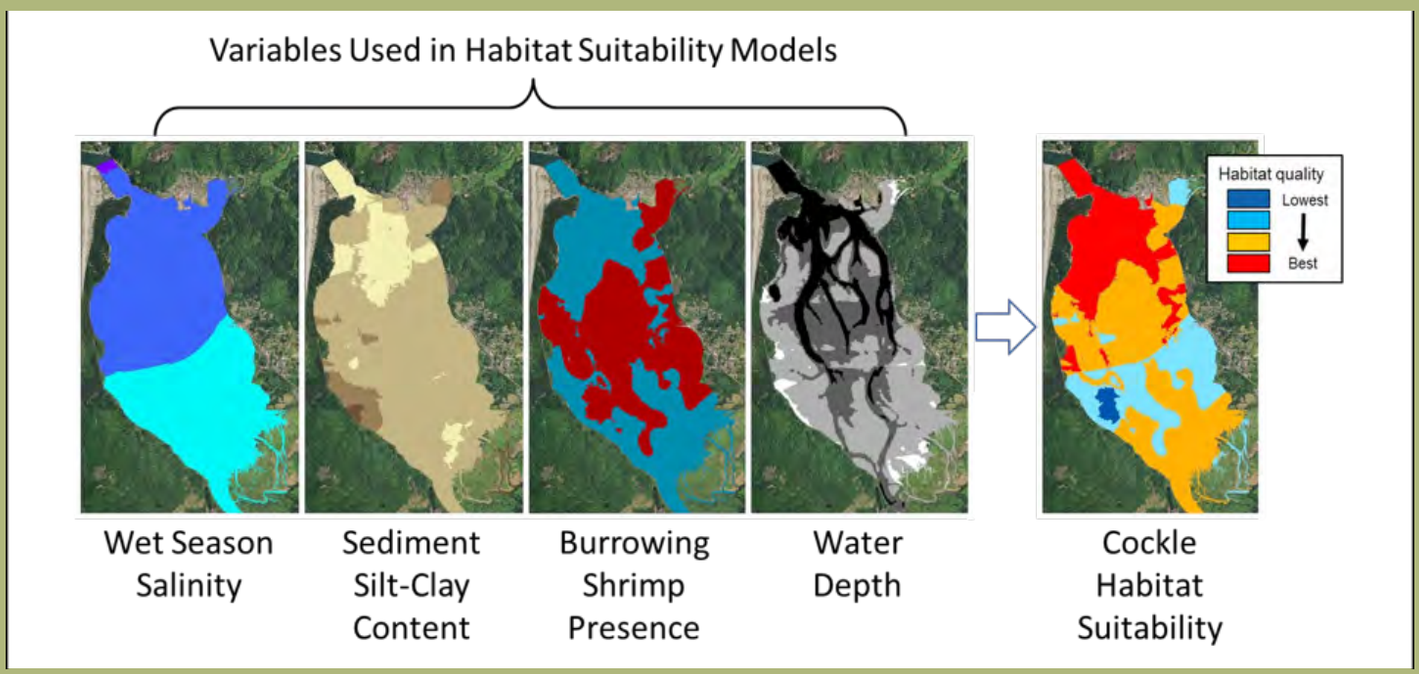
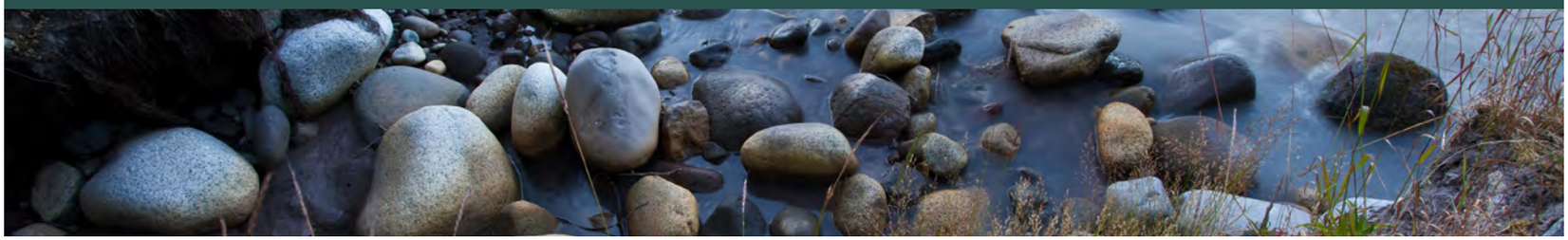


Illustration of the habitat variable data sets that were used by US EPA to produce habitat suitability models and maps for bay clams in Tillamook Bay.

