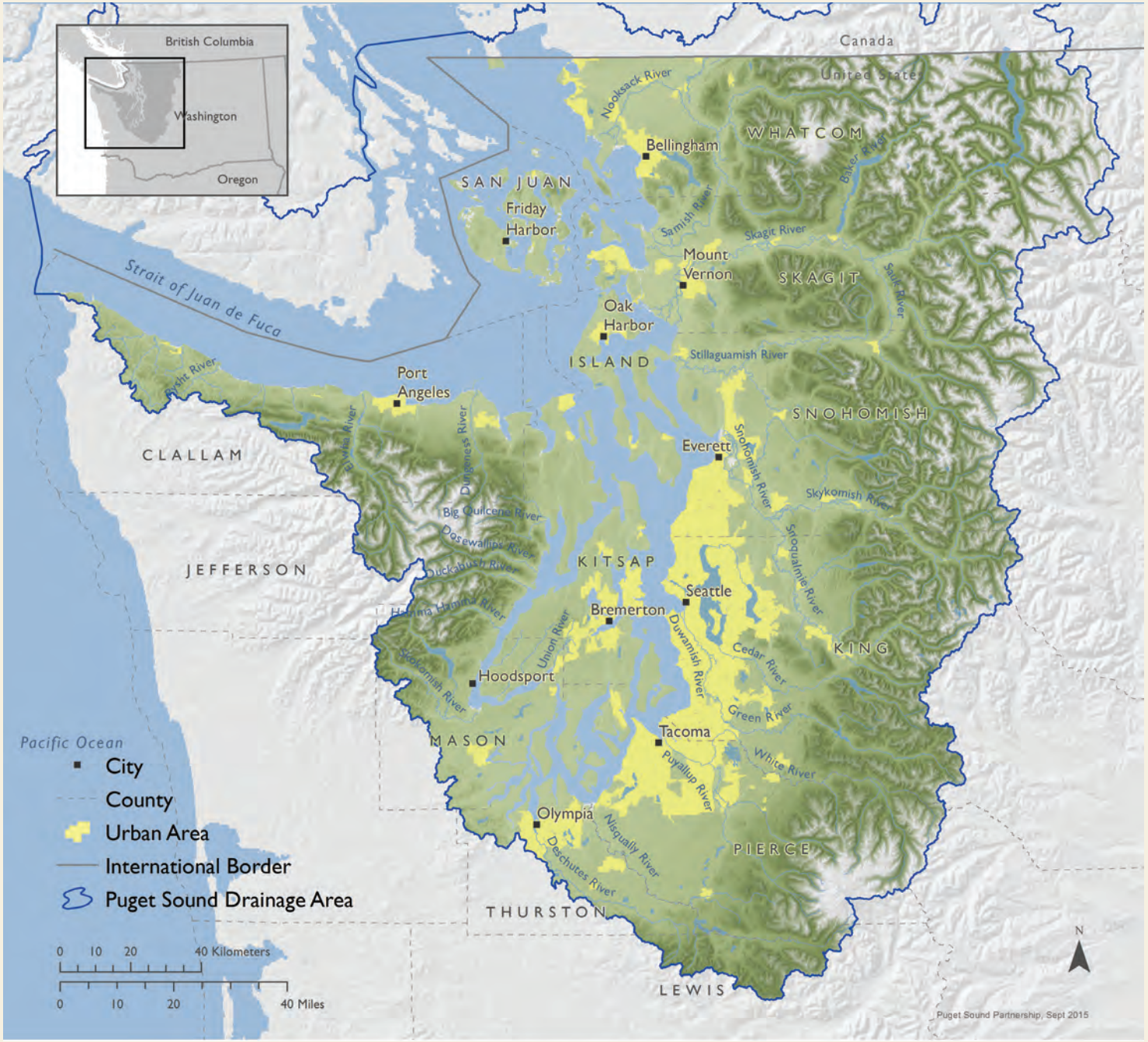
2015 STATE OF THE SOUND

REPORT ON THE PUGET SOUND VITAL SIGNS

PSEMP

Puget Sound Ecosystem Monitoring Program

PUGETSOUND PARTNERSHIP



For the purposes of this report, Puget Sound is defined as all salt waters of the Puget Sound estuary and the adjacent drainage basin where rivers and streams flow into Puget Sound.

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Cover photo: The newly restored Nisqually River estuary. The restoration of the mouth of the Nisqually River is the largest tidal marsh restoration project in the Pacific Northwest. Photo by Kiliii Fish.

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TABLE OF CONTENTS

ABOUT THIS REPORT

> "In our dream for the Salish Sea, we see a day when we all recognize and know our marine resources better than we now know corporate logos. We will watch and monitor the ecosystem better than we now watch the weather or monitor the NASDAQ or Dow Jones Industrial Average. And we will restore and protect the Salish Sea as if our lives and our livelihoods depend on it—because they do."
>
> *Audrey DeLella Benedict and Joseph K. Gaydos, The Salish Sea Jewel of the Pacific Northwest*

The purpose of this report is to provide an overview of the progress in Puget Sound recovery. We do this through the Puget Sound Vital Sign indicators, which provide insight into ecosystem health and recovery progress of Puget Sound. Inside this document you will find 27 individual reports that present the latest evaluation of the indicators, how they have changed over time, and their progress relative to targets for ecosystem recovery.

This report is a companion to the *2015 State of the Sound: Report to the Governor and Legislature,* which documents the Puget Sound Partnership's assessment of Puget Sound recovery efforts through the lens of the Puget Sound Action Agenda. This report represents the findings of the Puget Sound Ecosystem Monitoring Program (PSEMP) with regard to the Puget Sound Vital Signs.

The data and information in the *Report on the Puget Sound Vital Signs* are compiled from a variety of monitoring programs and funding organizations in Puget Sound, including state and federal agencies, tribes, local jurisdictions, and non-governmental organizations. Technical and scientific experts from those organizations provide the data and oversee the interpretation of the results. Data quality assurance and documentation remain the primary responsibility of the individual contributors. The Vital Sign indicator reports represent not only the work and achievements of many scientists, but also a significant collaboration among many of the PSEMP partners from across the region, including staff at the Puget Sound Partnership. The editorial team for this report included Puget Sound Partnership staff, members of the PSEMP Steering Committee, and representatives of workgroups that coordinate and collaborate on technical aspects of monitoring in Puget Sound.

FIGURE 1. THE PUGET SOUND VITAL SIGNS.
The outer ring shows each of the six recovery goals for Puget Sound, established by Washington State Legislature. The inner wedges represent the 21 Vital Signs. In this figure, Vital Signs are associated with their primary recovery goal.

ABOUT THE PUGET SOUND ECOSYSTEM MONITORING PROGRAM

The Puget Sound Ecosystem Monitoring Program (PSEMP) is a collaboration of hundreds of monitoring professionals, researchers, and data users from federal, tribal, state, and local government agencies; universities; non-government organizations; watershed groups; businesses; and private and volunteer groups.

The objective of PSEMP is to create and support a collaborative, inclusive, and transparent approach to regional monitoring and assessment that builds upon and facilitates communication among the many monitoring programs and efforts operating in Puget Sound. PSEMP's fundamental goal is to assess progress toward the recovery of the health of Puget Sound.

ABOUT THE PUGET SOUND PARTNERSHIP

The Puget Sound Partnership is the state agency formed to lead the region's collective effort to restore and protect Puget Sound, working with hundreds of tribal, federal, and state governments; cities and counties; universities; non-government organizations; watershed groups; businesses; and nonprofit organizations. Consistent with its backbone role, the Partnership brings these partners together to develop and implement the priority actions needed to accelerate recovery. The Partnership does this by:

- **Mobilizing partners around a shared agenda.** The Partnership stewards the effort to collaboratively build the Puget Sound Action Agenda so that recovery resources can be efficiently allocated based on a science-driven, prioritized system. The Partnership ensures decision-makers are well-informed and have the information they need to do their part to advance these priorities.
- **Improving systems through common measures.** The Partnership advances a shared, science-based system of measurement and monitoring that allows assessment of actions for accountability, effectiveness, and progress. This information helps inform decisions about the most efficient and effective way to allocate future investments.
- **Supporting and enabling partners on the ground.** The Partnership strives to remove financial, regulatory, and resource barriers for partners by directing outside resources toward priority actions, improving the policy and regulatory environment, and working to catalyze the system to get the job done.

This report was produced by the Puget Sound Partnership.

INTRODUCTION

Puget Sound is a deep fjord estuary located within the broader Salish Sea, south of the border between the United States and Canada. As a saltwater body, it is far from being uniform: each basin, carved by recessing glaciers over 10,000 years ago, varies in its physical, chemical, and biological properties. Together they contain an astounding diversity of life.

For the purposes of this report, Puget Sound is defined as all saltwaters inside the international boundary line between Washington and British Columbia and lying east of the junction of the Pacific Ocean and the Strait of Juan de Fuca. It also includes the rivers and streams draining to Puget Sound, as mapped by Water Resource Inventory Areas (WRIAs) 1 through 19 in WAC 173-500-040 as it existed on July 1, 2007 (RCW 90.71.010: Definitions, n.d.). Furthermore, Puget Sound includes the entire watershed—the land where rivers and streams drain into Puget Sound—as well as the Strait of Juan de Fuca and the San Juan archipelago.

Considered the largest estuary by volume in the United States, the Puget Sound is deep and vast, a complex ecosystem encompassing mountains, farmlands, cities, rivers, forests, and wetlands. Humans have long relied on a healthy Puget Sound for food and water and the other services it provides, like reducing the impact of droughts and floods. Puget Sound supports a large part of our state's economy and provides vital recreational, spiritual, and other essential quality-of-life benefits.

But over the past 100 years, human use has damaged the Sound. The Puget Sound region is experiencing degradation of water quality, water quantity, and habitat. Many Puget Sound species are in decline, and food webs are changing. The human population keeps growing, bringing with it more land development, more infrastructure, and more pollution. And the impact of climate change is ever-present, with warmer streams and ocean waters, reduced snowpack, more extreme weather events, and increased fires and floods. As a result, the pressures on the ecosystem are relentless and continue to take their toll on Puget Sound and the wellbeing of residents around the region.

Puget Sound will never again be the same as it was 100 years ago. But the future health of this region is being defined by today's actions. The Puget Sound Partnership brings partners together to mobilize efforts and prioritize actions for a resilient Puget Sound as determined by six important recovery goals identified by the Washington State Legislature:

- **Healthy Human Population:** A healthy population supported by a healthy Puget Sound that is not threatened by changes in the ecosystem.
- **Vibrant Quality of Life:** A quality of human life that is sustained by a functioning Puget Sound ecosystem.
- **Thriving Species and Food Web:** Healthy and sustaining populations of native species in Puget Sound, including a robust food web.
- **Protected and Restored Habitat:** A healthy Puget Sound where freshwater, estuary, nearshore, marine, and upland habitats are protected, restored, and sustained.
- **Abundant Water Quantity:** An ecosystem that is supported by groundwater levels as well as river and stream flows sufficient to sustain people, fish, wildlife, and the natural functions of the environment.
- **Healthy Water Quality:** Fresh and marine waters and sediments of a sufficient quality to support water that is safe for drinking, swimming, and other human uses and enjoyment, and are not harmful to the native marine mammals, fish, birds, and shellfish in the region.

To track progress toward these recovery goals, the Partnership chose a specific set of measures called the Puget Sound Vital Signs (Figure 1). The Vital Signs gauge the health of Puget Sound in a way that is scientifically valid and also resonates with the public. Tracking and reporting of Vital Signs is the foundation of the shared measurement system the Partnership relies on to show the collective impact.

OVERALL MESSAGES ON PUGET SOUND VITAL SIGNS PROGRESS

MIXED RESULTS, PRESSURES CONTINUE, CHANGE IS SLOW, FEW INDICATORS WILL REACH 2020 TARGETS

The evaluation of change over time for Vital Sign indicators reveals varied results:

- 10 indicators are getting better
- 6 indicators are not changing
- 4 indicators have mixed results
- 5 indicators are getting worse
- 12 indicators have no data available to evaluate progress

Four indicators are already meeting or nearly meeting 2020 targets:

- Rate of septic systems inventory
- Rate of forest loss
- Marine Sediment Triad Index
- Marine Sediment Chemistry Index

The majority of Vital Sign indicators are, at best, only slowly changing. Few are at—or even within reach of—their 2014 interim targets. Therefore, there is little evidence they are on a trajectory to reach the 2020 targets. However, there has been some progress in some indicators and at more local scales.

- Evaluation of progress for each Puget Sound ecosystem recovery goal shows that indicators of the Protect and Restore Habitat goal are making the most advances. None of the indicators for the Thriving Species and Food Webs goal are getting better.
- The two Vital Signs that report on pressures in Puget Sound—Land Development and Shoreline Armoring—also show varied results. The conversion of ecologically important lands to human development has increased in recent years. Shoreline armoring continues to occur in Puget Sound, potentially damaging shoreline habitat. However, for the first time, results from permit data suggest that shoreline armoring is slowing down and that more armoring was removed than added in 2014.
- Abundant Water Quantity is measured by the summer low flow indicator, which shows improvement for this report. However, the data for this year's report do not include the flows for the summer of 2015, a year with unusually warm weather and record low snowpack. The unusual conditions in 2015 may change the outlook of this indicator in the future and may offer insights into challenges the Puget Sound ecosystem will face related to climate change.

THE PUGET SOUND VITAL SIGNS

Are there fewer toxic chemicals in Puget Sound? Are there more salmon? How much habitat has been restored? These are just some of the questions that the evaluation of the Puget Sound Vital Signs helps answer in this report.

WHAT ARE THE PUGET SOUND VITAL SIGNS, THEIR INDICATORS, AND ECOSYSTEM RECOVERY TARGETS?

The Puget Sound Vital Signs are measures that the Puget Sound Partnership chose to gauge the health of Puget Sound. The Partnership tracks 21 Vital Signs to report on progress toward Puget Sound recovery goals established by the Legislature. These six goals can be summarized as: Healthy Human Population, Vibrant Quality of Life, Thriving Species and Food Webs, Protected and Restored Habitat, Healthy Water Quality, and Abundant Water Quantity.

While the Vital Signs represent the different overarching measures for determining the health of Puget Sound, indicators representing each Vital Sign serve as the specific and measurable metrics. Examples of indicators include eelgrass acreage under the Eelgrass Vital Sign, Chinook salmon abundance under the Chinook Vital Sign, and the number of Southern Resident Killer Whales under the Orca Vital Sign (Figure 2). Each Vital Sign is represented by one or more indicators.

Indicators for Puget Sound were formally adopted by the Puget Sound Partnership in 2010. The intent of these measures was to be:

- Scientifically and theoretically sound surrogates for ecosystem attributes
- Relevant to management concerns
- Predictably responsive to ecosystem changes and management actions
- Linkable to a reference point or baseline condition
- Supported by available, high-quality data
- Understood by the public and policymakers

To assess progress toward the six recovery goals more precisely, the Partnership adopted specific and quantitative milestones, known as 2020 ecosystem recovery targets. These targets are policy statements, sometimes considered aspirational, that reflect the region's commitments to and expectations for recovering Puget Sound by the year 2020.

Ecosystem recovery targets are associated with the indicators for 16 of the 21 Vital Signs. Ecosystem recovery targets were not adopted under five Vital Signs: Quality of Life, Sound Behavior, Recreational Fishing, Commercial Fisheries, and Birds. Targets were not set because the indicators were not sufficiently developed at the time, or the Partnership did not have a clear picture for the desired future conditions or direction of the targets.

In 2012, the Partnership adopted a series of interim targets for the years 2014, 2016, and 2018 for 12 of the Vital Signs: Shellfish Beds, Chinook Salmon, Orcas, Toxics In Fish, Marine Sediment Quality, Marine Water Quality, Summer Stream Flows, Swimming Beaches, Onsite Sewage Systems, Estuaries, Eelgrass, and Floodplains. Interim targets are viewed as describing the path to successful achievement of the 2020 targets. The interim targets are composed of outcome and output statements.

FIGURE 2. DEPICTION OF HOW THE PUGET SOUND PARTNERSHIP RECOVERY GOALS RELATE TO VITAL SIGNS INDICATORS AND TARGETS

Outcome statements are designed to reflect specific increments of progress toward the 2020 recovery targets. For example, the outcome statement for the 2014 interim target associated with orcas is to achieve 89 individuals in the end-of-year census.

