This document contains overall and specific condition of the Tillamook Estuaries Partnership from the National Estuary Program Coastal Condition Report. The entire report can be downloaded from
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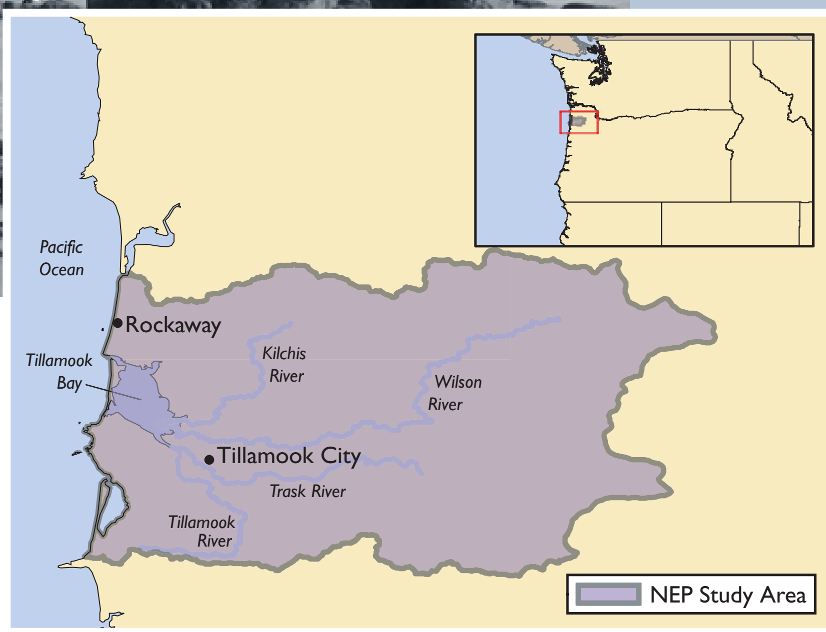
National Estuary Program Coastal Condition Report

Chapter 6: West Coast National Estuary Program Coastal Condition, Tillamook Estuaries Partnership

June 2007

Tillamook Estuaries Partnership



Tillamook Estuaries Partnership
A National Estuary Project

www.tbnep.org

Background

Although it is Oregon's second-largest estuary, Tillamook Bay is relatively small (approximately 13 mi^2) and shallow (average depth of 6 feet) compared to other NEP estuaries. Located on Oregon's northern coast, Tillamook Bay is part of a coastal, temperate rainforest ecosystem. Annual precipitation averages 90 inches in the lower basin and close to 200 inches in the uplands. This rainfall supplies fresh water to the basin's five major rivers (Tillamook, Trask, Wilson, Kilchis, and Miami), which drain a 597-mi^2 watershed that includes some of North America's richest timber and dairy lands (TBNEP, 1999). Known as the "land of cheese, trees, and ocean breeze," Tillamook County boasts a greater population of cows than people and is dominated by federal, state, and private forest land, which comprises almost 90% of the county (TBNEP, 1998). Tillamook Bay supports an oyster aquaculture industry, a commercial/recreational port, and a recreational salmon fishery (TBNEP, 1999).

Historically dependent on resource-extraction industries, the local economy of Tillamook County increasingly relies on tourism and transfer payments to provide for the county's 25,000 citizens (TBNEP, 1999). The county's median household income is well below the state average and was only 80% of the national average in 2002 (U.S. Census Bureau, 2006). Although the service sector is expanding because of tourism and a growing population of retirees, dairy farming, logging, and fishing still define the cultural landscape of the area (TBNEP, 1999).

By the early 1990s, local citizens began to voice concerns about the basin's declining natural resources. Loss of spawning and rearing habitat had reduced salmon runs, and decreasing water quality regularly violated federal water quality standards and led to closures of commercial shellfish beds. Erosion and sediment deposition, combined with development in the floodplain, exacerbated water quality issues and habitat degradation while increasing the magnitude and frequency of flood events. To reverse these trends, the Tillamook Estuaries Partnership (TEP) undertook five years of research, public outreach, and policy analysis, resulting in completion of the *"Restoring the Balance": Comprehensive Conservation and Management Plan for Tillamook Bay, Oregon* in 1999 (TBNEP, 1999). The TEP implements its CCMP under three program areas: habitat enhancement, education, and research and monitoring. The TEP also supports partner-led projects through its Local Grant Program.