UNDERSTANDING ENVIRONMENTAL DRIVERS OF FECAL COLIFORM LEVELS IN TILLAMOOK ESTUARY FOR IMPROVED DECISION-MAKING ON SHELLFISH HARVEST AREA CLOSURE**

Tillamook River Watershed – EPA (WAQ-01, -05, CEE-04, -05)



Statistical modeling efforts applied in this work improved water quality attainment estimations and understanding of drivers of water quality, providing a framework for shellfish managers to utilize historical data for improved management of Pacific Northwest (PNW) shellfish-harvesting waters. Oregon Department of Agriculture (ODA) bases harvest closure decisions on river flow and precipitation, which works well during wet seasons when runoff may carry fecal bacteria from urban or agricultural sources into shellfish growing areas. However, these environmental variables do not predict elevated fecal bacteria levels well during dry, summer months at peak shellfish-harvesting season. EPA, in collaboration with ODA, developed models to characterize environmental conditions indicative of unsafe levels of fecal bacteria within Tillamook Bay. The models incorporated environmental drivers (such as rainfall, wind strength, temperature, river discharge, tide stage) associated with changes in the fecal bacteria concentrations at several locations within the estuary using ODA's bacterial data. Analysis revealed seasonal and locational differences of which environmental drivers had the greatest influence on bacterial levels. Consequently, under a given set of environmental conditions, some parts of the estuary might not require harvest closure, whereas others would. High precipitation and river discharge lead to elevated bacteria levels during wet months (October–May), as expected. During the dry season (June–September), this research indicates elevated bacterial levels were associated with strong winds and tidal extremes. These models can be used to inform ODA's approach to shellfish harvest closures and improve the effectiveness of future bacterial monitoring efforts.

Leo Adams' years of dedication to TEP programs created immeasurable results in our community and made a lasting impression on the hearts of those with whom he worked. Every other week for 21 years, he collected water samples from the Trask River and Mill Creek—that's over 11 million water droplets! Leo dedicated time to TEP's native plant nursery and our education programs and volunteered with many partners. In gratitude for Leo's gifts and time, TEP awarded him the 2019 Jim Mundell Environmental Stewardship Award posthumously to recognize his efforts.

Community Engagement

Increasing community understanding, acceptance, involvement, and well-being while supporting environmental protection

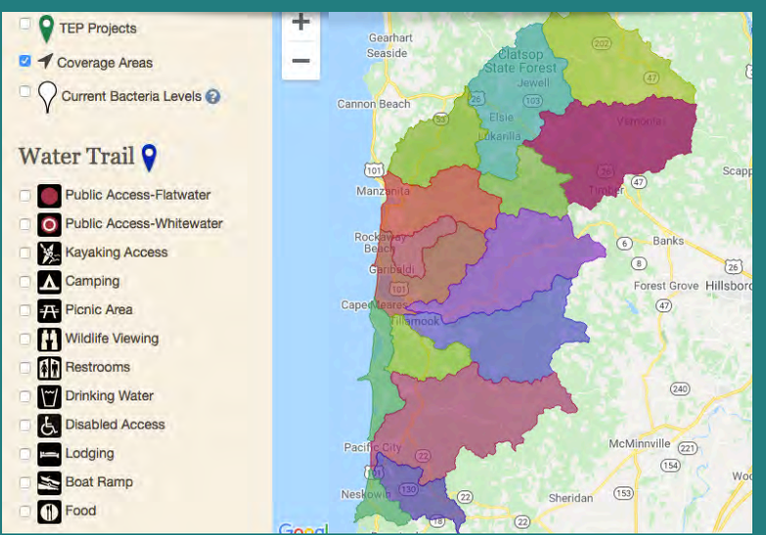
VOLUNTEER WATER QUALITY MANAGEMENT PROGRAM

Tillamook County – TEP (WAQ-05, CEE-04)

In 1997, TEP began monitoring E. coli in the Tillamook Bay watershed to evaluate rivers and streams for bacterial contamination. Today, the program includes all six Tillamook County estuaries and lower watersheds.