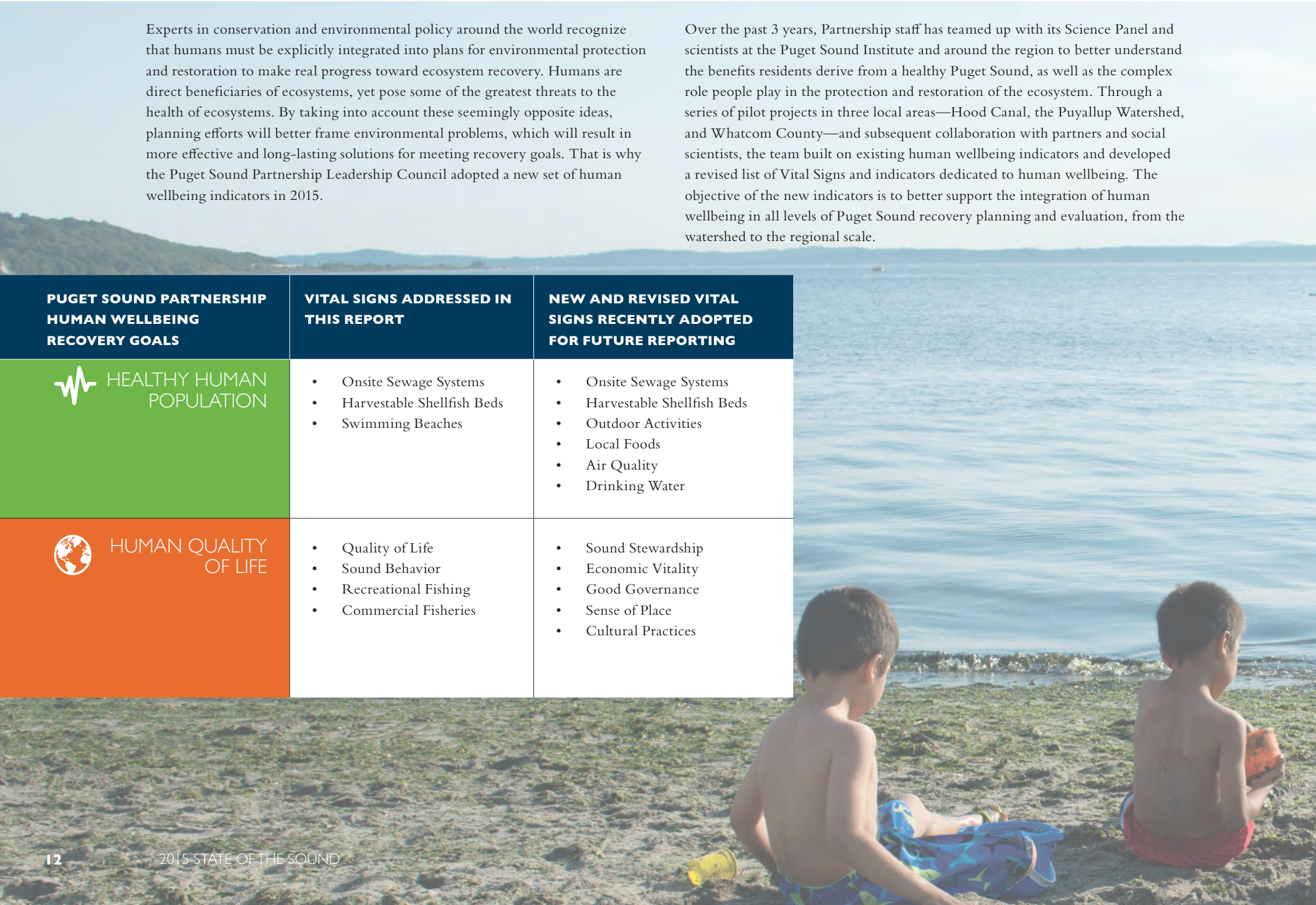
Outputs are measurable actions directly related to the interim targets. An example of one of the outputs for the 2014 interim target associated with orcas is "Evaluation of post-regulation vessel behavior completed (B5.1)." The outputs were viewed as necessary to meet the next period's interim targets. However, the group of outputs was not intended to be an exhaustive list of all actions required to meet the respective interim targets. An assessment of outcomes is included in this report; information on outputs can be found in the State of the Sound material available online at www.psp.wa.gov/sos.

NEW VITAL SIGNS AND INDICATORS OF HUMAN HEALTH AND HUMAN QUALITY OF LIFE

Experts in conservation and environmental policy around the world recognize that humans must be explicitly integrated into plans for environmental protection and restoration to make real progress toward ecosystem recovery. Humans are direct beneficiaries of ecosystems, yet pose some of the greatest threats to the health of ecosystems. By taking into account these seemingly opposite ideas, planning efforts will better frame environmental problems, which will result in more effective and long-lasting solutions for meeting recovery goals. That is why the Puget Sound Partnership Leadership Council adopted a new set of human wellbeing indicators in 2015.

Over the past 3 years, Partnership staff has teamed up with its Science Panel and scientists at the Puget Sound Institute and around the region to better understand the benefits residents derive from a healthy Puget Sound, as well as the complex role people play in the protection and restoration of the ecosystem. Through a series of pilot projects in three local areas—Hood Canal, the Puyallup Watershed, and Whatcom County—and subsequent collaboration with partners and social scientists, the team built on existing human wellbeing indicators and developed a revised list of Vital Signs and indicators dedicated to human wellbeing. The objective of the new indicators is to better support the integration of human wellbeing in all levels of Puget Sound recovery planning and evaluation, from the watershed to the regional scale.

PUGET SOUND PARTNERSHIP HUMAN WELLBEING RECOVERY GOALS	VITAL SIGNS ADDRESSED IN THIS REPORT	NEW AND REVISED VITAL SIGNS RECENTLY ADOPTED FOR FUTURE REPORTING
HEALTHY HUMAN POPULATION	• Onsite Sewage Systems • Harvestable Shellfish Beds • Swimming Beaches	• Onsite Sewage Systems • Harvestable Shellfish Beds • Outdoor Activities • Local Foods • Air Quality • Drinking Water
HUMAN QUALITY OF LIFE	• Quality of Life • Sound Behavior • Recreational Fishing • Commercial Fisheries	• Sound Stewardship • Economic Vitality • Good Governance • Sense of Place • Cultural Practices



VITAL SIGNS TRACK ECOSYSTEM CONDITIONS, PRESSURES AND RESTORATION ACTIONS

There are a total of 37 Vital Sign indicators. Ten of the Vital Signs are represented with a single indicator; the remaining 11 are each represented with two to four indicators. This set of measurements tracks a variety of different conditions related to Puget Sound recovery, including the following:

- Metrics of the biological, physical, and chemical condition of Puget Sound, such as the extent of habitats, animal population size, and properties of water quality and water quantity.
- Indicators related to healthy human populations and human quality of life. These indicators were chosen because humans are dependent in part on a resilient and healthy Puget Sound.
- Pressures on the ecosystem that measure human-caused threats to Puget Sound, such as the amount of new and removed shoreline armoring, land development on ecologically important lands, and population increases in urban growth areas (UGAs). Pressure indicators are all captured under the Protect and Restore Habitat recovery goal.
- Activities to restore key habitats for salmon and other fish and wildlife in Puget Sound, such as estuaries, riparian corridors, and floodplains.
- Management actions to protect water quality and benefit human health, such as onsite sewage systems inventory and inspection. These types of indicators are under direct human control and may be more sensitive than indicators of water quality and quantity, habitat extent, and species of Puget Sound.

The Sound Behavior Index is unique among all the indicators because it is the only one that tracks behavioral change; more specifically, whether Puget Sound residents adopt over time more behaviors that are either harmful or beneficial to Puget Sound.

APPROACH TO EVALUATING THE INDICATORS AND PROGRESS RELATIVE TO TARGETS

DETERMINING INDICATOR STATUS AND CHANGE OVER TIME

Indicator status refers to the most current condition of indicators. Most often, the status represents conditions in a single year, though sometimes it can cover a number of years. Averages over recent years are used primarily when the indicators vary considerably from year to year.

There is an inherent lag between when data are collected and then reported due to the time needed for data management, analysis, and vetting. In this report, the most current data are for 2014 for the majority of indicators, although a few also include the year 2015. If 2014 data were not available, then data for earlier years are presented. Status is also a value summarized for the entirety of Puget Sound's marine waters or watersheds, but information at the sub-regional scale may be reported as well, depending on the indicator.

Change in an indicator was measured over time relative to a baseline reference that was determined based on an evaluation of the monitoring program, the data, and how the target was defined. The baseline reference should not be confused with a historical baseline or a representation of pristine conditions. Indicator change was evaluated either by calculating a trend over time, or by comparing values in two time periods, with or without the use of a statistical tool.

EVALUATING INDICATORS RELATIVE TO ECOSYSTEM RECOVERY TARGETS

A binary "yes or no" approach was used to evaluate whether the interim targets were met. A target was either met because all the conditions were satisfied, or not met because only some or none of the conditions were satisfied. Twelve Puget Sound Vital Signs have 2014 interim targets; some have more than one. Results are presented for each interim targets in the indicator reports, and are summarized in Table 2.

Because data for 2014 were not available for some indicators with interim targets, the evaluation of the indicator relative to the 2014 interim targets use data prior to 2014.

Progress made toward 2020 targets was evaluated by the change in the indicator relative to the baseline reference and results are categorized as follows:

If an indicator made gains relative to the baseline reference.

If an indicator lost ground relative to a baseline reference.

If there was no significant trend.

This category was applicable only to the handful of indicators composed of multiple parts, such as PCBs and PBDEs, two toxic chemicals found in Pacific herring. Mixed results indicates that the change in the components was different.

VITAL SIGN INDICATOR RESULTS AND PROGRESS

KEY FINDINGS

The evaluation of indicator change over time reveals varied results (Table 1).

The majority of Vital Sign indicators are, at best, only slowly changing. Few are at—or even within reach of—their 2014 interim targets (Table 2). Therefore, there is little evidence they are on a trajectory to reach the 2020 targets. However, there has been some progress in some indicators and at more local scales.

LOCAL IMPROVEMENTS IN WATER QUALITY DO NOT ADD UP TO REGIONAL TRENDS IN PROGRESS

Marine water quality is far from being uniform across Puget Sound. For instance, marine water quality is relatively good in some bays, and safe for harvesting shellfish and for swimming. But in other bays, water quality is very poor and not meeting standards. Sediment and fish in Puget Sound may be polluted with toxic chemicals, particularly in urban bays, but not in others. Consequently, a harvest of shellfish is not allowed and beaches are closed to swimming in some areas of Puget Sound. Overall though, trends for marine water quality have been generally getting worse.

Results are also mixed for freshwater quality. The Water Quality Index, an indicator that integrates information about oxygen, temperature, pH, and bacteria, shows no trend in water quality across large rivers in Puget Sound. However, improvements in local areas have been observed. The Benthic Index of Biotic Integrity, a second indicator of freshwater quality, shows improvement of the biological condition of many stream sites, particularly those that were initially classified as having only fair conditions. Furthermore, a number of lake, river, and stream segments were de-listed from the 303(d) list under the Clean Water Act because water quality improved enough to meet the standards. These improvements were the result of successful long-term implementation of pollution control programs—in particular, efforts to reduce fecal bacteria pollution. However, freshwater quality has also declined in many places. On balance, local improvements are outpaced by the degradation at the regional scale.

DEVELOPMENT PRESSURES CONTINUE, WITH SHORELINE ARMORING POSSIBLY TURNING THE CORNER

The Vital Sign indicator summaries address two pressures in Puget Sound, and results are somewhat varied for those as well. The conversion of ecologically important lands to human development has increased in recent years, a trend that is leading it away from the 2020 recovery target. Shoreline armoring continues to occur in Puget Sound, potentially damaging shoreline habitat. However, for the first time, results from permit data suggest that shoreline armoring is slowing down and that more armoring was removed than added in 2014.

INDICATORS OF THE HABITAT GOAL SHOW THE MOST PROGRESS

The evaluation of progress for each recovery goal shows that indicators in the Protect and Restore Habitat goal are making the most advances (Table 2). The Protect and Restore Habitat goal is the one with the most indicators in absolute terms, but it also has the largest proportion of indicators showing improvement. The Thriving Species and Food Web goal is particularly noteworthy for not having any indicators that are getting better.

SPECIES INDICATORS CONTINUE TO SIGNAL TROUBLE

Herring spawning biomass, marbled murrelet population size, Chinook salmon abundance, and orca population size continue to be extremely low relative to their baseline reference, and their fragile status remains a cause for concern. Although there is incremental progress in restoring important habitats, such as estuaries, riparian corridors, and floodplains, most species indicators are in decline or, at best, holding steady.

IMPROVEMENT IN THE WATER QUANTITY GOAL LIKELY SHORT-LIVED

The Abundant Water Quantity goal is represented by a single indicator, the summer low flow indicator, which shows improvement in this edition. However, the data for summer low flows do not include the year 2015, a year with unusually warm temperatures and record-low snowpack. This unusual event may change the outlook of this indicator in the near future.

INDICATORS MEASURING HABITAT RESTORATION ARE MAKING THE MOST PROGRESS

Indicators that are making progress, perhaps as expected, are measures of a human action, compared to the measures of the biological, physical, or chemical conditions of Puget Sound. All indicators for habitat restoration are making progress, reflecting investments over time in restoring estuaries, floodplains, and riparian corridors to benefit salmon and other fish and wildlife habitat. Indicators showing progress also include onsite sewage system inventory and inspections. However, some of the indicators making progress are also measures that are less under human control and are typically affected by multiple pressures and natural drivers outside of human control, such as water quality indicators (harvestable shellfish beds and marine sediments meeting sediment standards), water quantity (summer low flows), and habitat (forest loss).

LACK OF CHANGE CAN BE GOOD, DEPENDING ON THE STATUS OF INDICATORS

Indicators nearly meeting or already meeting 2020 targets include the following:

- Rate of septic system inventory
- Rate of forest loss
- Marine Sediment Triad Index
- Marine Sediment Chemistry Index

Of the 14 indicators with 2014 interim targets, two met all the interim targets: Sediment Quality Triad Index and summer low flow. Three did not meet interim targets, four had mixed results, and three had insufficient data to evaluate the status relative to the interim target.

Many indicators are lagging behind or not changing. The current status of indicators is important to consider when trying to understand what progress really means. Even if indicators are not changing over time, such as the Marine Sediment Triad Index, a static trend could be viewed as a satisfactory result if these indicators are already near to or meeting their 2020 target. However, for other indicators that have fallen behind their baseline reference or are far from the recovery target values, such as Chinook salmon population abundance, a static trend or no change in status is concerning.

NO DATA FOR 12 INDICATORS

Progress could not be evaluated for 12 indicators because there was not sufficient data or no data were reported to evaluate progress (Table 1). In some cases, adequate data simply do not exist or are difficult to obtain, such as for septic system repairs, freshwater impairments, and floodplain function. In some cases, data were collected and exist but need further processing and analysis for reporting, such as indicators for toxics in fish and the terrestrial bird indicators.

In other cases, only one year of data exists, which is not enough to confirm a trend. For example, the human contribution to dissolved oxygen in Puget Sound was modeled for a single year and would need to be repeated to understand how the human contribution changed over time. Another example is the indicator measuring growth in Urban Growth Areas (UGAs), which uses U.S. Census data. The indicator used 2010 census data and will be updated after the next census in 2020.

Finally, in the remaining cases, programs or actions that indicators are meant to measure have not been fully formed or implemented, including expanding Marine Recovery Areas to unsewered shoreline, tracking shoreline armoring around feeder bluffs, and the use of soft shore techniques.

In recognition of a number of high-priority gaps in Vital Sign monitoring identified by PSEMP, the Partnership requested and received $1.004 million from the Washington State Legislature in the 2015-17 biennium to augment Vital Sign and effectiveness monitoring efforts. This includes $800,000 to begin filling current gaps in Vital Sign monitoring, and $200,000 to increase capacity for effectiveness monitoring.

TABLE 1. LIST OF VITAL SIGN INDICATORS FOR EACH CATEGORY OF PROGRESS. For details, please consult the indicator reports.