Environmental Concerns

The most significant environmental problems in the Tillamook Bay watershed are habitat loss and simplification, water quality, erosion and sedimentation, and flooding, and the TEP researched and characterized these problems during its CCMP development. The Tillamook Bay basin has lost almost 85% of its historical intertidal wetlands to agricultural and urban development (TBNEP, 1999). In addition, populations of four of the five anadromous salmonid species (coho and chum salmon, steelhead and cutthroat trout) have dramatically decreased from historical levels. Loss of spawning and rearing habitats are the major contributors to the declining populations. None of Tillamook County's major watersheds meets the Clean Water Act standards established by EPA and ODEQ, and bacterial contamination and elevated water temperatures are the two parameters of highest priority. The flood of 1996, as well as the many floods that came before it, displaced residents and caused major environmental degradation and millions of dollars in property damage. Loss of floodplain function and stream complexity are the key contributors to increased flooding and are a focus of the TEP's enhancement efforts (TBNEP, 1999).

Population Pressures

The population of the NOAA-designated coastal county (Tillamook) coincident with the TEP study area increased by only 28% during a 40-year period, from 18,955 people in 1960 to 24,262 people in 2000 (Figure 6-25) (U.S. Census Bureau, 1991; 2001). This rate of population growth for the TEP study area was one of the lowest rates of population growth for the West Coast NEPs, and only one-fourth the population growth rate of 100.3% for the collective NEP-coincident coastal counties of the West Coast region. Tillamook County also had the lowest population density (22 persons/mi^2) of any of the West Coast NEPs (U.S. Census Bureau, 2001). This estuary is not surrounded by the large metropolitan areas that are characteristic of some West Coast NEP estuaries, such as Puget Sound or the San Francisco Estuary.

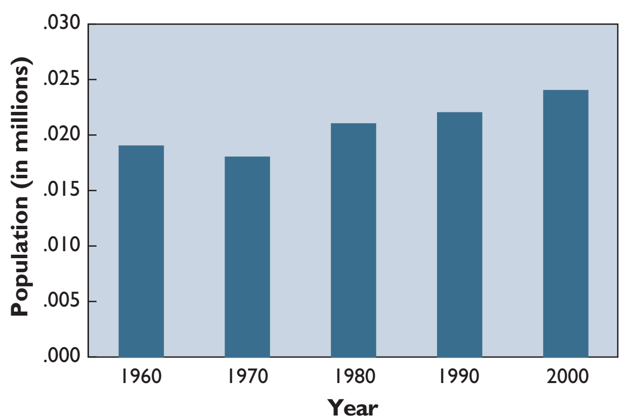


Figure 6-25. Population of NOAA-designated coastal county of the TEP study area, 1960–2000 (U.S. Census Bureau, 1991; 2001).

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NCA Indices of Estuarine Condition—Tillamook Bay

The overall condition of Tillamook Bay is rated good based on the four indices of estuarine condition used by the NCA (Figure 6-26). The water quality index is rated fair, and the sediment quality, benthic, and fish tissue contaminants indices are rated good. Figure 6-27 provides a summary of the percentage of estuarine area rated good, fair, poor, or missing for each parameter considered. This assessment is based on data collected by ODEQ from 29 stations sampled in 1999. Please refer to Tables 1-24, 1-25, and 1-26 (Chapter 1) for a summary of the criteria used to develop the rating for each index and component indicator.

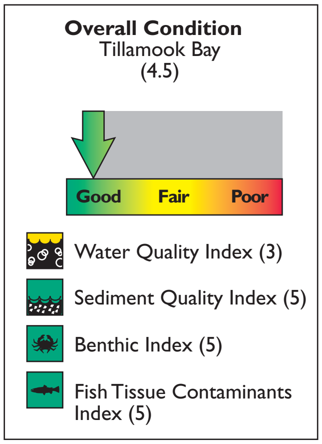

Figure 6-26. The overall condition of the TEP estuarine area is good (U.S. EPA/NCA).