Citizen science volunteers adopt a local sampling route and collect water samples at 75 established monitoring locations twice a month, year-round. Involving local volunteers with a stake in watershed health cultivates community environmental stewardship and, with their observations and experiences, helps us identify opportunities for habitat improvement. Currently, 10 volunteers–some involved for 20 years or more–collect samples throughout the county and many are TEP's biggest advocates.

Data are used to document changes in water quality; trend data can point to potential habitat restoration projects and provides important monitoring information after project implementation. The most recent data is available to communities through an online interactive map that allows citizens to review water quality before swimming, paddling, fishing, or crabbing in their favorite location.



~8,725 water samples

16 volunteers since 1997, currently 10

~2,300 volunteer hours

EXPLORE NATURE

Tillamook County – (CEE-03, -04, -05)

Representing a collaborative effort of eight local non-profit organizations, Explore Nature, provides meaningful activities showcasing the unique qualities of Tillamook County and our work to conserve the area's natural resources, restore biodiversity, and preserve natural resource-based industries.

Hosting events throughout Tillamook County, Explore Nature activities include guided hikes, walks, paddles, and stewardship opportunities designed for and marketed to both visitors and community members. We believe our passion will inspire others to love and protect Tillamook County as we do. Our goal is to encourage a stewardship mindset that fosters positive interactions with our natural areas and reduces impact on the environment. From 16 events in the inaugural 2016 season to 86 events in 2019, Explore Nature has extended both engagement and reach. Since the first *Kayak Netarts Bay* event, the Explore Nature program has hosted 220+ events with 4,020 total attendees, 68% of whom are local to Tillamook County.

ESTUARY SCIENCE SYMPOSIUM

TEP (CEE-02, -03, -04)

Initiated as part of TEP's 25th anniversary, the first Estuary Science Symposium brought together scientists and community to share information related to research and monitoring projects in Tillamook County– from monitoring water quality, shellfish, nutrient and bacterial inputs to lost habitats, ecosystem services, and contemporary forest management impacts on aquatic ecosystems. The symposium was an opportunity to learn about active projects, network, and create collaborations. TEP plans to make this an ongoing event—look for the next gathering in 2021.

MT. ADAMS INSTITUTE VETSWORK: ENVIRONMENT PROGRAM (CEE-02)

Through VetsWork, military veterans participate in an eleven-month Americorps career development internship program in natural resources management, public lands, and the environmental sector. Vets provide project support while gaining work experience and exploring potential career paths. TEP has enjoyed hosting VetsWork interns in 2019 and 2020.

Education

creating early awareness and potential long-term support

CHILDREN'S CLEAN WATER FESTIVAL

TEP (CEE-01, -04)

Since 2001, TEP hosted 18 Clean Water Festivals bringing in partners, community organizations, and volunteers from throughout northwest Oregon. Demonstrating the significance of clean water for the environment, wildlife, and people, volunteers lead Tillamook County's 4th graders through a series of activities during this experiential field trip. Students take an Incredible Journey "becoming" water droplets and explore a local wetland, identifying aquatic insects and plants.

300 students annually

30 teachers annually

75 volunteers annually

DOWN BY THE RIVERSIDE

TEP (CEE-01, -04)

Build-a-Bug, Migration Headache, Chips & Dips, and Riparian Art are hallmark activities of this outdoor, environmental science focused field trip for Tillamook County's 3rd graders. Students learn about aquatic macro-invertebrate adaptations, native and invasive plants, habitat use, and environmental stewardship. Each year since 2002, students from Tillamook County public school districts, private schools, and home school programs enjoyed a day of hands-on learning centered on the different habitats of an ecologically and culturally important stream.