GETTING BETTER	NOT CHANGING	MIXED RESULTS	GETTING WORSE	NO DATA[1]
10 INDICATORS	6 INDICATORS	4 INDICATORS	5 INDICATORS	12 INDICATORS
Inventory and inspections of onsite sewage systems	Condition of swimming beaches	Population abundance of marine birds[2]	Chinook salmon population abundance	Repairs of septic systems and expansion of Marine Recovery Areas
Harvestable shellfish beds	Sound Behavior Index[2]	Benthic Index of Biotic Integrity	Number of Southern Resident Killer Whales	Quality of Life Index
Pounds of salmon caught in commercial harvest[2]	Recreational fishing license sales[2]	Sediment Quality Triad Index	Biomass of spawning Pacific herring	Population abundance of terrestrial birds[2]
Amount of shoreline armoring removals	Eelgrass area	Toxics in fish: Herring	Land development pressure: Conversion of ecologically important lands	Armoring on feeder bluffs
Land cover change: Forest to developed	Water Quality Index for freshwater		Marine Water Condition Index[2]	Use of soft shore techniques
Riparian restoration	Sediment Chemistry Index			Human population growth in Urban Growth Areas
Floodplain restoration				Floodplain function
Area of estuarine wetlands restored to tidal flooding				Estuary restoration meeting salmon recovery goals
Summer low flows				Freshwater impairments
Percent of chemical measurements exceeding Sediment Quality Standards				Dissolved oxygen
				Toxics in fish: English sole
				Toxics in fish: salmon

[1] *These indicators did not have sufficient data or any data reported to evaluate progress.*

[2] *These indicators were adopted by the Puget Sound Partnerships but do not have 2020 targets.*

REMARKS ABOUT THE VITAL SIGNS AND THE DATA

INDICATORS PROVIDE INSIGHTS BUT NOT FULL SPECTRUM OF CHANGES

Vital Sign indicators are intended to provide insights into the health of Puget Sound and the success of recovery efforts over time. However, Vital Sign indicators do not capture the full spectrum of conditions and changes in Puget Sound. For example, the Vital Sign indicators miss the increase in jellyfish blooms observed in the south end of Puget Sound, changes in the nutrient balance and phytoplankton communities in marine waters, and the increase in harbor porpoise throughout the region, all of which indicate potential shifts in the food web.

Furthermore, important forces such as climate change and ocean acidification are becoming strong influences on the system. As the Partnership tries to anticipate and mitigate pressures on the efforts to restore and sustain Puget Sound, these two interrelated issues must be factored into the analysis. Climate change and ocean acidification are global issues, and much of their effects are beyond local control. However, they affect all of Puget Sound and have the potential to influence data collected and summarized by the Partnership. Fortunately, monitoring efforts are evolving to account for these influences.

ACCOUNTING OF HABITAT LOSS AND GAINS

Five Vital Signs are classified under the Protect and Restore Habitats goal that provide measures of habitat extent, restoration activities, and pressures. However, for a given habitat, the Vital Sign indicators often present a somewhat incomplete portrayal of the gains and losses of habitat over time. For instance, the indicators of riparian and estuary restoration help gauge habitat gains over time. However, there are no Vital Sign indicators accounting for the degradation or loss of these key habitats. As a result, there is no information in this report on whether these types of habitats are disappearing faster than are being protected or restored. Knowing the net impact of restoration, protection, degradation, and loss of habitat over time is essential not only for understanding the status of other indicators such as Chinook salmon and forage fish, but also the overall accomplishments of Puget Sound recovery efforts.

There are important nuances to each Vital Sign indicator that are not conveyed in the high-level indicator summaries in Table 1 and Table 2. These summaries can mask important local improvements resulting from successful protection and restoration efforts. The opposite is true as well: local declines as a result of pressures damaging to the environment may be occurring and should be revealed to better inform recovery efforts.

INDICATORS EXPECTED TO RESPOND SLOWLY

The Vital Sign indicators are useful as longer-term measures of environmental health, with a recognition that their status responds to the collective impacts of the Action Agenda, as well as the human footprint not accounted for in the Action Agenda, and forces and natural drivers outside of human control. The Vital Sign indicators in this report were not designed to measure the effectiveness or short-term impact of specific Near Term Actions and programs planned in the 2012 or 2014 Action Agendas. Also, the indicators should not be viewed as measures of the overall impact of the 2012 or 2014 Action Agendas. The majority of the Vital Sign indicators respond to a myriad of activities and forces in the environment, many of which are not included in the Action Agendas or are out of human control. Furthermore, most Vital Sign indicators are expected to change slowly because they have slow generation times, such as orcas, or are affected by multiple pressures that need to be removed or reduced to see improvement.

It was beyond the scope of this evaluation of Vital Sign indicators to provide a diagnosis for why indicators may be getting better, getting worse, or not changing. Much of that information either does not exist or would require additional resources to develop. A number of publications provide more detail or summarize additional aspects of ecosystem conditions, including the following:

- PSEMP's annual Marine Waters in Review reports (www.psp.wa.gov/PSEMP/PSmarinewatersoverview.php)
- Reports from the underlying monitoring programs (as are available as links on the Vital Sign web pages www.psp.wa.gov/vitalsigns)
- Encyclopedia of Puget Sound (www.eopugetsound.org)

CLIMATE CHANGE AND OCEAN ACIDIFICATION

TWO FORCES TO BE RECKONED WITH

Puget Sound is facing unprecedented environmental changes. Not only is there evidence for a changing climate in the Pacific Northwest, but the global ocean that influences Puget Sound is undergoing acidification. Environmental changes associated with climate change and ocean acidification will continue, although there are still many unknowns that remain to be addressed. Climate change and ocean acidification have the potential to profoundly affect ecosystems, and many, if not all, of the Vital Signs are likely to be affected in one way or another.

CLIMATE CHANGE

The term "climate change" refers to the long-term change in weather around the world. Human activities have increased atmospheric levels of greenhouse gases (carbon dioxide, methane, and nitrous oxide) to levels unprecedented in at least the past 800,000 years. This increase in greenhouse gases has had repercussions on the climate; these changes are expected to accelerate in the coming years, with increasing impacts on local ecosystems, human economies, and cultures. As the climate changes, scientists expect that local patterns in temperature, precipitation, and humidity—both averages and extreme events—will change.

THE CLIMATE IS CHANGING IN THE PACIFIC NORTHWEST

There is compelling evidence of long-term change in the regional climate, water resources, and local sea level, even considering large natural variations. Already observed changes include higher air temperature, decreased glacial area and spring snowpack, earlier peak streamflows in many rivers, and rising sea level at most locations in and around Puget Sound.

Projections for future climate change depend in part on the ability to foresee greenhouse gas emissions, which will in turn be determined by society's choices about energy sources and use. To forecast future climate, scientists use a range of low to high greenhouse gas emissions scenarios. All scenarios indicate continued warming in the Pacific Northwest in general, and Puget Sound in particular. However, natural variability will remain an important feature of global and regional climate, at times amplifying or counteracting the long-term trends caused by rising greenhouse gas emissions.

OBSERVED CHANGES IN THE PAST CENTURY	PREDICTED CHANGES IN THE NEXT CENTURY
• Air temperature increased by about +1.3°F between 1895 and 2011	• Even warmer temperatures, more extremes in weather, more droughts
• Precipitation totals (rain or snow) stayed about the same, with no significant trend	• Small changes in precipitation, with heavy rainfall becoming more extreme
• Snowpack thinned, glacial area decreased, most Washington glaciers are in decline	• Spring snowpack will decline
• Streamflows are peaking earlier in the year for many snowmelt-influenced rivers in the Pacific Northwest as a result of decreased snow accumulation and earlier spring melt	• Streamflows will peak even earlier • Winter streamflow will increase • Summer streamflow will decrease • More floods • Lower summer low flows
• Sea level is rising at most locations. Local sea level changes range from a decline along the northwest Olympic peninsula, a region experiencing uplift, to sea level rise in parts of the Puget Sound and the outer coast where land is subsiding	• Coastal areas in Washington will experience sea level rise, with perhaps the exception of areas like the northwest Olympic Peninsula, where the land is uplifting
• Ocean temperature trends vary with location. In the Strait of Georgia and West of Vancouver Island: significant warming observed. Average for top 330 ft was +0.4°F/decade between 1970 and 2005	• Ocean temperature offshore of Washington will continue to go up, by about +2°F by the 2040s (2030-2059, relative to 1970-1999) for a medium greenhouse gas scenario

OCEAN ACIDIFICATION

The term "ocean acidification" refers to a long-term change in seawater pH toward the acidic end of the pH scale. Ocean acidification is caused as carbon dioxide (CO_2) from the atmosphere dissolves into seawater. Over time, the addition of CO_2 causes changes in seawater chemistry, lowering the pH and reducing the carbonate ion concentrations of the seawater. Ocean acidification will increase as fossil fuel combustion and deforestation continue to add CO_2 to the atmosphere.

The acidity of the global ocean has increased by about 26 percent since 1750. The acidity is projected to further increase roughly 100 to 150 percent by 2100 relative to pre-industrial levels. Ocean waters on the outer coast of Washington and the Puget Sound have seen an acidity increase of about 10 to 40 percent since 1800 (decline in pH of 0.05 to 0.15).

OCEAN ACIDIFICATION IS A REALITY IN THE PACIFIC NORTHWEST

Significant effects of rising atmospheric CO_2 from human sources are detectable in Pacific Northwest waters now, and these effects will continue to grow as CO_2 continues to increase. The Puget Sound and adjacent Pacific Northwest marine waters are particularly vulnerable to ocean acidification due to the combination of several factors that affect the dissolved CO_2 concentration, pH, and aragonite saturation state of seawater. These can include the amount of global CO_2 in the atmosphere, the emission of other acidic gases besides CO_2, the high rates of plankton growth that ultimately drive oxygen down and release CO_2 via respiration in the water column, runoff of nutrients that fuel plankton growth, and upwelling off the Washington coast that brings nutrient-rich and low pH waters up to the surface. Through ocean circulation, these waters eventually can make their way into Puget Sound.

Oceanic waters at depths of 150 to 300 meters on the coast of Washington naturally have higher dissolved CO_2 concentrations than surface waters, due to respiration. Upwelling causes this water to rise upward closer to the surface where it mixes with the increased dissolved CO_2 from the atmosphere. This results in waters that are more corrosive than during pre-industrial times. Current atmospheric CO_2 concentrations cause an increase in coastal surface water corrosive conditions from 11 to 33 percent of the time.

Puget Sound waters meet federal and state water quality standards in terms of pH. However, southern Hood Canal and the Whidbey Basin are of particular concern because pH levels there are among the lowest in Puget Sound, partially because the high productivity leads to high biological respiration rates producing more CO_2, which adds to the atmospheric CO_2 signal.

IMPACTS ON SPECIES

Direct changes to marine water quality will occur as seawater pH declines and corrosiveness increases. These changes will alter biological communities in Puget Sound. Species that build shells or other internal structures from calcium, such as molluscs, crustaceans, and echinoderms are affected by corrosive conditions, with negative consequences on shell formation, survivorship, or reproduction. Of the species likely to be affected, molluscs have so far received the most attention. Laboratory tests have shown impacts on Olympia oysters, pteropods (also known as sea angels and sea butterflies), red urchins, and northern abalone. Combining two or more stressors—for example, high temperature and low pH or aragonite saturation state—can cause more harm than either stressor alone. While most marine organisms can tolerate a range of environmental conditions, at some point their tolerance fails. Evidence of conditions in Puget Sound that exceed the tolerance of some native species—pteropods, for instance—have been detected.

Corrosive conditions are particularly of concern to the shellfish industry in Puget Sound, which depends on good water quality to grow oysters, clams, and mussels. Already, this industry has had to make changes to its culture practices to adapt to lower pH water.

Ecosystem-based models suggest that changes to crustacean abundance—especially copepods, a kind of zooplankton—will have a strong impact on overall food web structure. Not only would Vital Sign indicators such as the Marine Water Condition Index and harvestable shellfish beds be among those impacted by ocean acidification, but also planktivorous forage fish and those species higher up in the food web, such as salmon and marine birds that depend on forage fish for food.

Supporting references used for climate change and ocean acidification can be found in the list of references on page 86.

TABLE 2. SUMMARY OF PROGRESS OF THE PUGET SOUND VITAL SIGN INDICATORS. For details, please consult the indicator reports.

Goal	Vital Sign	Indicator	What is the progress of the indicator?[1]	Are the 2014 interim targets met?[2]
HEALTHY HUMAN POPULATION	ONSITE SEWAGE SYSTEMS	Inventory, inspection, and repair of onsite sewage systems	GETTING BETTER	MIXED RESULTS
		Percent of unsewered shoreline that has an inspection program	NO DATA	NO 2014 INTERIM TARGET
	SWIMMING BEACHES	Conditions of swimming beaches	NOT CHANGING	NO
	SHELLFISH BEDS	Harvestable shellfish beds	GETTING BETTER	NO
HUMAN QUALITY OF LIFE	QUALITY OF LIFE	Quality of Life index	NO DATA	NO 2014 INTERIM TARGET
	SOUND BEHAVIOR	Sound Behavior Index[3]	NOT CHANGING	NO 2014 INTERIM TARGET
	RECREATIONAL FISHING	Recreational angling and crabbing license sales[3]	NOT CHANGING	NO 2014 INTERIM TARGET
	COMMERCIAL FISHERIES	Pounds of salmon caught in commercial harvest[3]	GETTING BETTER	NO 2014 INTERIM TARGET
SPECIES AND FOOD WEB	CHINOOK SALMON	Chinook salmon population abundance as measured by the number of natural-origin adult fish returning to spawn	GETTING WORSE	NO
	ORCAS	Number of Southern Resident Killer Whales	GETTING WORSE	NO
	PACIFIC HERRING	Biomass of spawning Pacific herring	GETTING WORSE	NO 2014 INTERIM TARGET
	BIRDS	Population abundance of marine birds[3]	MIXED RESULTS	NO 2014 INTERIM TARGET
		Population abundance of terrestrial birds[3]	NO DATA	NO 2014 INTERIM TARGET

TABLE 2. CONTINUED

Goal	Vital Sign	Indicator	What is the progress of the indicator?[1]	Are the 2014 interim targets met?[2]
PROTECT AND RESTORE HABITAT	SHORELINE ARMORING	Amount of shoreline armoring	GETTING BETTER	NO 2014 INTERIM TARGET
		Armoring on feeder bluffs	NO DATA	NO 2014 INTERIM TARGET
		Use of soft shore techniques	NO DATA	NO 2014 INTERIM TARGET
	EELGRASS	Eelgrass area	NOT CHANGING	MIXED RESULTS
	LAND DEVELOPMENT AND COVER	Land cover change: Forest to developed	GETTING BETTER	NO 2014 INTERIM TARGET
		Land cover change: Riparian restoration	GETTING BETTER	NO 2014 INTERIM TARGET
		Land development pressure: Conversion of ecologically important lands	GETTING WORSE	NO 2014 INTERIM TARGET
		Land development pressure: Growth in Urban Growth Areas (UGAs)	NO DATA	NO 2014 INTERIM TARGET
	FLOODPLAINS	Floodplain restoration	GETTING BETTER	NO 2014 INTERIM TARGET
		Floodplain function	NO DATA	NO 2014 INTERIM TARGET
	ESTUARIES	Area of estuarine wetlands restored to tidal flooding	GETTING BETTER	NO
		Estuary restoration meeting salmon recovery goals	NO DATA	NO DATA

TABLE 2. CONTINUED

Goal	Vital Sign	Indicator	What is the progress of the indicator?[1]	Are the 2014 interim targets met?[2]
WATER QUANTITY	SUMMER STREAM FLOWS	Percent of rivers with stable, increasing, or decreasing flows	GETTING BETTER	YES
WATER QUALITY	MARINE WATER QUALITY	Marine Water Condition Index[3]	GETTING WORSE	NO 2014 INTERIM TARGET
		Dissolved oxygen in marine waters	NO DATA	NO 2014 INTERIM TARGET
	FRESHWATER QUALITY	Water Quality Index	NOT CHANGING	NO 2014 INTERIM TARGET
		Freshwater impairments	NO DATA	NO 2014 INTERIM TARGET
		Benthic Index of Biotic Integrity	MIXED RESULTS	NO 2014 INTERIM TARGET
	MARINE SEDIMENT QUALITY	Sediment Quality Triad Index	MIXED RESULTS	YES
		Sediment Chemistry Index	NOT CHANGING	MIXED RESULTS
		Percent of chemical measurements exceeding Sediment Quality Standards	GETTING BETTER	NO 2014 INTERIM TARGET
	TOXICS IN FISH	English sole contaminants and disease	NO DATA	NO DATA
		Pacific herring contaminants	MIXED RESULTS	MIXED RESULTS
		Salmon contaminants	NO DATA	NO DATA

TABLE 2 LEGEND. CONTINUED

[1] Progress conclusions are summarized as one of the following categories:

Indicator made positive progress relative to the baseline reference.