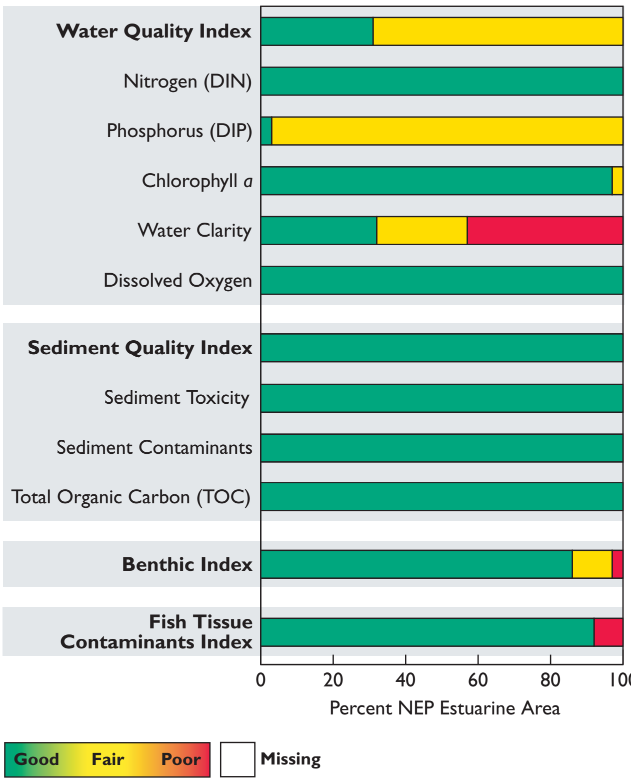

Figure 6-27. Percentage of NEP estuarine area achieving each ranking for all indices and component indicators — Tillamook Bay (U.S. EPA/NCA).

Water Quality Index

Based on NCA survey results, the water quality index for Tillamook Bay is rated fair. This index was developed using NCA data on five component indicators: DIN, DIP, chlorophyll *a*, water clarity, and dissolved oxygen. Most (69%) of the estuarine area was rated fair because of limited water clarity and moderate levels of DIP (Figure 6-28).

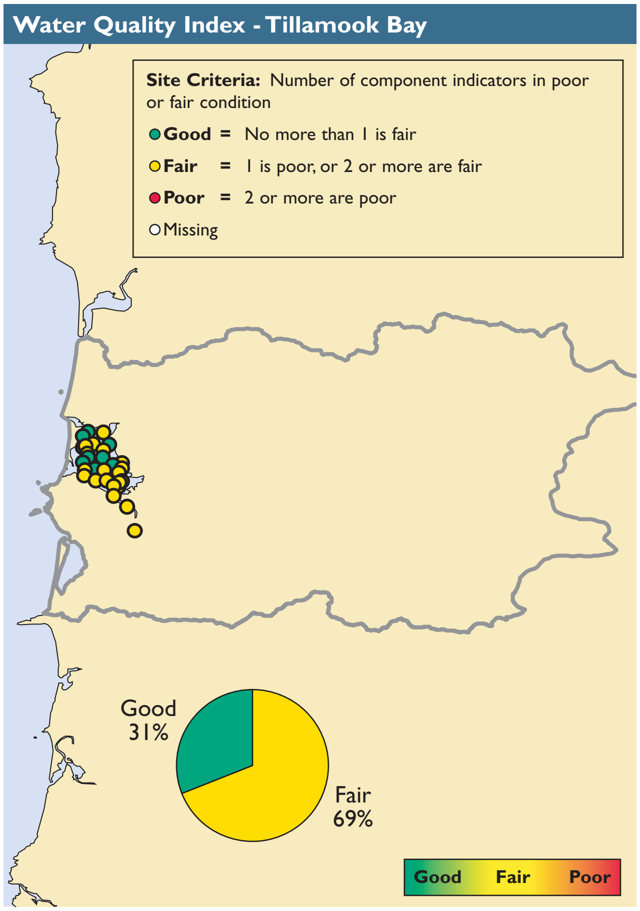

Figure 6-28. Water quality index data for Tillamook Bay, 1999 (U.S. EPA/NCA).

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Dissolved Nitrogen and Phosphorus | Tillamook Bay is rated good for DIN concentrations and fair for DIP concentrations. Concentrations of DIN were rated good in 100% of the estuarine area, and DIP concentrations were rated fair in 97% of the area.

Chlorophyll a | Chlorophyll *a* concentrations in Tillamook Bay are rated good. Three percent of the estuarine area was rated fair for this component indicator, with the remainder of the area (97%) rated good. None of the TEP estuarine area was rated poor for chlorophyll *a* concentrations.

Water Clarity | Water clarity in Tillamook Bay is rated poor. Approximately 43% of estuarine area was rated poor for this component indicator, and 25% of the area was rated fair.