275 students annually

25 teachers annually

60 volunteers annually

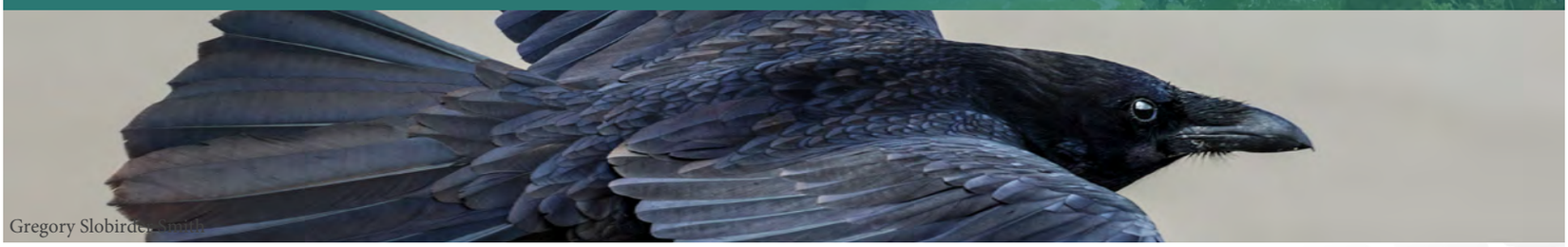
TILLAMOOK COUNTY STEM

TEP (CEE-02, -03, -04)

TC STEM vision is that all students in the county have equal access to high-quality, hands-on, inquiry-based Science, Technology, Engineering, and Math (STEM) field and classroom programs that promote real-world problem solving.

In the early 2000s, TC STEM, a collaborative effort among Tillamook County organizations, increased efforts to provide students with outdoor experiences focused on environmental science and stewardship. Since the early days of Children's Clean Water Festival and Day at the Bay, partners worked to help students create a sense of place, increase environmental and STEM literacy, and lay a foundation for a stewardship ethic. Building on early successes, partners now offer more than 20 programs annually. Recognizing that programs were not reaching all Tillamook County students, the TC STEM Partnership was formalized in 2019 to expand participation to include all K–8 students in Tillamook County and increase the capacity of partner organizations.

The TC STEM is expanding programming, evaluating current programs and barriers, developing a well-trained network of Science Coaches, and creating new partnerships within the community.



Gregory Slobirds Smith

2019 accomplishments include:

23 Inquiry-based STEM education programs offered. All TSD K–8 students participate in programs annually.

2 Venues stocked with program materials available by reservation

2 County-wide Field Trips

New partnerships with TBCC and OSU Open Campus

Upcoming Projects– PRIORITY 2020–2024

PETERSON CREEK

Miami River Watershed -TEP and Tillamook County (HAB-07, -09, -10, WAQ-03, -04)

Peterson Creek bridge at the Miami River confluence during culvert removal in July 2020.

The temporary bridge allows dismantling of the original infilled roadbed and culvert shown here. After culvert removal and final grading along Peterson Creek's edge, the new bridge will be above the confluence. A priority location for The Salmon Superhwy, this configuration reconnects approximately six miles of habitat upstream from the Miami River.

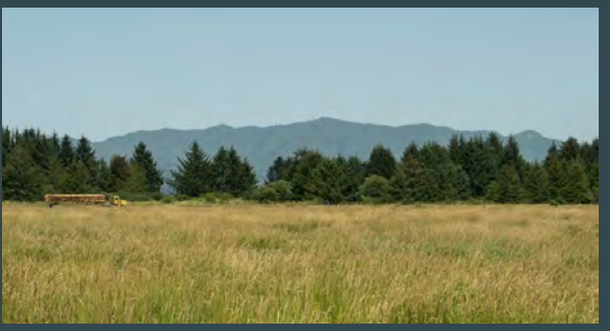
(photo credit Trav Williams, Broken Banjo Photography)

~~ *Mabardy, R. A. et al. (2015) 'Perception and Response of the U.S. West Coast Shellfish Industry to Ocean Acidification: The Voice of the Canaries in the Coal Mine', Journal of Shellfish Research, 34(2), pp. 565–572. doi: 10.2983/035.034.0241.*

TILLAMOOK RIVER WETLANDS

Tillamook River Watershed – TEP (HAB-01, -03, -04, -06, 09, -10, -11, -12, WAQ-03, 04)

TRW is in the conceptual design phase. With the feasibility study complete and acquisition accomplished by North Coast Land Conservancy (NCLC) in July 2020, TRW is underway. This 73-acre parcel of tidal wetland is separated from the Tillamook River by four tide gates and Burton-Fraser Road. It has three-quarters of a mile of road frontage and is currently dominated by non-native reed canary grass. Built on 90 feet of tidal mud, Burton-Fraser Road is overtopped by nine-foot tides–even in calm weather. Considered an emergency egress road, its structural integrity is failing, and the probability of withstanding a tsunami or earthquake to provide an evacuation route is low. The primary alternative design proposes to realign the road by upgrading another existing road that connects the same areas of Netarts and Tillamook. This option will benefit community infrastructure and emergency access while reconnecting TRW to tidal influence and facilitating reestablishment of salmon rearing habitat and native plant communities.