Indicator had no trend or there was no change relative to the baseline reference.

Component parts of the indicator had different trends or changes went in different directions.

Indicator lost ground relative to the baseline reference.

No data or not enough data were available to make a conclusion about progress.

[2] Interim target results are summarized for each indicator as one of the following categories:

All the interim targets for this indicator were met.

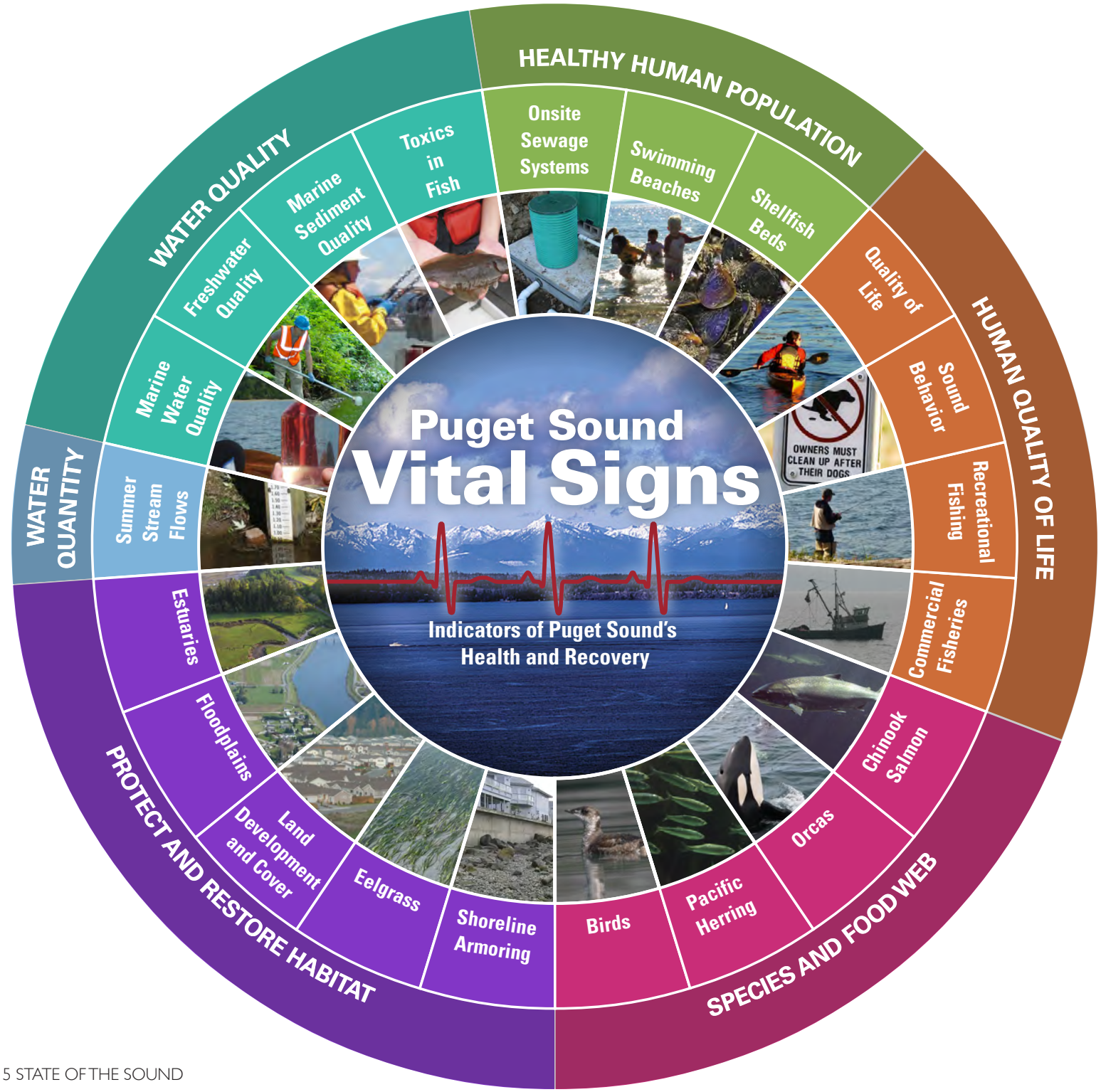
Only some of the interim targets for this indicator were met; others were not.

None of the 2014 interim targets for this indicator were met.

No data or no sufficient data available to make a conclusion about whether the 2014 interim target was met.

NO 2014 INTERIM TARGET
No 2014 interim target was adopted for this indicator.

[3] These indicators were adopted by the Puget Sound Partnership but do not have 2020 targets and interim targets.


Puget Sound
Vital Signs
Indicators of Puget Sound's Health and Recovery
WATER QUALITY
Toxics in Fish
Marine Sediment Quality
Freshwater Quality
Marine Water Quality
HEALTHY HUMAN POPULATION
Onsite Sewage Systems
Swimming Beaches
Shellfish Beds
HUMAN QUALITY OF LIFE
Quality of Life
Sound Behavior
Recreational Fishing
Commercial Fisheries
SPECIES AND FOOD WEB
Chinook Salmon
Orcas
Pacific Herring
Birds
PROTECT AND RESTORE HABITAT
Shoreline Armoring
Eelgrass
Land Development and Cover
Floodplains
Estuaries
WATER QUANTITY
Summer Stream Flows
OWNERS MUST CLEAN UP AFTER THEIR DOGS

VITAL SIGN INDICATOR REPORTS

A CONTRIBUTION FROM THE ECOSYSTEM MONITORING COMMUNITY OF PUGET SOUND

This section contains detailed reports for 27 individual Puget Sound Vital Sign indicators. These reports provide the latest evaluation of the indicators, including how they have changed over time and their progress relative to targets for ecosystem recovery. These reports are the basis for the analysis provided in the previous section.

ONSITE SEWAGE SYSTEMS

INDICATOR: INVENTORY, INSPECTION, AND REPAIR OF ONSITE SEWAGE SYSTEMS

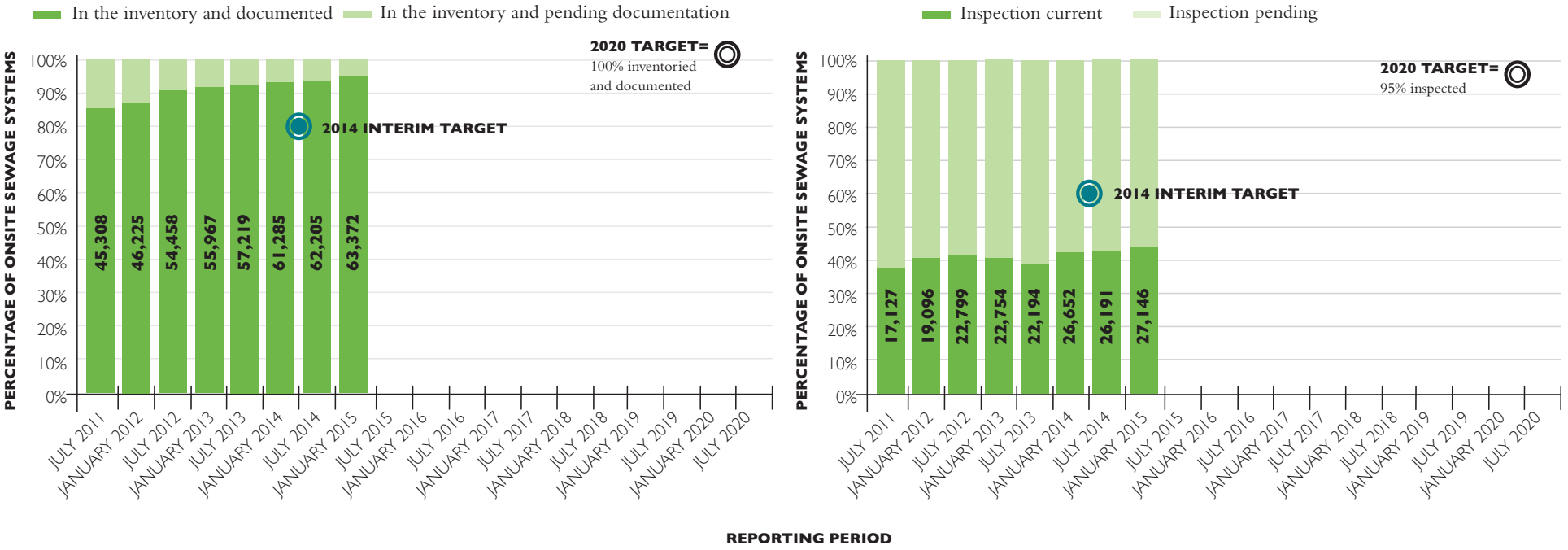
INDICATOR LEAD AND AFFILIATION:
Stuart Glasoe, Washington State Department of Health

2020 TARGET: Inventory all onsite sewage systems in Marine Recovery Areas and other specially designated areas; be current with inspections at 95 percent; and fix all failures.

PROGRESS:

MIXED RESULTS

FIGURE 3. STATUS OF ONSITE SEWAGE SYSTEMS INVENTORIED IN DESIGNATED AREAS[1]
2011 – 2015, semiannual



Left panel: Results show progress on inventorying and documenting septic systems. Right panel: Results show the number of septic system inspections. Numbers in the bars represent the number of septic systems. Designated areas include Marine Recovery Areas and other areas with comparable requirements.

Source: Washington State Department of Health, Office of Environmental Health and Safety

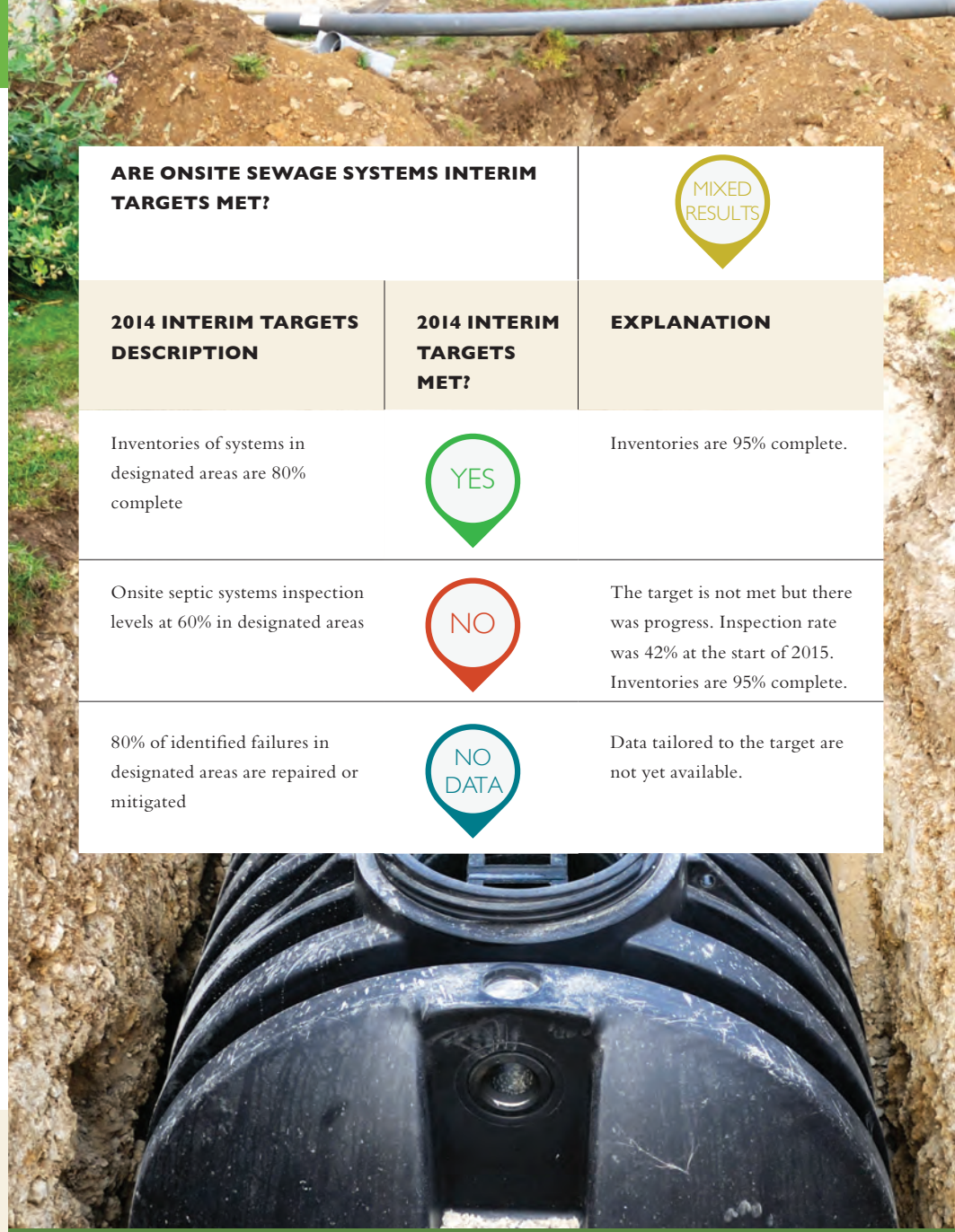
Onsite sewage systems, commonly known as septic systems, are widely used around Puget Sound to treat sewage from properties not served by municipal sewers. When septic systems leak or malfunction, raw sewage can surface or move through the soil to groundwater, streams, lakes, rivers, and Puget Sound.

All homeowners are required to regularly inspect and maintain their septic systems. In Marine Recovery Areas and other designated areas, local health jurisdictions engage more directly with homeowners to help ensure systems are inventoried, inspected, and maintained to reduce public health risks.

PROGRESS SUMMARY:
The 2014 interim target for inventories was met, but the interim target for inspection rates fell short.

- Collectively, local health jurisdictions have inventoried more than 65,000 septic systems. Of these, 95 percent are fully documented, generally meaning that the county has a record of the system in their database, including its condition and inspection status.
- Local health jurisdictions have made advances in inventorying and inspecting septic systems since 2011. Most recently, more than 27,000 systems were up-to-date with inspections, or 42 percent of the inventory.
- Progress on fixing failed septic systems is not yet available. This indicator is still being developed.

MARINE RECOVERY AREAS:
Marine Recovery Areas, defined by state statute, are designated where septic systems are associated with the degradation of shellfish growing areas, marine waters are listed as polluted for low dissolved oxygen levels or fecal coliform, or marine waters where nitrogen has been identified as a contaminant of concern.



ARE ONSITE SEWAGE SYSTEMS INTERIM TARGETS MET?		MIXED RESULTS
2014 INTERIM TARGETS DESCRIPTION	**2014 INTERIM TARGETS MET?**	**EXPLANATION**
Inventories of systems in designated areas are 80% complete	YES	Inventories are 95% complete.
Onsite septic systems inspection levels at 60% in designated areas	NO	The target is not met but there was progress. Inspection rate was 42% at the start of 2015. Inventories are 95% complete.
80% of identified failures in designated areas are repaired or mitigated	NO DATA	Data tailored to the target are not yet available.