Dissolved Oxygen | Dissolved oxygen conditions in Tillamook Bay are rated good, with 100% of the estuarine area rated good for this component indicator. Although conditions in Tillamook Bay appear to be generally good for dissolved oxygen, measured values reflect daytime conditions, and some areas of the Bay may still experience hypoxic conditions at night.

Fishing for Chinook salmon is popular in Tillamook Bay (TEP).

Sediment Quality Index

The sediment quality index for Tillamook Bay is rated good (Figure 6-29). This index was developed using NCA data on three component indicators: sediment toxicity, sediment contaminants, and sediment TOC. No area of the Bay exceeded thresholds for any of these component indicators.

Sediment Toxicity | Sediment toxicity for Tillamook Bay is rated good, with none of the estuarine area rated poor for this component indicator.

Sediment Contaminants | Tillamook Bay is rated good for sediment contaminant concentrations, with 100% of the estuarine area rated good for this component indicator.

Total Organic Carbon | Tillamook Bay is rated good for TOC concentrations, with 100% of the estuarine area rated good for this component indicator.

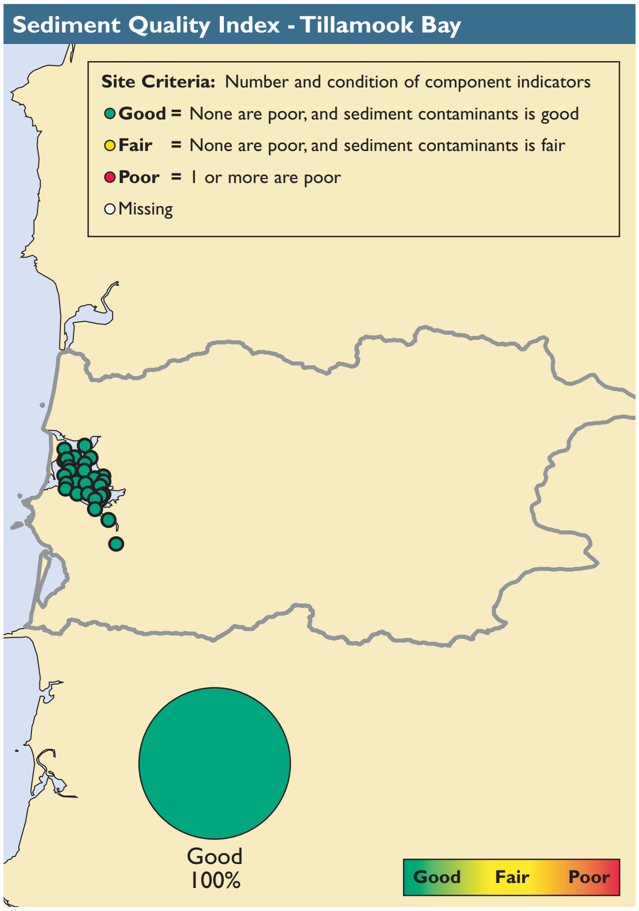

Figure 6-29. Sediment quality index data for Tillamook Bay, 1999 (U.S. EPA/NCA).

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Benthic Index

The condition of the benthic invertebrate communities in Tillamook Bay is rated good based on deviations from the expected species richness (Figure 6-30). This analysis was based on 28 benthic samples collected during 1999. A significant linear regression between log species richness and salinity was found in Tillamook Bay, although it was not strong ($r^2 = 0.31$, $p < 0.01$). One site, representing about 3% of the estuarine area, was rated poor based on a lower-than-predicted species richness. The cause for the less-than-expected species richness at this site is not readily apparent because no sediment ERMs were exceeded, only three ERLs were exceeded, and TOC concentrations were within the range found in the Bay. Another three sites, representing 11% of the estuarine area, were rated fair, and 24 sites, representing 86% of the area, were rated good.

Fish Tissue Contaminants Index

This fish tissue contaminants index for Tillamook Bay is rated good (Figure 6-31), with only 8% of all stations sampled where fish were caught exceeding EPA Advisory Guidance values for whole-fish contaminant concentrations. These risk calculations are appropriate for populations that consume whole fish. The contaminant found most often in fish tissues from Tillamook Bay was total PCBs.

Sediment Contaminant Criteria (Long et al., 1995)

ERM (Effects Range Median)—Determined for each chemical as the 50th percentile (median) in a database of ascending concentrations associated with adverse biological effects.