TRW reed canary grass meadow – the logging truck is moving east on Burton-Fraser Road.

TILLAMOOK BAY COASTAL ACIDIFICATION MONITORING ~~

Tillamook Bay – EPA (WAQ-05)

Since 2017, US EPA's Pacific Coastal Ecology Branch (PCEB) studied coastal acidification dynamics in Tillamook Bay. Coastal acidification is broadly defined as the lowering of pH in coastal ocean and estuarine waters as a result of human activities, including fossil fuel combustion, land-use change, and eutrophication. Despite documented impact on shellfish aquaculture industry productivity, relatively little work was done to understand process dynamics in west coast estuaries. Over half of industry stakeholders, including Whiskey Creek Shellfish Hatchery in Netarts Bay, stated coastal acidification affects their business (Mabardy et al., 2015). As an estuary of national significance, Tillamook Bay is home to extensive shellfish aquaculture and agricultural industries. PCEB's research, therefore, focuses on quantifying magnitude, frequency, and location of reductions in water quality due to coastal acidification.

Multiple water quality monitoring stations, including a station at the Garibaldi Dock (pictured), monitor acidity and oxygen levels in Tillamook Bay. These monitoring stations autonomously record measurements multiple times every hour providing quality data to help researchers understand the causes of acidification in Tillamook Bay. In collaboration with the USDA, juvenile Pacific oysters are grown alongside the chemical sensors to understand how the bay's acidity levels impact the growth and development of this commercially important species. A statistical model built from these results will be used to assess juvenile Pacific oyster growth rates relative to chemical conditions in the bay and identifies a means of integrating biological monitoring into existing acidification monitoring efforts. In conjunction with other projects in the Tillamook area, this research helps to inform the effectiveness of potential management strategies for improving water quality, as well as maintaining successful

Sensors measure acidity and CO_2, dissolved oxygen, chlorophyll a, temperature, salinity, and water depth.

recreational and commercial fisheries, in Tillamook Bay. Results from this monitoring program, the first of its kind in Oregon, contribute to improved acidification monitoring in estuaries around the United States. The project also served as an educational opportunity with multiple internships through the EPA, TEP, Oregon Sea Grant, and OSU.

ESTUARY EXPLORATION AND EDUCATION CENTER AND LAB

TEP (CEE-03, -04, -05)

Phase 1 of a recently completed feasibility analysis indicates an estuarine education and interpretive center will benefit the community, align with destination management objectives, and support TEP's organizational mission. The new facility will include office space, lab facilities, a conference room, and an educational interpretative center.

Phase 2—siting assessment for the new facility (whether new construction or renovation), design plans, obstacles and opportunities—is underway. The Center's proposed program would include information on estuarine science, the importance of restoration, and the ocean/estuarine economy. The study will be completed in 2021; development plans will be driven by the results.

ACKNOWLEDGEMENTS AND PARTNERS

Following is a list of major supporters who have been involved in the projects and programs described in this report. TEP's supporters are too extensive to include herein, so we extend our heartfelt gratitude to the many stakeholders, technical advisors, grantors, donors, project partners, volunteers, and members of the community who support our work. We thoroughly appreciate the time, effort, and thoughtfulness of those who contribute to TEP's mission to conserve and restore Tillamook County's estuaries and watersheds. We sincerely apologize for any unintentional omissions or errors.