FOR MORE IN-DEPTH INFORMATION, PLEASE SEE:
www.psp.wa.gov/vitalsigns/onsite_sewage

SWIMMING BEACHES

INDICATOR: CONDITION OF SWIMMING BEACHES

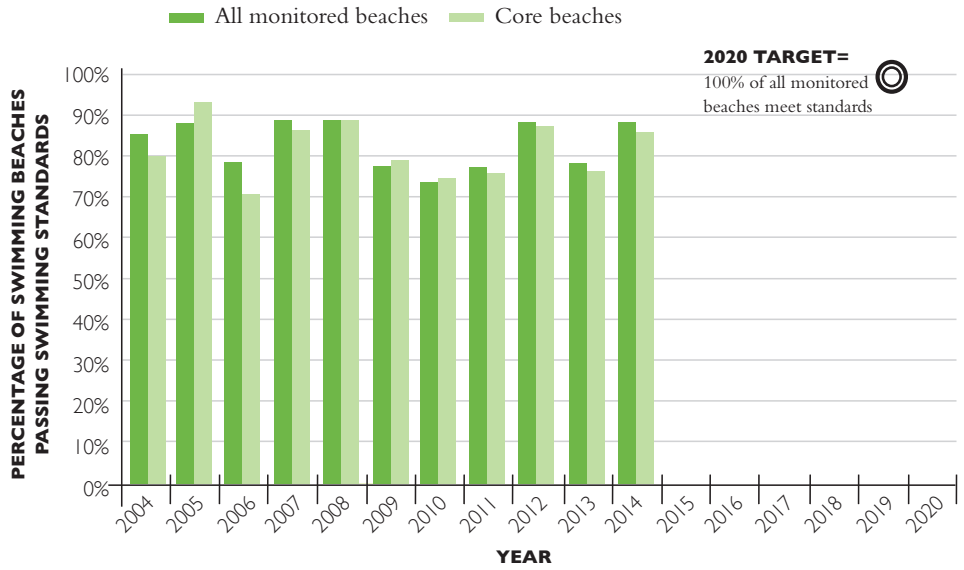
INDICATOR LEAD AND AFFILIATION:
Debby Sargeant, Washington State Department of Ecology

2020 TARGET: All the monitored beaches in Puget Sound meet EPA standards for *enterococcus*, a type of fecal bacteria.

PROGRESS:

NOT CHANGING

FIGURE 4. PUGET SOUND SWIMMING BEACHES MEETING EPA STANDARDS FOR *ENTEROCOCCI*, A TYPE OF FECAL BACTERIA
2004 – 2014



Core beaches are a subset of all monitored beaches that are sampled every year. Core beaches have been used to assess the trend in the condition of swimming beaches since 2004. There are about 43 core beaches (range is 36 to 48) and 63 total beaches sampled every year (range is 46 to 76). The 2020 target applies to all monitored beaches.

Source: Washington State Department of Ecology, BEACH program

The condition of swimming beaches reflects marine water quality in areas heavily used for recreation. Swimming beaches not meeting water quality criteria indicate increased risk of people getting sick through gastrointestinal illnesses, respiratory illnesses, and skin infections.

For this indicator, a beach that passes swimming standards means there is no more than one swimming advisory or closure during the summer. The number of monitored swimming beaches varies from year to year depending on availability of funding and where water quality issues arise. A subset of beaches are sampled every year and are called the "core" beaches.

PROGRESS SUMMARY:

Over the longer term, there was no upward or downward trend. The interim target was not met because the target value was only achieved in one of two consecutive years. Although this indicator was close to meeting the desired goal in 2014, it has not made progress toward the 2020 target.

- The average annual rate of meeting the water quality criteria between 2004 and 2014 for all monitored beaches hovered around 83 percent (range was 74 percent to 89 percent). Between 46 and 76 beaches were monitored on an annual basis during that time. A subset of those beaches, considered core beaches, were sampled every year.
- Many of the local sources of bacteria problems have been identified and subsequently corrected, thereby improving water quality. However, while there has been year-to-year variability, the trend in beaches passing swimming standards has been essentially flat. A range of 36 to 48 core beaches were used to assess this trend.

ARE THE SWIMMING BEACHES INTERIM TARGETS MET?		NO
2014 INTERIM TARGETS DESCRIPTION	**2014 INTERIM TARGETS MET?**	**EXPLANATION**
85% of monitored Puget Sound beaches meet *enterococcus* standard, for previous two consecutive years	NO	In 2013 and 2014, 78% and 88% of beaches met standards, respectively.

FOR MORE IN-DEPTH INFORMATION, PLEASE SEE:
www.psp.wa.gov/vitalsigns/swimming_beaches

SHELLFISH BEDS

INDICATOR: HARVESTABLE SHELLFISH BEDS

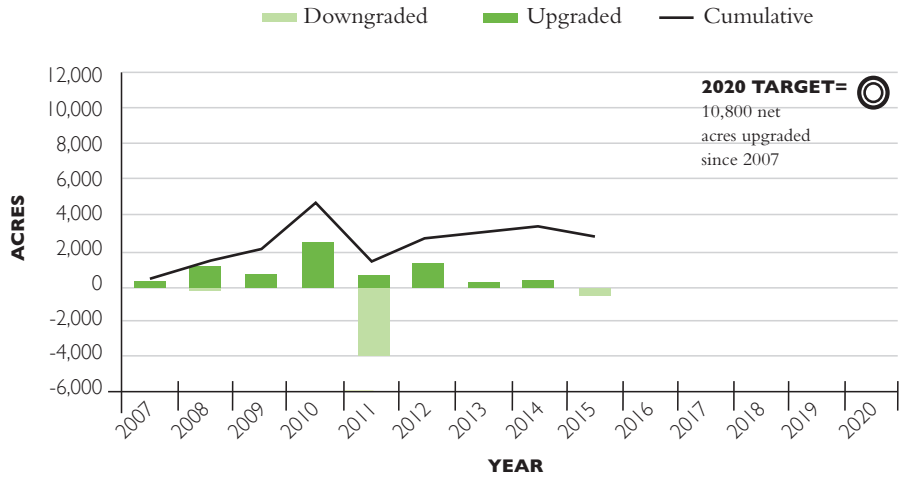
INDICATOR LEAD AND AFFILIATION:
Scott Berbells, Washington State Department of Health

2020 TARGET: A net increase of 10,800 harvestable shellfish acres between 2007 and 2020, including 7,000 acres where harvest had been prohibited.

PROGRESS:

GETTING BETTER

FIGURE 5. ACRES OF UPGRADED AND DOWNGRADED SHELLFISH BEDS IN PUGET SOUND
2007 – May 2015



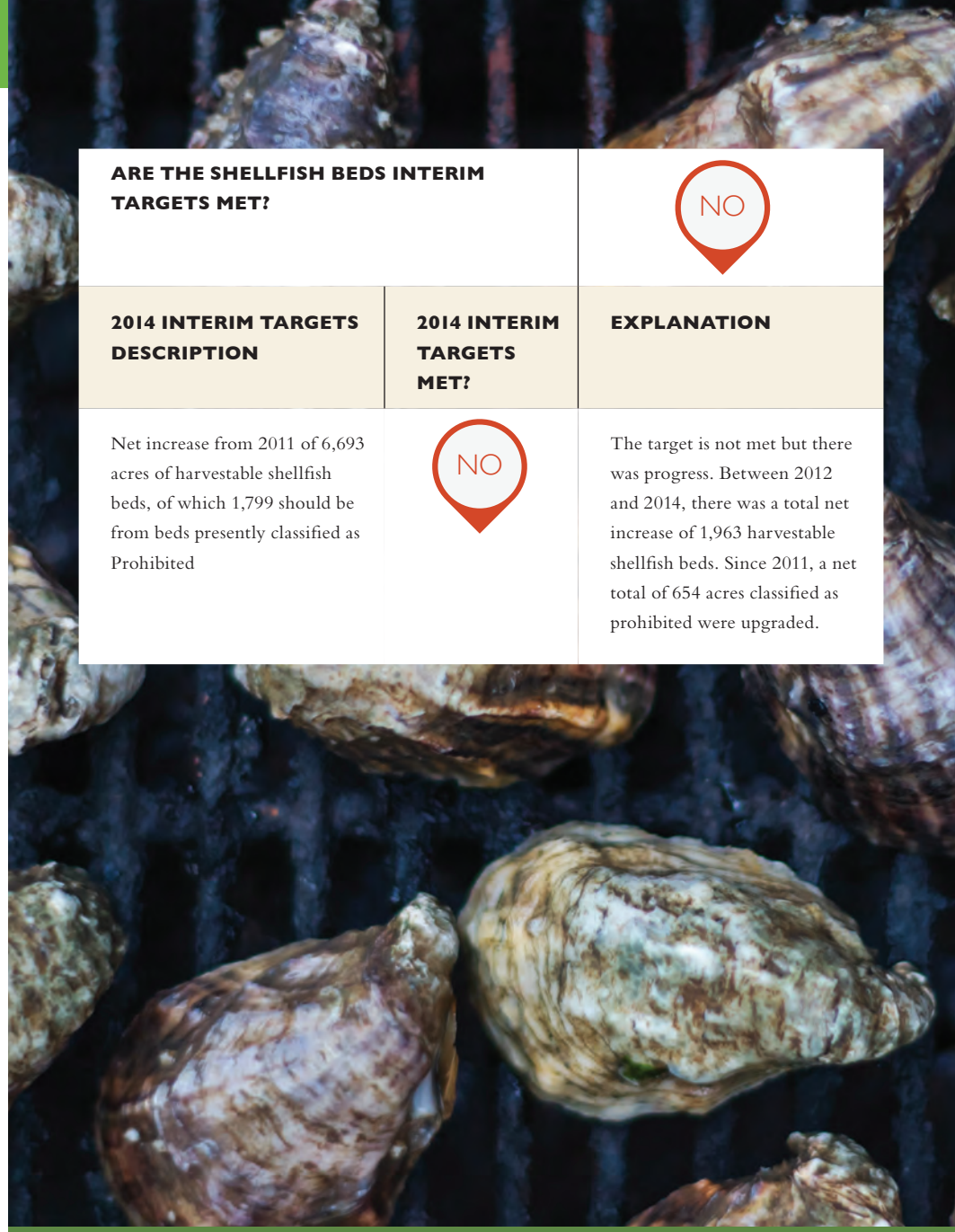
Source: Washington State Department of Health, Office of Environmental Health and Safety

Around Puget Sound, there are approximately 190,000 acres of classified commercial and recreational shellfish beds. However, about 36,000 acres of shellfish beds—or 19 percent—are closed due to pollution, most of which comes from fecal bacteria from humans, livestock, and pets. When fecal bacteria and other contaminants get into the water, they threaten the areas where oysters, clams, and other bivalve shellfish grow.

The Washington State Department of Health classifies shellfish growing areas based on the water quality. Upgrades in classification mean that water quality has improved, allowing for fewer restrictions on shellfish harvest.

PROGRESS SUMMARY:
Because there was an overall increase in cumulative net area since 2007, including from the prohibited category, the indicator is making progress toward 2020 target. However, little progress has been made since 2012 and the 2014 interim target is not met. About 81 percent (154,000 acres) of the shellfish growing areas are currently suitable for harvest.

- Since 2007, the baseline reference, more acres of shellfish beds were upgraded than downgraded across all classifications, resulting in a net increase of 2,851 acres of harvestable shellfish beds (7,828 acres gain, 4,977 acres loss).
- During the same time period, a net 4,091 acres of shellfish beds were upgraded from the "prohibited" classification (4,287 acres upgraded minus 196 acres downgraded to "prohibited").



ARE THE SHELLFISH BEDS INTERIM TARGETS MET?		NO
2014 INTERIM TARGETS DESCRIPTION	**2014 INTERIM TARGETS MET?**	**EXPLANATION**
Net increase from 2011 of 6,693 acres of harvestable shellfish beds, of which 1,799 should be from beds presently classified as Prohibited	NO	The target is not met but there was progress. Between 2012 and 2014, there was a total net increase of 1,963 harvestable shellfish beds. Since 2011, a net total of 654 acres classified as prohibited were upgraded.

FOR MORE IN-DEPTH INFORMATION, PLEASE SEE:
www.psp.wa.gov/vitalsigns/shellfish_beds_reopened

SOUND BEHAVIOR

INDICATOR: SOUND BEHAVIOR INDEX

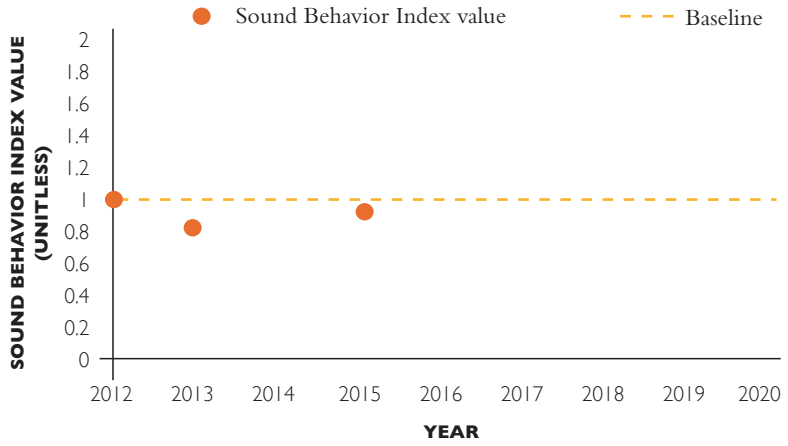
INDICATOR LEAD AND AFFILIATION:
Dave Ward, Puget Sound Partnership

2020 TARGET: There is no adopted target for this indicator

PROGRESS:

NOT CHANGING

FIGURE 6. SOUND BEHAVIOR INDEX
2012 – 2015



Source: Puget Sound Partnership

Many of our common day-to-day behaviors seem benign on their own, but when multiplied by 4.5 million residents, their cumulative effects can harm Puget Sound. Fostering beneficial behaviors and reducing detrimental ones is a crucial step in Puget Sound's recovery.

The Sound Behavior Index tracks 28 specific practices that can affect water quality and aquatic habitat. The index is based on a survey conducted every 2 years among a sample of Puget Sound residents. The Sound Behavior Index distills the region's environmental performance into a single score for a year. The value 1.0 is the baseline. Index values above 1.0 indicate a shift toward behaviors and practices helpful to Puget Sound. Index values falling below 1.0 indicate that behaviors and practices are becoming more harmful to Puget Sound.

PROGRESS SUMMARY:

It is still early in the index's life, and this index will detect meaningful change only in the long-term. Results from three surveys so far show that about half (11) of the behaviors improved slightly, about half (10) declined and a few (7) did not change. When combined into an index score, results indicate very little change over time.

FOR MORE IN-DEPTH INFORMATION, PLEASE SEE:
www.psp.wa.gov/vitalsigns/sound_behavior_index

RECREATIONAL FISHING

INDICATOR: RECREATIONAL FISHING LICENSE SALES

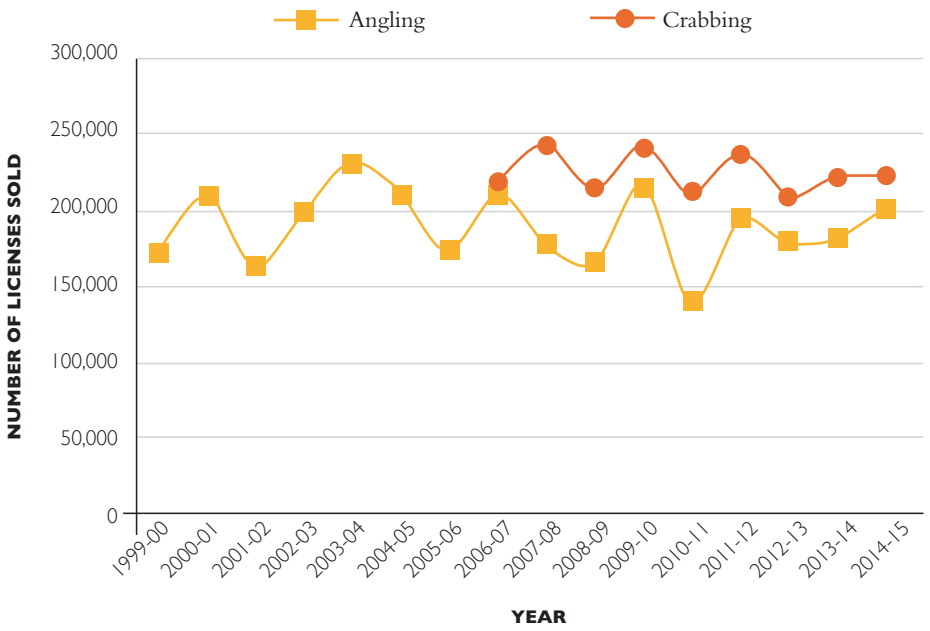
2020 TARGET: There is no adopted target for this indicator

PROGRESS:

NOT CHANGING

INDICATOR LEAD AND AFFILIATION:
Eric Kraig, Washington State Department of Fish & Wildlife

FIGURE 7. RECREATIONAL FISHING AND CRABBING LICENSE SALES IN PUGET SOUND
1999 – 2000 to 2014 – 2015 seasons



Source: Catch Record Card Data, Washington Department of Fish & Wildlife, Washington Interactive License Database (WILD) Dedicated Fund Telephone Survey

For generations, residents of Puget Sound and many visitors have enjoyed fishing in Puget Sound and along its numerous rivers and streams. Today, because of the decline in some populations of fish, recreational fishing is closely co-managed by treaty tribes in Puget Sound and the State of Washington to avoid harming individual species or stocks that need protection.