ERL (Effects Range Low)—Determined for each chemical as the 10th percentile in a database of ascending concentrations associated with adverse biological effects.

Benthic Index - Tillamook Bay

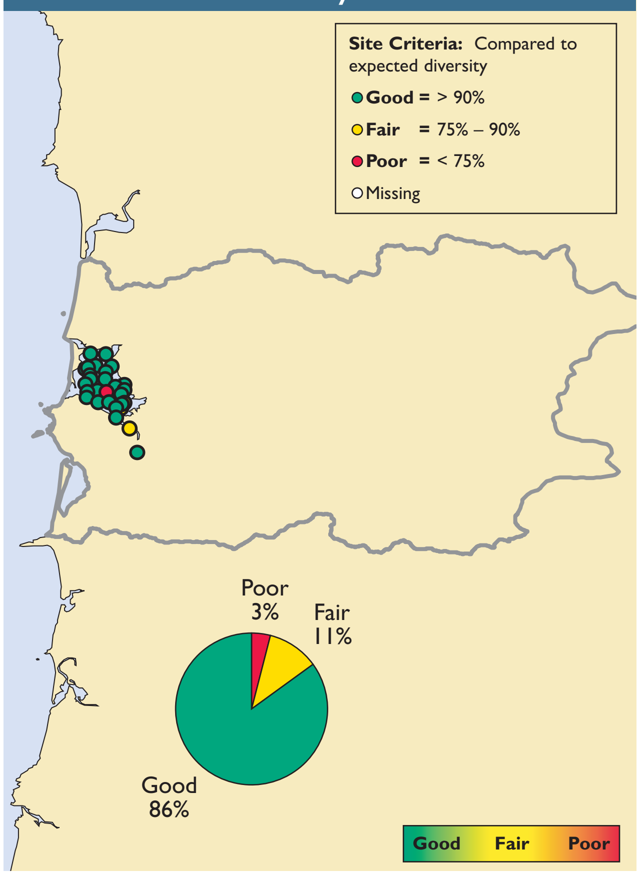

Figure 6-30. Benthic index data for Tillamook Bay, 1999 (U.S. EPA/NCA).

Fish Tissue Contaminants Index - Tillamook Bay

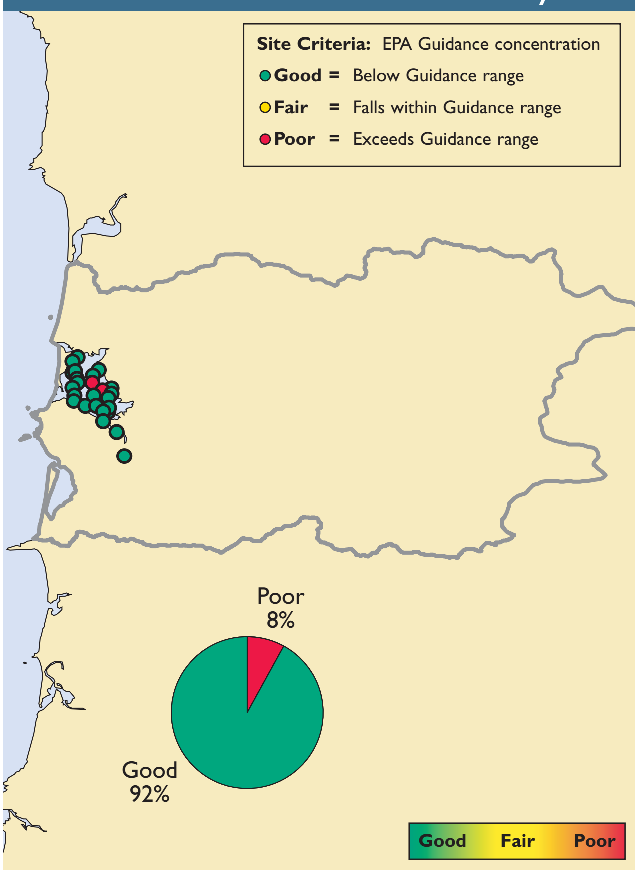

Figure 6-31. Fish tissue contaminants index data for Tillamook Bay, 1999 (U.S. EPA/NCA).