Arbor Day Foundation
Association of National Estuary Programs
Building Conservation Trust
Bureau of Land Management
Cascade Pacific Resource Conservation and Development
City of Bay City
City of Tillamook
Ecotrust
Encore Fellowship Program
Environmental Protection Agency
Friends of Cape Falcon Marine Reserve
Friends of Netarts Bay WEBS
Gray Family Foundation
Gregory S Cermak and Melody L Oakley Fund for Disabilities, Education and the Environment
Institute for Applied Ecology
John Goche
John Robinson
Jubitz Foundation
Lower Nehalem Community Trust
Lower Nehalem Watershed Council
Meyer Memorial Trust
Mt. Adams Institute
National Fish and Wildlife Foundation
National Oceanic and Atmospheric Administration
National Park Service
Necanicum Watershed Council
Nestucca Neskowin and Sand Lake Watershed Councils
North Coast Land Conservancy
Oregon Community Foundation
Oregon Department of Environmental Quality
Oregon Department of Fish and Wildlife
Oregon Department of Fish and Wildlife - Restoration and Enhancement Program
Oregon Department of Forestry
Oregon Parks and Recreation Department
Oregon State Marine Board
Oregon State University
Oregon Watershed Enhancement Board
Oregon Wildlife Foundation
Oregon Youth Authority
Pacific States Marine Fisheries Commission
Port of Garibaldi
Port of Tillamook Bay
Salmon Superhighway
Siuslaw Collaborative Watershed Restoration Program
Telenations/MediaTree
The Nature Conservancy
Tillamook Bay Flood Improvement District
Tillamook Bay Watershed Council
Tillamook County
Tillamook County Creamery Association
Tillamook County Cultural Coalition
Tillamook County Soil and Water Conservation District
Tillamook Public Utility District
Travel Oregon
Trout Unlimited
Twin Rocks Friends Camp
United States Fish and Wildlife Service
United States Forest Service
University of Oregon
Visit Tillamook Coast

WWW.TBNEP.ORG

TEP STAFF
Kristi Foster, *Executive Director*
Claudine Rehn, *Deputy Director*
York Johnson, *Water Resources Manager*
David Harris, *Habitat Enhancement Team Leader*
Maysa Miller, *Native Plant Nursery Coordinator*
Alix Lee, *Community Education and Engagement Coordinator*
Tamara Enz, *Habitat Assessment and Monitoring Coordinator*
Bruce Cardin, *Education Event Assistant*
Debra Grace, *Administrative Assistant*

VETSWORK FELLOWS
Christopher Sutherland
Gina Kennedy

TEP BOARD MEMBERS
Liane Welch, *President*
Nancy Hoffman, *Vice President*
Derek Wiley, *Secretary/Treasurer*
Directors: Chris Knutsen, David Johnson, Kurt Heckeroth, Valerie Hendon, Amy Bennett, Sarah Absher

EPA STAFF Nancy Laurson, Peter Murchie, Joel Salter, Yvonne Vallette

CONTRIBUTING RESEARCHERS AND WRITERS FOR THIS STATE OF THE BAYS REPORT
Christopher Janousek, Stan van de Wetering, Scott Bridgham, Laura Brophy, Erin Peck, Laura Brown, Michael Ewald, Ted DeWitt, Cheryl Brown, Steve Pacella, Jim Kaldy, Sarah Zwissler, Chrissy Smith, Zac Mallon, Garshaw Imidi-Abraham, York Johnson, Alix Lee, Tamara Enz

ABBREVIATIONS AND ACRONYMS
EPA – Environmental Protection Agency
LNWC – Lower Nehalem Watershed Council
NCLC – North Coast Land Conservancy
NNSLWC – Nestucca Neskowin Sand Lake Watersheds Council NORP – Northwest Oregon Restoration Partnership
ODA – Oregon Department of Agriculture
OPRD – Oregon Parks & Recreation Department
OSU – Oregon State University
OYA – Oregon Youth Authority
PCEB – Pacific Coastal Ecology Branch
SFC – Southern Flow Corridor – Landowner Preferred Alternative
TBWC – Tillamook Bay Watershed Council
TC STEM – Tillamook County Science Technology Engineering & Math Partnership
TEP – Tillamook Estuaries Partnership
TU – Trout Unlimited
USDA – US Department of Agriculture
USFS – US Forest Service
USGS – US Geologic Survey
VWQMP – Volunteer Water Quality Management Program
WEBS – Friends of Netarts Bay Water, Beach, and Sea

Tillamook Estuaries Partnership
503-322-2222 | P.O. Box 493 | 613 Commercial Street Garibaldi, Oregon 97118