The indicator for recreational fishing license sales is viewed as a proxy for the opportunity to fish and relates to human wellbeing. Recreational fishing license sales for both angling and crabbing are estimated in Puget Sound based on all license types—annual and shorter-term. Recreational fishing license sales fluctuate up and down about every 2 years, primarily because of the large number of pink salmon that return to Puget Sound rivers and the Fraser River in odd years.

PROGRESS SUMMARY:

Over the long-term, there was no upward or downward linear trend in the sale of angling and crabbing licenses. License sales hovered around an average of 189,000 licenses and 225,000 licenses, respectively, per year.

FOR MORE IN-DEPTH INFORMATION, PLEASE SEE:

www.psp.wa.gov/vitalsigns/recreational_fishing_permit_sales

COMMERCIAL FISHERIES

INDICATOR: POUNDS OF SALMON CAUGHT IN COMMERCIAL HARVEST

INDICATOR LEAD AND AFFILIATION:
Marjorie Morningstar, Washington State Department of Fish & Wildlife

2020 TARGET: There is no adopted target for this indicator

PROGRESS:

GETTING BETTER

FIGURE 8. POUNDS OF ALL SALMON CAUGHT IN PUGET SOUND COMMERCIAL HARVEST
1997 – 2014

Source: Licensing and Fish Ticket (LiFT) System maintained by the Washington Department of Fish & Wildlife

Commercial fishing is a key industry in Puget Sound. Millions of dollars of revenue are generated annually from fish sales. The treaty tribes in Puget Sound, along with the State of Washington, jointly manage the fish and shellfish resources.

Collectively, tribal and non-tribal fishers are each entitled to up to half of the harvestable amount by treaty. Every year, limits are set based upon a set of factors that are used to predict how many fish will be available for harvest, taking into account the status of protected and non-protected stocks. Overall limits on fishing are set to ensure that harvests are sustainable and there will be adequate salmon resources into the future. Then the allowable catch must be divided into commercial, recreational, subsistence, and ceremonial harvest.

Between 1997 and 2014, annual commercial harvest was, on average, 21 million pounds (range 6 to 43 million pounds). Similar to the recreational fishing license sales indicator, commercial harvest fluctuates up and down about every 2 years, primarily because of pink salmon return to the area in large numbers in odd years.

PROGRESS SUMMARY:

Based on a simple linear trend, there was a slight increase in the commercial harvest of salmon since 1997. This slight trend is probably due to a combination of factors:

- Larger returns of Puget Sound and Fraser River pink salmon in recent odd years.
- Return cycles of chum and sockeye, returning primarily as 4-year-olds.
- Higher numbers of chum in 2002, 2004, and 2006.
- Record returns in 2010 of Fraser River sockeye, leading to high catches in even years even without pink salmon traveling through Puget Sound.

FOR MORE IN-DEPTH INFORMATION, PLEASE SEE:

www.psp.wa.gov/vitalsigns/commercial_fisheries_harvest

CHINOOK SALMON

INDICATOR: CHINOOK SALMON POPULATION ABUNDANCE

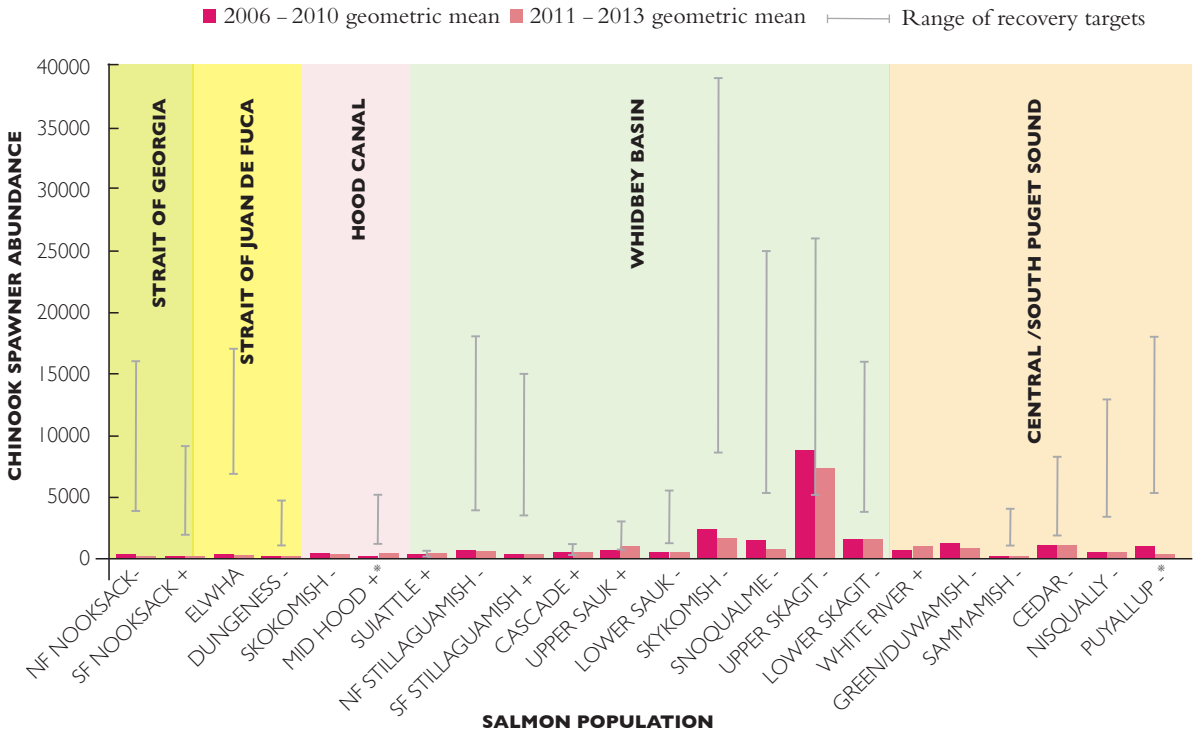
INDICATOR LEAD AND AFFILIATION:
Joseph Anderson, Washington State Department of Fish & Wildlife

2020 TARGET: Stop the overall decline and start seeing improvements in wild Chinook salmon abundance in two to four populations in each biogeographic region.

PROGRESS:

GETTING WORSE

FIGURE 9. MEAN CHINOOK SALMON SPAWNER ABUNDANCE IN EACH POPULATION IN PUGET SOUND, SHOWN BY GEOGRAPHIC REGION.
2006 – 2010 vs 2011 – 2013



Spawner abundance is the number of naturally spawning Chinook salmon, either natural-origin natural spawners, or total natural spawners (in populations where hatchery-origin natural spawners are not discriminated). The brown and red bars show the geometric mean annual abundance for 2006 – 2010 and 2011 – 2013, respectively. The gray vertical lines show the recovery target ranges from National Marine Fisheries Service's Final Supplement to the Shared Strategy's Puget Sound Recovery Plan (2006). There are no targets available for Skokomish, White, and Green rivers. The + symbol for six populations and the – symbol for 13 of the 22 populations indicate that the population increased or declined, respectively, over the time period. The analysis of change over time for three populations was not possible. The * indicates the difference was statistically significant for two populations.

Source: Washington Department of Fish and Wildlife, SaSI database

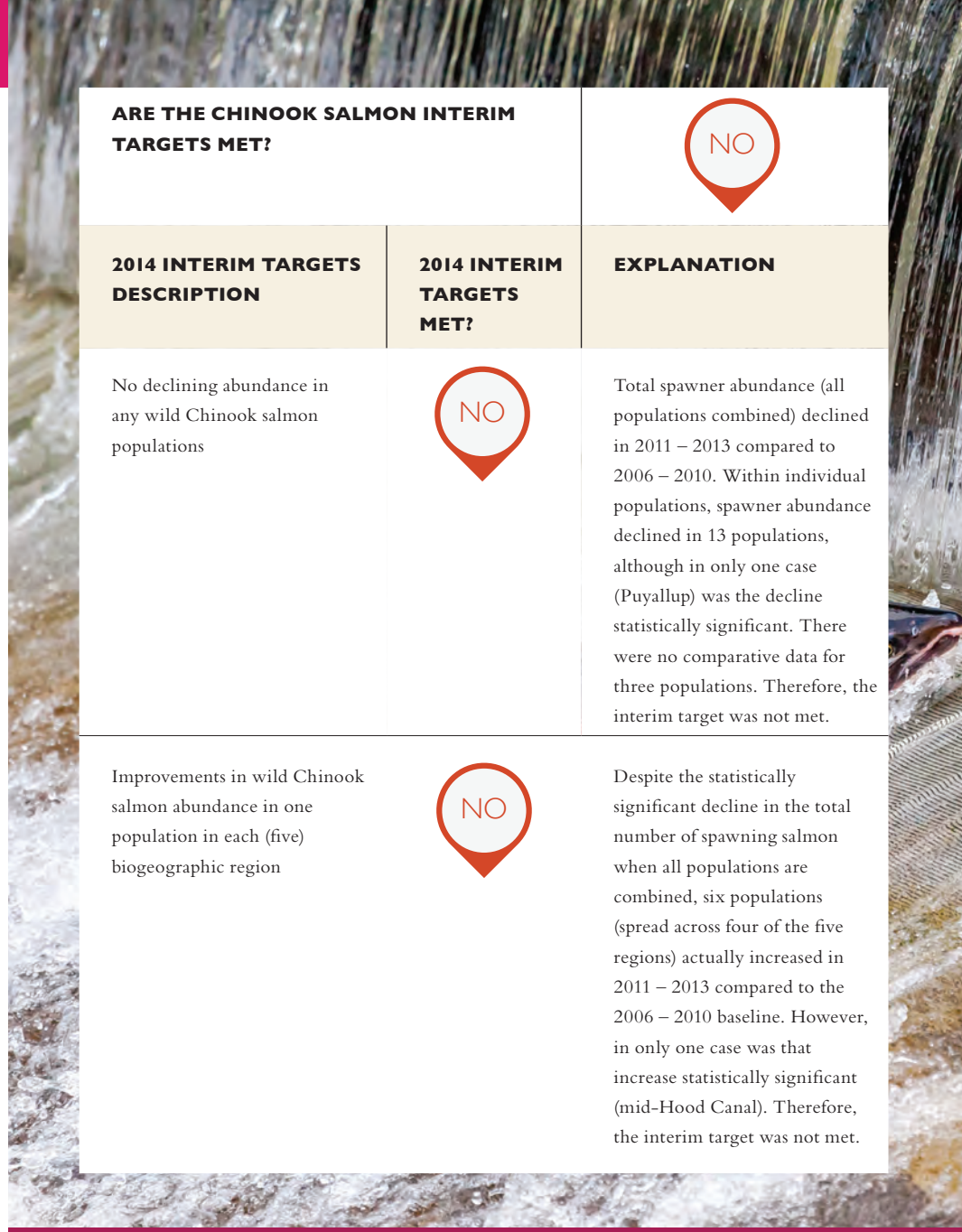
Chinook salmon are the largest of the salmon species. They are a favorite food of orcas, are highly prized by anglers and commercial fisherman, and are an important cultural and economic resource for tribes. Puget Sound Chinook salmon are about one-third as abundant now as they were in the early 1900s, and were listed in 1999 as Threatened under the federal Endangered Species Act. Today, 22 populations of Chinook salmon spawn in Puget Sound rivers.

To evaluate change over time, the mean (annual) abundance of spawning Chinook salmon for the 3-year period 2011 – 2013 was compared to the 5-year baseline period 2006 – 2010. The comparison was done both for the total abundance (all populations combined), and the change in abundance of each population individually.

PROGRESS SUMMARY:

The total number of naturally spawning Chinook salmon has declined, the 2014 interim targets for spawning Chinook salmon have not been met, there is little sign of improvement in each biogeographic region, and most populations remain far below their recovery planning targets adopted by the National Marine Fisheries Service. Natural-origin natural spawners are wild Chinook, salmon spawning naturally in a stream or river. In contrast, total natural spawners are the count of all Chinook salmon spawning naturally in a stream or river, including both wild Chinook as well as hatchery-produced Chinook that did not return to the hatchery but instead spawned in a stream or river.

- The mean total abundance of naturally spawning Chinook was lower in 2011 – 2013 than in 2006 – 2010, and this decline was statistically significant (p=0.08).
- Among the 22 individual populations, 13 declined and 6 increased. In the three remaining cases (Elwha, North Fork Stilliquamish, South Fork Stilliquamish), the methods of estimating population abundance changed over the time period such that direct comparisons cannot be made.



ARE THE CHINOOK SALMON INTERIM TARGETS MET? NO

2014 INTERIM TARGETS DESCRIPTION	2014 INTERIM TARGETS MET?	EXPLANATION
No declining abundance in any wild Chinook salmon populations	NO	Total spawner abundance (all populations combined) declined in 2011 – 2013 compared to 2006 – 2010. Within individual populations, spawner abundance declined in 13 populations, although in only one case (Puyallup) was the decline statistically significant. There were no comparative data for three populations. Therefore, the interim target was not met.
Improvements in wild Chinook salmon abundance in one population in each (five) biogeographic region	NO	Despite the statistically significant decline in the total number of spawning salmon when all populations are combined, six populations (spread across four of the five regions) actually increased in 2011 – 2013 compared to the 2006 – 2010 baseline. However, in only one case was that increase statistically significant (mid-Hood Canal). Therefore, the interim target was not met.

FOR MORE IN-DEPTH INFORMATION, PLEASE SEE:
www.psp.wa.gov/vitalsigns/salmon

ORCAS

INDICATOR: NUMBER OF SOUTHERN RESIDENT KILLER WHALES

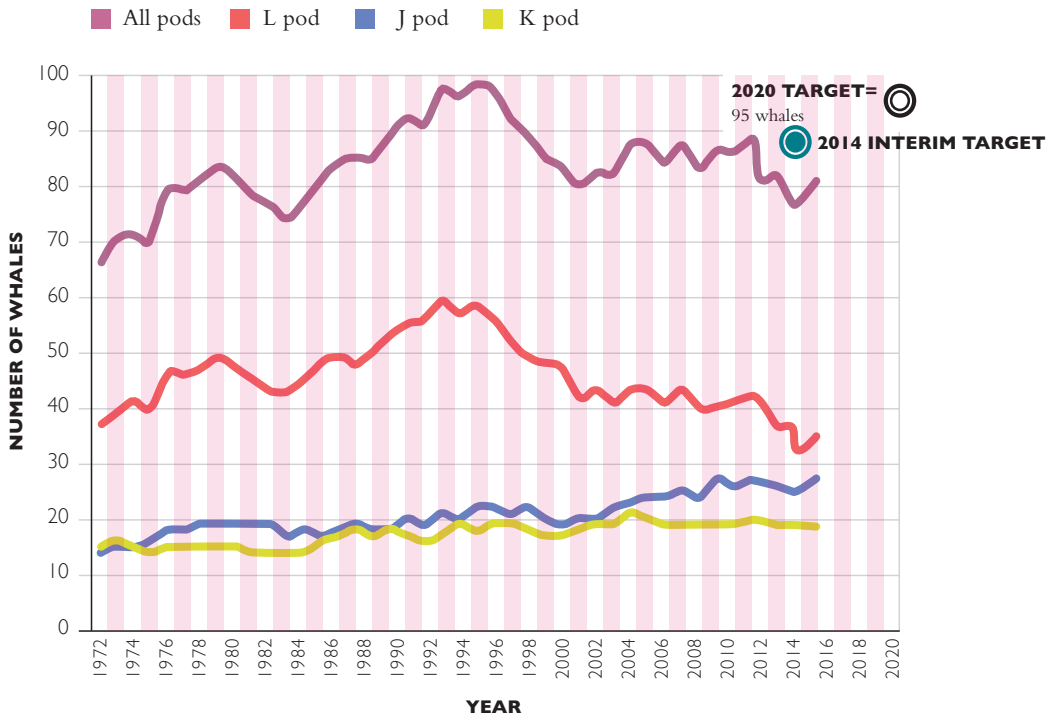
INDICATOR LEAD AND AFFILIATION:
Ken Balcomb, Center for Whale Research

2020 TARGET: By 2020, achieve an end-of-year census of 95 individual Southern Resident Killer Whales, which would represent a 1 percent annual average growth rate from 2010 to 2020.