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Addressing Bacterial Contamination in Tillamook Bay

The driving force behind Tillamook Bay's nomination to the NEP was bacterial contamination. Inputs of fecal coliform bacteria have resulted in frequent water quality standard exceedences in the Bay's tributaries and periodic closures of the Bay's oyster shellfishing industry (Sullivan et al., 2005). To combat this problem, the TEP has initiated an innovative monitoring strategy to answer three key questions relating to bacteria in the Bay and its watershed:

1. Is bacteria loading to the lower reaches of the Bay's tributary rivers increasing or decreasing over timescales of years to decades?

2. Where, how often, and for what length of time does each of the Bay's five major tributary rivers violate state water quality standards for bacteria?

3. What are the sources of the contamination, and how much pollution do they contribute?

The TEP has instituted two complementary monitoring approaches to try and answer these questions: the Storm-Based Monitoring Program and the Volunteer Monitoring Program. In addition, the TEP has partnered with Oregon State University to embark on a complementary three-year Genetic Marker Study.

The Storm-Based Monitoring Program measured fecal coliform bacteria concentrations and loads (as well as other water quality parameters) to the Bay during storm events. Between 1996 and 2002, the program monitored approximately 28 separate storms on the Bay's five tributary rivers. Results of this effort included the following insights: (1) fall storm events exhibited the highest levels of bacterial loading to the Bay; (2) bacteria concentrations increased dramatically during storm events, but varied greatly among the Bay's five rivers; (3) bacteria concentrations measured in the rivers appeared to be strongly influenced by precipitation patterns prior to a storm and by rainfall intensity during the storm; and (4) drier conditions prior to a storm and greater rainfall during a storm generally resulted in higher bacteria concentrations in the rivers (Sullivan et al., 2002).

In addition to the initial set of storm-sampling sites, the Storm-Based Monitoring Program also conducted an intensive storm-monitoring effort during a two-year period on two river reaches identified as major bacteria-contributing areas. Potential bacteria sources were documented and mapped using photos, global positioning systems (GPSs), and field surveys to attempt to link bacteria concentration spikes to likely sources. Results of this effort are being used to identify those source areas that appear to be the largest bacteria contributors to the rivers and to prioritize the areas for corrective action (Sullivan et al., 2002).

Since 1995, participants in TEP's Volunteer Monitoring Program have braved wind, rain, sleet, and occasional sun to collect water samples from 37 sites across all 5 of the major tributaries entering Tillamook Bay. Monitoring results from this effort are entered into a long-term database that is shared with both local and state partners (TEP, 2006b). This information assisted in the development of a bacteria TMDL (ODEQ, 2001) for the watershed and has guided the TEP's process to prioritize sites for enhancement. Results of the Volunteer Monitoring Program revealed the following insights: all five of Tillamook Bay's main tributary rivers routinely violate Oregon's bacteria water quality standard for water contact recreation; bacteria concentrations peak during the summer low-water period and during some fall, winter, and spring storms; and the Tillamook River routinely has the highest bacteria concentrations of the five rivers (ODEQ, 2001).

Because bacterial contamination is largely a problem resulting from non-point source pollution, researchers are searching for new methods to differentiate among potential sources, such as manure from pastures, failing septic systems, and STP overflows. A joint study by Oregon State University and the TEP seeks to identify bacteria sources by detecting genetic marker sequences that are specific to the host species that produced the feces. The intent of the study is to enable researchers to discriminate among human, cow, domestic pet, waterfowl, and other wildlife bacteria sources. Preliminary results indicate that ruminants (e.g., cows, elk) are a source of widespread bacterial contamination and that human contributions to the contamination in some river segments are also significant (TEP, 2006b).

The results of these efforts have led the TEP to undertake several priority projects to reduce bacterial contamination in the Bay. In collaboration with the Tillamook County On-Site Sanitation Division, private septic systems in the watershed will be inspected and repaired as needed. The City of Tillamook has recently completed a Stormwater Management Plan that will identify measures to reduce bacterial loading and other contaminants. In addition, a buffer-strip effectiveness study is testing an experimental demonstration buffer strip to determine its effectiveness in removing bacteria from pasture runoff and help select BMPs for manure management. Finally, a pilot project has begun to develop and implement performance-based policies for agriculture to meet or exceed water quality standards in the lower Tillamook Bay basin (TEP, 2006b).

A volunteer collects a plankton sample in Tillamock Bay (TEP).