PROGRESS:

GETTING WORSE

FIGURE 10. NUMBER OF SOUTHERN RESIDENT KILLER WHALES IN PUGET SOUND
1972 – 2015



Source: Center for Whale Research

Killer whales, also called orcas, are among Puget Sound's most distinctive and charismatic inhabitants. They occupy an important niche at the top of the food web and support a multi-million dollar whale-watching industry. Southern Resident Killer Whales are a unique population of orcas that ranges in the Salish Sea and the West Coast. These whales eat fish and depend heavily on Chinook salmon for food. In the late-1990s, Southern Resident Killer Whales experienced a dramatic decline. The combination of a precarious food supply and threats from pollution, vessel traffic, and noise continues to jeopardize their survival. As a result, they are federally listed as endangered.

PROGRESS SUMMARY:

The 2014 interim target of 89 whales was not met. Although this orca population experienced an uptick in births in 2015, the population has decreased significantly since 2010, mainly driven by losses of individuals in L pod. The status of the population remains fragile.

- The July 2015 census led by the Center for Whale Research reports 81 whales, which includes four new calves. Since then, a fifth calf was discovered, bringing the count up to 82 whales.
- The 2014 census counted 78 whales, the lowest number reported in 20 years.

ARE THE ORCAS INTERIM TARGETS MET?		NO
2014 INTERIM TARGETS DESCRIPTION	**2014 INTERIM TARGETS MET?**	**EXPLANATION**
89 individuals in end-of-year census of Southern Resident Killer Whales	NO	In 2014, the census result was 78 whales. There were 81 whales as of July 1, 2015. Since then, a new calf was discovered, bringing the count up to 82 whales.

FOR MORE IN-DEPTH INFORMATION, PLEASE SEE:
www.psp.wa.gov/vitalsigns/orcas

PACIFIC HERRING

INDICATOR: BIOMASS OF SPAWNING PACIFIC HERRING

INDICATOR LEAD AND AFFILIATION:
Dayv Lowry and Kurt Fresh, Washington State Department of Fish & Wildlife

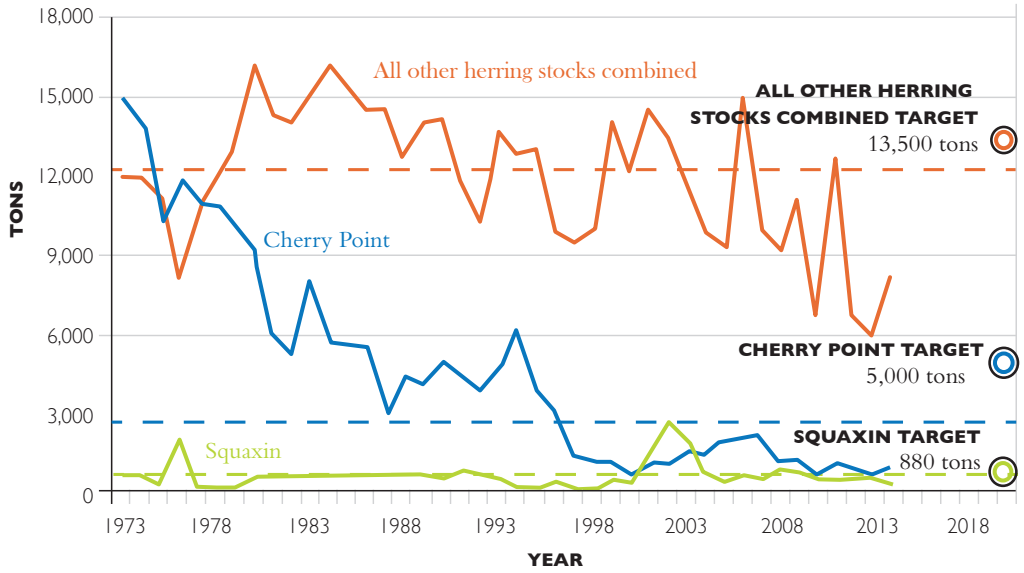
2020 TARGET: Increase the overall amount of spawning herring throughout Puget Sound to 19,380 tons. For each stock, the targets are:

- Cherry Point: 5,000 tons
- Squaxin Pass: 880 tons
- All other stocks: 13,500 tons

PROGRESS:

GETTING WORSE

FIGURE 11. SPAWNING BIOMASS OF PACIFIC HERRING STOCKS IN PUGET SOUND
1973 – 2014



Annual spawner abundance estimates for each stock are shown with solid lines; each color corresponds to a different stock. The dotted lines represent the 25-year mean from 1986 to 2010 for the corresponding stock. The 2020 target is shown with a dot for each stock.

Source: Washington Department of Fish & Wildlife, Fish Program

Together with a few other small, schooling fish species, herring play a unique role in the food web. Herring are an essential source of food for larger fish, seabirds, and marine mammals. As intermediates in the food web, they play a major role in energy transfer up to these higher-level consumers.

Herring in Puget Sound are subdivided into three stocks that reflect three unique genetic groupings: Cherry Point, Squaxin Pass, and all other stocks. The spawning biomass of Pacific herring is the estimated annual tonnage of spawning herring in Puget Sound. The 25-year mean biomass for each stock for 1986 – 2010 is intended to provide perspective for the current status of each stock (the 2-year mean of 2013 and 2014).

PROGRESS SUMMARY:
This indicator is getting worse.

- Overall, the current spawning biomass of all stocks is below both their respective 25-year mean reference and their 2020 target values.
- The Cherry Point herring stock in North Puget Sound, once the largest stock in the Sound, has declined by more than 90 percent since the earliest sampling date in 1973.
- The Squaxin Pass and other Puget Sound stocks do not exhibit the sharp decline seen in the Cherry Point stock. Although these stocks show broad annual fluctuations, they are relatively closer to their 2020 target values than the Cherry Point stock. In fact, in some years, these stocks have gone above their target values.

FOR MORE IN-DEPTH INFORMATION, PLEASE SEE:
www.psp.wa.gov/vitalsigns/pacific_herring

BIRDS

INDICATOR: POPULATION ABUNDANCE OF MARINE BIRDS

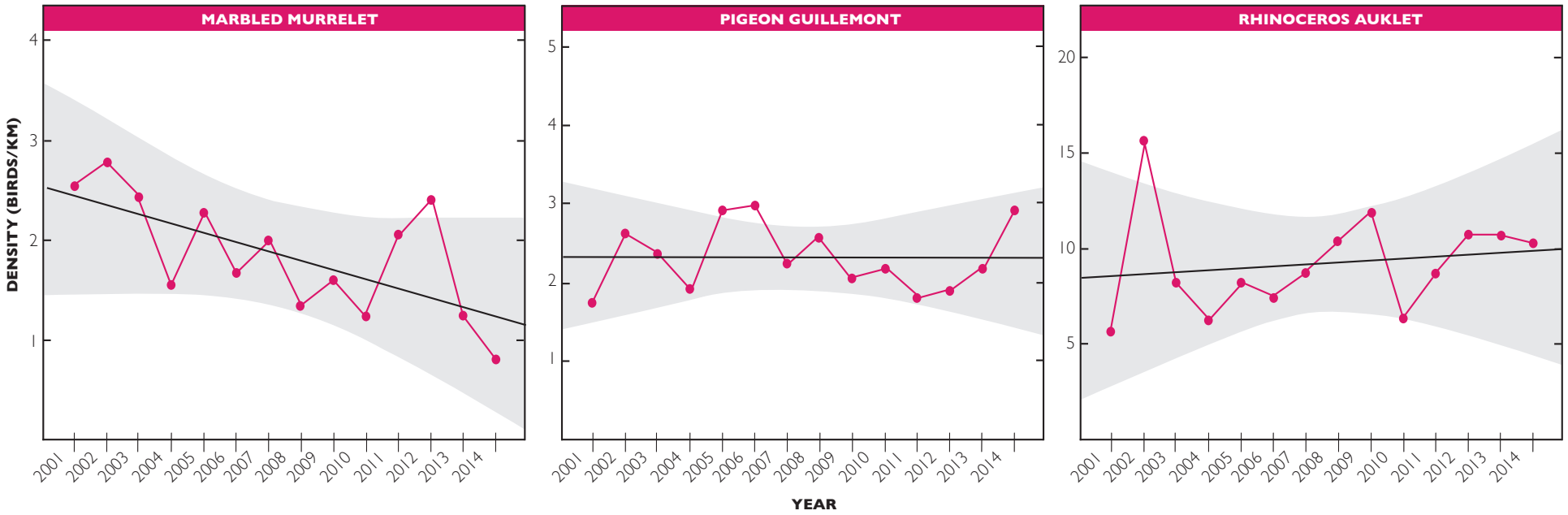
2020 TARGET: There is no adopted target for this indicator

PROGRESS:

MIXED RESULTS

INDICATOR LEAD AND AFFILIATION:
Scott Pearson, Washington State Department of Fish & Wildlife

FIGURE 12. DENSITY ESTIMATES AND TRENDS OF MARINE BIRD INDICATORS IN PUGET SOUND
2001 – 2014



Magenta dots and line are density estimates. Black line shows the linear trend. Grey band is the 95% confidence interval of the trend.

Source: Washington Department of Fish & Wildlife

A large community of aquatic and terrestrial bird species depend on Puget Sound and its watersheds for reproduction and survival. Each winter, thousands of seabirds, seaducks, and waterfowl migrate from all directions to converge in the relatively calm and food-rich waters of Puget Sound. In summer, colonies of seabirds are busy attending their young. In spring and fall, the shorelines are full of shorebirds that stop to feed and rest during migration. The indicators for marine birds are the following:

- Spring/summer at-sea densities of rhinoceros auklet, pigeon guillemot, and marbled murrelet. These species are highly dependent on the marine environment of, and breed in, Puget Sound.
- At-sea abundance trends of scoter species that overwinter in Puget Sound and Strait of Juan de Fuca. These species are highly dependent on the marine environment of Puget Sound, but do not breed there.

PROGRESS SUMMARY:

Data show mixed results for changes over time in marine bird species:

- Soundwide the densities of pigeon guillemot and rhinoceros auklet have fluctuated year-to-year but show no trend over the past 14 years.
- In contrast, the marbled murrelet population has declined by 5.4 percent per year over the past 14 years, and this trend is statistically significant.
- Long-term trends of scoter populations are forthcoming, as a new data analysis and processing approach is in development.

FOR MORE IN-DEPTH INFORMATION, PLEASE SEE:

www.psp.wa.gov/vitalsigns/birds

SHORELINE ARMORING

INDICATOR: AMOUNT OF SHORELINE ARMORING

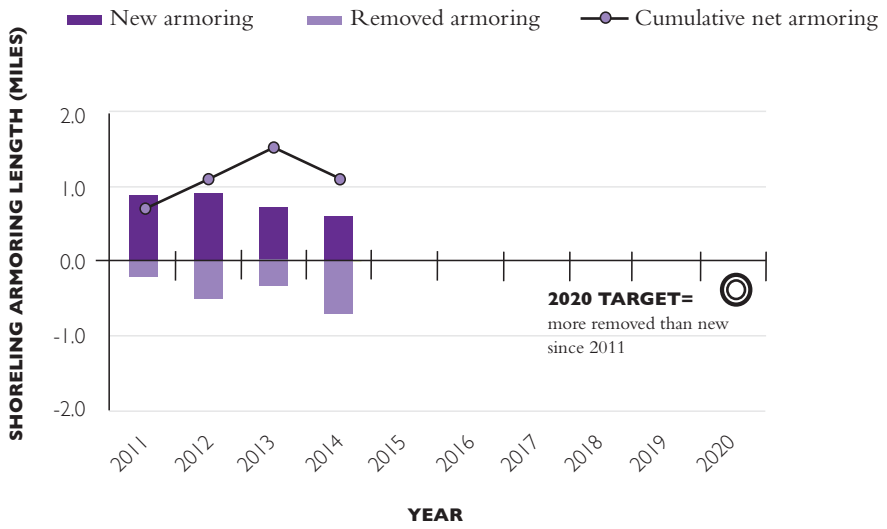
INDICATOR LEAD AND AFFILIATION:
Randy Carman, Washington State Department of Fish & Wildlife and Hugh Shipman, Washington State Department of Ecology

2020 TARGET: From 2011 to 2020, the total amount of armoring removed should be greater than the total amount of new armoring in Puget Sound (total miles removed is greater than the total miles added).

PROGRESS:

GETTING BETTER

FIGURE 13. NEW, REMOVED AND CUMULATIVE NET ARMORING IN PUGET SOUND
2011 – 2014



Source: Data compiled from Hydraulic Project Approvals issued by Washington Department of Fish & Wildlife, Habitat Program.

Shoreline armoring is the most common type of shoreline modification on Puget Sound. Armoring directly alters geologic processes that build and maintain beaches and spits. Bulkheads also impact erosion patterns on nearby beaches, alter beach substrate and hydrology, and reduce the availability of large wood. These physical changes to beaches can diminish the availability and condition of habitat and can also directly impact plants and animals.

Because of these adverse impacts on coastal processes and shoreline habitat, the goal is to decrease the amount of new armoring that occurs on Puget Sound, while also seeking opportunities to reduce armoring where feasible.

PROGRESS SUMMARY:

Data are derived from the Hydraulic Project Approvals (permits issued for in-water work and shoreline construction activities). More armoring was gained than lost cumulatively since 2011, resulting in a net cumulative length of 1.1 miles (6,000 feet). However, in 2014, more armoring was removed than was added, a ratio that aligns well with the 2020 target. Because the rate of adding new armoring has slowed and more armoring was removed than added in 2014, this indicator appears to make some progress toward the 2020 target.

- New armoring continues to be constructed at an average pace of 0.7 miles (3,700 feet) per year (mean of 2011 – 2014), but the pace has slowed progressively since 2012.
- In contrast, shoreline armoring is removed at an average rate of 0.4 miles (2,200 feet) per year—not enough to balance out new armoring.

FOR MORE IN-DEPTH INFORMATION, PLEASE SEE:
www.psp.wa.gov/vitalsigns/shoreline_armoring

EELGRASS

INDICATOR: EELGRASS AREA

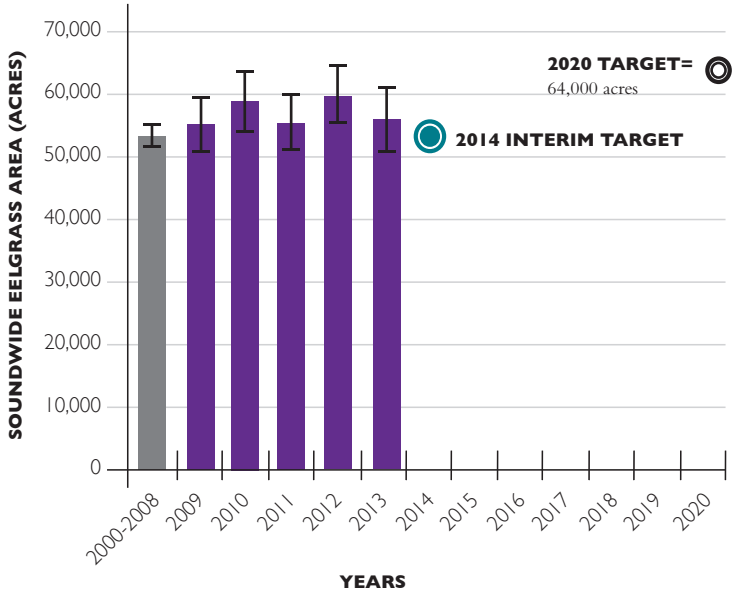
INDICATOR LEAD AND AFFILIATION:
Bart Christiaen, Washington State Department of Natural Resources

2020 TARGET: A 20 percent increase in the area of eelgrass in Puget Sound relative to the 2000 – 2008 baseline reference by the year 2020.

PROGRESS:

NOT CHANGING

FIGURE 14. ACRES OF EELGRASS IN PUGET SOUND
2000 – 2008 baseline average and 2009 – 2013 annual averages



Mean with standard error bars are shown.