Tillamook Estuaries Partnership Indices of Estuarine Condition

The TEP has developed a set of environmental indicators to assess water quality, habitat extent, and the status of living resources in Tillamook Bay. Each of the draft indicators is tied to objectives/goals from the TEP's CCMP and seek to answer one of the TEP's focus questions. For example, the number of stream miles opened through fish passage enhancement projects measures progress towards the CCMP goal of enhancing 100 miles of upland instream habitat by 2010 and determines whether more freshwater habitat is becoming available to native salmon and trout (TEP, 2004).

Water and Sediment Quality

Although not part of the NCA's water quality index, bacterial contamination is the priority water quality issue in Tillamook Bay and its tributaries (TBNEP, 1999). Sewer outfalls, leaking or malfunctioning septic tanks, and runoff from the watershed's dairy farms contribute fecal coliform bacteria to the Bay. Although bacterial loading has increased historically as farming and development in the area increased, recent monitoring has shown improving trends in some river reaches (TEP, 2006a). This is likely due to the implementation of the TEP's CCMP. The TEP indicators for water quality include ongoing monitoring in the Bay and tributaries to continue tracking changes in fecal coliform bacteria concentrations (TEP, 2004).

Dissolved oxygen concentrations and rises in stream temperatures are also major water quality concerns in the TEP study area (TEP, 2006a). Eutrophication and low dissolved oxygen concentrations have not been a problem in Tillamook Bay proper; however, low dissolved oxygen levels have been observed in some of the Bay's lowland sloughs and tributaries (TBNEP, 1999). Although the NCA data noted good dissolved oxygen concentrations throughout the Bay, the NCA sampling sites were primarily located in the main portion of the Bay. The TEP is working with ODEQ to further evaluate the extent and impact of low dissolved oxygen levels in Tillamook Bay sloughs. Low water temperatures in the Bay's streams are important for maintaining the area's salmon habitat; however, water temperatures in the Wilson, Trask, and Tillamook rivers

Dairy herds are a prominent agricultural use of land in Tillamook County (TEP).

have exceeded water quality standards for temperature (TBNEP, 1999). The TEP's indicators include monitoring water temperature in streams and dissolved oxygen levels in sloughs (TEP, 2004).

Habitat Quality

Maintaining and improving the habitats necessary to support this estuary's declining salmonid populations is an important priority for the TEP. Healthy freshwater and riparian habitats are important for maintaining low water temperatures and for providing spawning grounds for salmonids, whose young need salt marshes, tidal channels, and eelgrass beds for food and protection (TEP, 2006a). The TEP has developed several draft indicators for assessing habitat quality and quantity in Tillamook Bay, including changes in the distribution and type of riparian vegetation along the Bay's tributary rivers, the number of stream miles affected by fish passage enhancement projects, the areal extent of wetlands and open water restored through the removal of tidal restrictions, and changes in the extent of seagrass beds (TEP, 2004).

The amount of historical information available for the TEP indicators varies. For example, historic and recent data indicate that Tillamook Bay has lost roughly 85% of its intertidal wetlands to agricultural and residential development. To address these losses, the CCMP establishes a goal of restoring 750 acres of these habitats (TBNEP 1999), and the Partnership will have restored approximately 400 acres by the summer of 2007. In cases where the TEP knows little about historic habitats, indicators characterize the status of the resource and track change from the present. For example, the TEP monitors the change in eelgrass distribution from its current coverage of 897 acres (TEP, 2005).

Living Resources

The TEP has been implementing projects aimed at evaluating the status and trends of the abundance and distribution of aquatic species. Examples of these projects include an exotic species detection effort, a rapid bioassessment, and a study on fish use of the estuary. In addition, the TEP's living resource indicators of estuarine condition include the annual number of coho salmon adults returning to the study area for spawning, as well as the annual number of coho, chum, Chinook, steelhead, and cutthroat smolts migrating downstream from the Little North Fork Wilson River and Little South Fork Kilchis River (TEP, 2004).

The Exotic Species Project, which is being pursued for the LCREP, TEP, and PSAT, is seeking to develop a consistent approach for monitoring aquatic nuisance species. Together, these three NEPs and other partners in these basins will develop a regionally coordinated approach for monitoring aquatic nuisance species in the Pacific Northwest using models developed and tested in the San Francisco Estuary watershed (TEP, 2006b). As an initial step for this project, the TEP has developed *An Exotic Species Detection Plan for Tillamook Bay* (Cohen, 2004).

The TEP's Tillamook Bay Rapid Bio-Assessment is designed to quantify the abundance and distribution of four species of juvenile salmonids throughout the Bay's watershed. The full basin view of each species' distribution and their spatial shifts in abundance will provide valuable information for the development of a restoration strategy based on passage barriers, peak spawning and rearing reaches, temperature-limiting habitats, and upstream-migration behaviors. The three-year inventory began in 2005 and is encompassing approximately 350 stream miles. In 2005, the inventory found that the number of coho salmon returning to the Bay's streams for spawning was insufficient to adequately seed the watershed's available habitat (Bio-Surveys, L.L.C., 2005; TEP, 2006b).

The primary objectives of the Fish Use of the Estuary study were to develop baseline information on fish use of the Tillamook Bay estuary and to test and evaluate a sampling approach for long-term monitoring of fish abundance and distribution across major habitat types within the estuary. The sampling design for the long-term monitoring program was structured to allow the testing of hypotheses regarding the use of three regions of the estuary (lower, middle, and upper), two major substrate types (fine-grained and coarse-grained), and the effect-sampling time (months, within months, and years) for relatively abundant anadromous salmonid and non-salmonid species. Monitoring data from 1999 through 2001 indicated that fish species composition in the estuary has been relatively stable since the mid-1970s (Ellis, 2002; TEP, 2006b).

Current Activities, Accomplishment, and Future Goals

The TEP's primary goals are to enhance water quality to meet state and federal standards, restore native salmonid populations, reduce the frequency and impacts of catastrophic flooding, and encourage stewardship among residents and visitors. To attain these goals, the TEP and its many partners are implementing targeted resource-enhancement projects, characterizing the estuary and its watersheds, and educating citizens and visitors about the Bay's natural resources and the importance of stewardship. The TEP plans to continue pursuing these activities through three programs: the Habitat Enhancement Program (developing and implementing on-the-ground projects aimed at improving the production and function of natural systems); the Research and Monitoring Program (characterizing the interactions of human and natural systems, tracking system-wide trends, and evaluating the effectiveness of CCMP implementation); and the Education Program (working to facilitate a stewardship ethic among visitors and residents of Tillamook County through hands-on learning and outreach activities).

The TEP's annual workplan details the projects that the Partnership undertakes within each of these programs. One of the tools the TEP is using to track CCMP implementation is an innovative Web site known as the Performance Indicators Visualization and Outreach Tool (PIVOT), which is available at http://gisweb.co.tillamook.or.us/mapping/pivot/tillamook.htm. The TEP is also currently developing a comprehensive monitoring program to more fully characterize long-term, system-wide trends and the impact of CCMP implementation (TEP, 2005).

To implement the CCMP's actions aimed at reconnecting intertidal wetlands and enhancing tidal marshes, the TEP raised more than $1.3 million to acquire three properties that form a 375-acre peninsula at the confluence of the Wilson and Trask rivers. Currently underway, this project is expected to result in the protection and restoration of a natural, functioning ecosystem on approximately 200 acres within the formerly-diked tidelands and forested wetlands at the Bay's southern end. The remaining 175 acres will be restored under a "muted tidal connection" to ensure flood mitigation. Primarily, the fully reconnected areas will be restored to intertidal habitats consisting of high salt marsh, brackish marsh, and forested wetlands. Existing remnant floodplain forests will be permanently protected and managed to maintain their natural values (USACE, 2004a).

In 2003, the TEP initiated its Backyard Planting Program (BYPP) to help landowners on high-priority streams restore degraded riparian zones. The BYPP coordinator collaborates with interested landowners to develop an enhancement plan for their property. The BYPP provides free removal of invasive vegetation, plants native trees and shrubs, and maintains the site for three years. By the end of its third year, the BYPP will have enrolled more than 80 landowners and restored 15 miles and 75 acres of high-priority riparian habitat (TEP, 2006b).

Conclusion

Tillamook Bay is representative of many small Pacific Northwest estuaries. Dominated by rugged mountains with narrow coastal plains, it presents a challenging combination of environmental concerns. Elevated bacteria levels have closed oyster beds to shellfishing, and loss of habitat and increasing stream temperatures have impacted local salmonid populations. Based on the results of the NCA survey, the overall condition of Tillamook Bay is rated good. Although fair and poor conditions were noted for several indicators, this was the highest rating received by any of the six West Coast NEP estuaries monitored. The TEP is finding ways to protect both the area's natural resources and its natural resource-dependent economy. The TEP has focused on reducing bacteria contamination in the Bay and its tributaries and improving the area's habitat quality for salmonid populations.