Source: Washington State Department of Natural Resources, Submerged Vegetation Monitoring Program

Eelgrass *(Zostera marina)* is an important marine plant that serves as food source, nursery, and haven for birds, fish, crabs, shellfish, and other marine organisms. Eelgrass meadows can locally reduce the effects of ocean acidification, and play an important role in carbon cycling. Eelgrass also filters sediments and nutrients, improving water clarity, and stabilizes the sea floor, which protects shorelines from erosion.

Eelgrass is monitored at 347 sites in Puget Sound.

PROGRESS SUMMARY:

Although there has been little progress toward the 2020 target, recent increases in eelgrass area at local scales provide reason for cautious optimism regarding future gains.

- Between 2000 and 2008 (the baseline reference), total eelgrass area in Puget Sound was approximately 53,300 acres.
- Soundwide eelgrass area has changed little since 2000.
- Currently, the Soundwide estimate of eelgrass cover hovers around 57,000 acres, based on the 2011 to 2013 average.
- The 2011 – 2013 estimate is approximately 7 percent higher than the 2000 – 2008 baseline, but has a wide range of uncertainty.

ARE THE EELGRASS INTERIM TARGETS MET?		MIXED RESULTS
2014 INTERIM TARGETS DESCRIPTION	**2014 INTERIM TARGETS MET?**	**EXPLANATION**
Overall Soundwide eelgrass area increasing or stable relative to 2000 – 2008 baseline	YES	Overall Soundwide area is stable relative to the 2000 – 2008 baseline. Latest estimates do not include 2014 data, and instead are based on 2011 – 2013 averages.
Two or more of the five regions show eelgrass area stability or improvement	INSUFFICIENT DATA	Hood Canal is improving. Not enough information to make a conclusion for the other regions.
Within each region, fewer sites show eelgrass declines compared to 2011	INSUFFICIENT DATA	Hood Canal is improving. Not enough information to make a conclusion for the other regions.
Depth distribution identified	YES	Depth distribution identified. The report is available from the Department of Natural Resources.

FOR MORE IN-DEPTH INFORMATION, PLEASE SEE:
www.psp.wa.gov/vitalsigns/eelgrass

LAND DEVELOPMENT AND COVER

INDICATOR: LAND COVER CHANGE: FOREST TO DEVELOPED

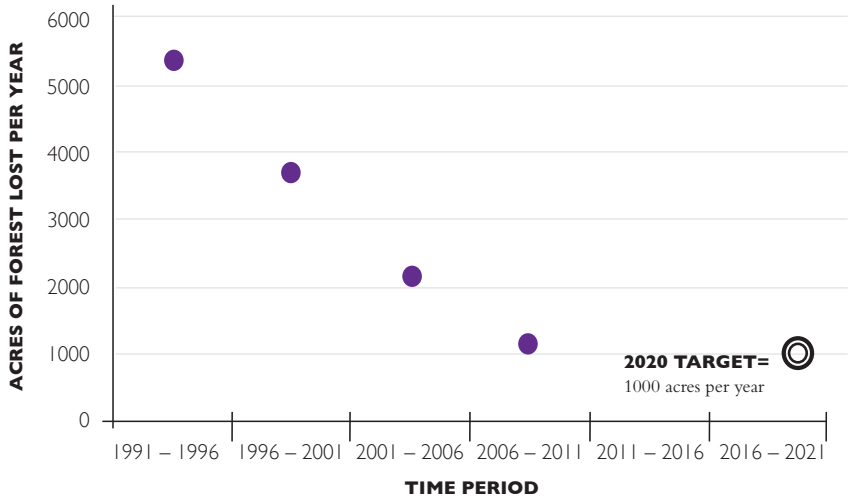
INDICATOR LEAD AND AFFILIATION:
Kenneth B. Pierce Jr., Washington State Department of Fish & Wildlife

2020 TARGET: The average annual loss of forested land cover to developed land cover in non-federal lands does not exceed 1,000 acres per year, as measured with Landsat-based change detection.

PROGRESS:

GETTING BETTER

FIGURE 15. FOREST LOSS ON NON-FEDERAL LANDS
1991 to 2011, reported in 5 year periods



Source: Washington Department of Fish & Wildlife, Habitat Program and National Oceanic and Atmospheric Administration (NOAA) Coastal Change analysis

Note: While the forest loss indicator provides a good measure of forest cover change across all Puget Sound watersheds, it underestimates forest conversion, particularly in urbanizing areas that exhibit complex mixes of land cover. Additionally, urban in-fill, or the continuing conversion of small forested parcels, often occurs at sizes too small to be captured reliably by the 30m NOAA satellite data used for this indicator. Work at the Washington Department of Fish & Wildlife is underway to develop a more sensitive land cover change analysis based on high-resolution photography.

Forests are important for the health of Puget Sound watersheds because forested landscapes provide habitat that support terrestrial species, deliver watershed functions that support freshwater systems, and provide ecological and cultural services for humans.

The forest loss indicator measures the loss of non-federal forested land cover to developed land cover. The indicator provides a check on the region's success in maintaining forest cover throughout the Puget Sound Basin. More specifically, this indicator tracks the conversion of forested cover, including coniferous, deciduous, and mixed forest classes, to developed land cover by using four classes of development intensity, based on Landsat satellite imagery with a 30m resolution.

While the forest loss indicator provides a good measure of forest cover change across all Puget Sound watersheds, it underestimates forest conversion, particularly in urbanizing areas that exhibit complex mixes of land cover. Additionally, urban in-fill, or the continuing conversion of small forested parcels, often occurs at sizes too small to be captured reliably by the 30m Landsat satellite data used for this indicator. Work at the Washington State Department of Fish & Wildlife is underway to develop a more sensitive land cover change analysis based on high-resolution photography.

PROGRESS SUMMARY:

The status of this indicator is improving relative to the baseline reference, and is making progress toward the 2020 target.

- Non-federal forestlands were lost to development at a rate of 2,176 acres per year for the period 2001 – 2006, the baseline reference year.
- Between 2006 and 2011, the most recent period with available data, the rate of forest loss decreased by almost half, down to 1,196 acres per year. The target value of 1,000 acres per year was nearly reached during the 2006 – 2011 period.

FOR MORE IN-DEPTH INFORMATION, PLEASE SEE:

www.psp.wa.gov/vitalsigns/land_cover_and_development

LAND DEVELOPMENT AND COVER

INDICATOR: LAND COVER CHANGE: RIPARIAN RESTORATION

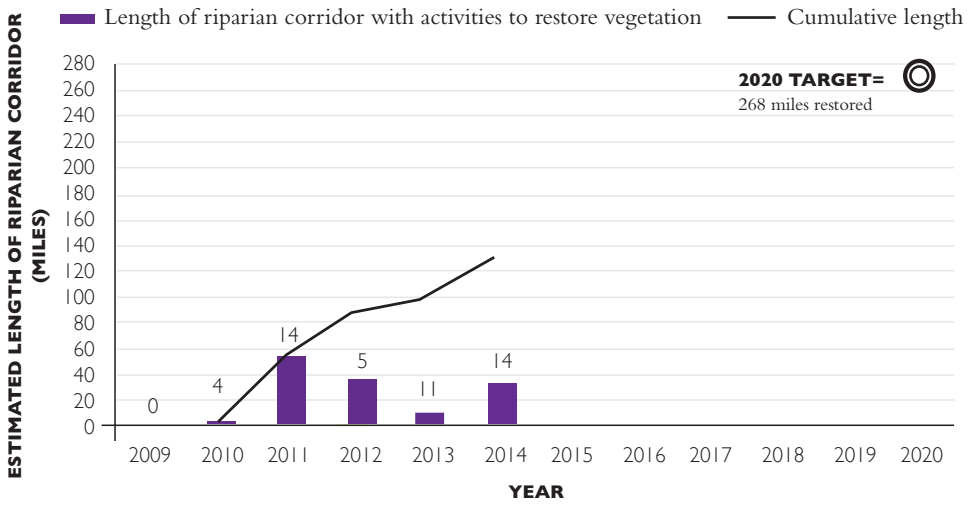
INDICATOR LEAD AND AFFILIATION:
Jeanette Dorner and Alex Mitchell, Puget Sound Partnership

2020 TARGET: Restore 268 miles of riparian vegetation or have an equivalent extent of restoration projects under way.

PROGRESS:

GETTING BETTER

FIGURE 16. ESTIMATED FOOTPRINT OF PROJECTS THAT RESTORED VEGETATION IN RIPARIAN CORRIDORS
2009 – 2020



The numbers over the bars show the number of projects that reported activities to restore vegetation in riparian corridors, for a total of 48 completed projects between 2009 and 2014. Years represent Federal Fiscal Year (2009 refers to Oct. 1, 2008, to Sep. 30, 2009). Cumulative length is the total between 2009 and 2014.

Source: National Estuary Program On-Line Report (NEPORT). Most projects in NEPORT were derived from the Project Information System (PRISM).

Land development has significantly degraded riparian vegetation corridors along Puget Sound rivers and streams. Intact riparian corridors are critical for keeping fresh and marine waters clean and cool, moderating variability in water volume and timing of flow (flood storage), and offering key habitat for myriad terrestrial, freshwater, and interface species, such as salmon.

The intent of the riparian restoration indicator is to measure the amount of new vegetated cover delivered by restoration projects along riparian corridors. Habitat restoration projects are compiled by the Puget Sound Partnership on behalf of the U.S. Environmental Protection Agency. Data indicate that activities to restore vegetation in riparian corridors, such as planting native species, were reported as completed for 67 projects in the Puget Sound basin from Federal Fiscal Years 2009 to 2014 (Oct. 1, 2008, through Sept. 30, 2014). The footprint of those activities was reported only for 48 of those projects. No projects were reported in 2009.

PROGRESS SUMMARY:

Because the cumulative amount of restoration of vegetation along riparian corridors increases incrementally every year, progress of the indicator is categorized as getting better.

- Cumulatively, activities to restore vegetation in riparian areas occurred along an estimated 135 linear miles of streams and rivers during that time period.
- This estimate is about half of the 2020 target of 268 miles.

FOR MORE IN-DEPTH INFORMATION, PLEASE SEE:

www.psp.wa.gov/vitalsigns/land_cover_and_development

LAND DEVELOPMENT AND COVER

INDICATOR: LAND DEVELOPMENT PRESSURE: CONVERSION OF ECOLOGICALLY IMPORTANT LANDS

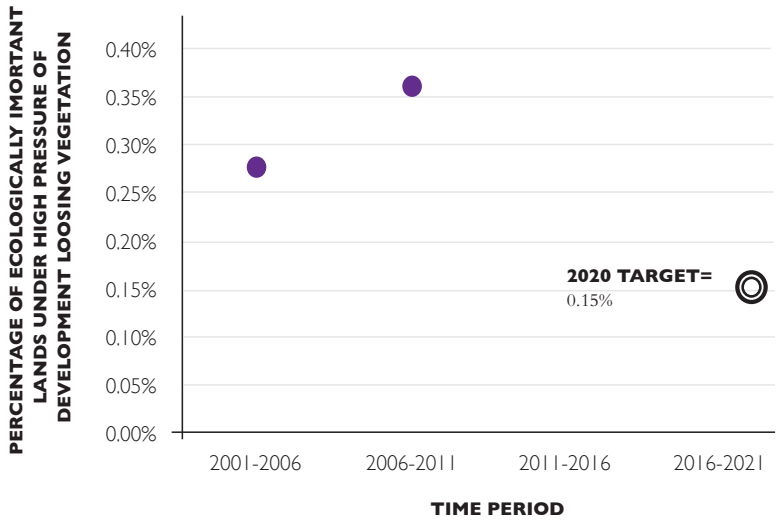
INDICATOR LEAD AND AFFILIATION:
Kenneth B. Pierce Jr., Washington State Department of Fish &Wildlife and Kari Stiles, Puget Sound Partnership

2020 TARGET: Basin-wide loss of vegetation cover on ecologically important lands under high pressure from development does not exceed 0.15 percent of the total 2011 baseline land area over a 5-year period.

PROGRESS:

GETTING WORSE

FIGURE 17. LAND CONVERSION FROM VEGETATED TO DEVELOPED COVER, OF ECOLOGICALLY IMPORTANT LANDS UNDER HIGH PRESSURE OF DEVELOPMENT IN 12 PUGET SOUND COUNTIES.
2001 – 2011, reported in 5-year periods



The percentage shown is the area of ecologically important lands under high pressure of development that was converted from vegetated to developed cover, as a percent of total area of ecologically important lands under high development pressure.

Source: Washington Department of Fish & Wildlife, Habitat Program. Analysis based on many federal, state, and local data sources.

This indicator tracks the fate of ecologically important lands under development pressure in Puget Sound watersheds.

The measure is the proportion of vegetated cover on undeveloped lands identified as both ecologically important and under high pressure from development for residential, commercial, and industrial uses, and that is converted in a given time period to developed cover. The rate of conversion of vegetated cover is estimated using Landsat satellite imagery with a 30m resolution.

PROGRESS SUMMARY:

Estimates of conversion show that this indicator is losing ground.

- The 5-year baseline rate of land cover change across all 12 counties in Puget Sound for the period 2001 – 2006 was 0.28 percent and increased to 0.36 percent over the period 2006 – 2011.
- Achieving the 2020 target will require reducing the conversion of ecologically important lands to development to less than half the rate of conversion observed in 2006 – 2011.

FOR MORE IN-DEPTH INFORMATION, PLEASE SEE:

www.psp.wa.gov/vitalsigns/land_cover_and_development

FLOODPLAINS

INDICATOR: FLOODPLAIN RESTORATION

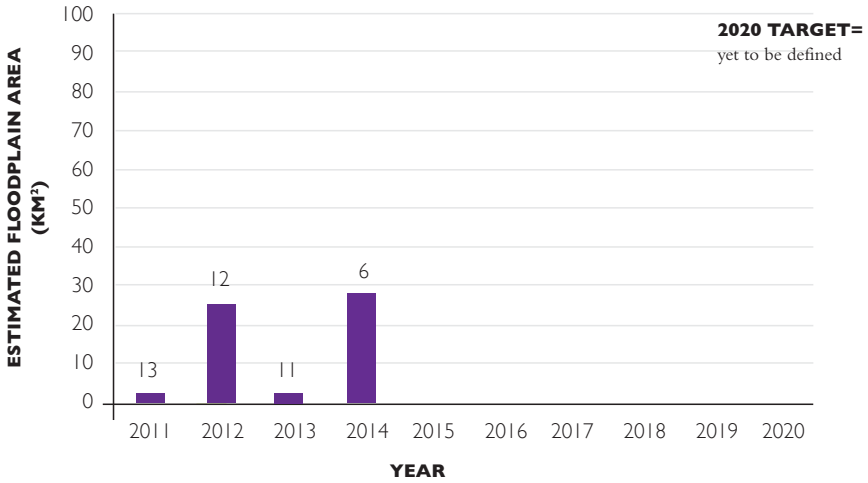
INDICATOR LEAD AND AFFILIATION:
Jennifer Burke, Nathalie Hamel, and Alex Mitchell, Puget Sound Partnership

2020 TARGET: Restore, or have projects underway to restore, 15 percent of degraded Puget Sound floodplain area, and there is no additional loss of floodplain function in any Puget Sound watershed relative to a 2011 baseline.

PROGRESS:

GETTING BETTER

FIGURE 18. ESTIMATED FOOTPRINT OF PROJECTS THAT WERE REPORTED TO IMPROVE FLOODPLAIN CONDITION IN PUGET SOUND'S 17 MAJOR RIVERS
2011 – 2014



The numbers over the bars show the number of projects that reported activities to improve floodplain condition in the extent of floodplains estimated by the FEMA 500-year floodplain maps and the USGS floodplain assessment along 17 major rivers in Puget Sound. Years represent federal fiscal years (2011 refers to Oct. 2010 to Sep. 2011).

Source: National Estuary Program On-Line Report (NEPORT). Most projects in NEPORT were derived from the Project Information System (PRISM).

Rivers and streams around Puget Sound respond to winter storms and melting snowpack by rising and flooding low-lying areas in the floodplain. By absorbing this overflow, floodplains provide functions and services like refuge, food, and fresh water for a variety of species, rich agricultural land, and level land that supports a variety of human uses. Unfortunately, floodplains have been degraded over time. Projects are underway to better manage floodplains, restore hydrologic connectivity and natural flows, reduce flood hazards, and improve habitat for salmon.

For each of Puget Sound's 17 major rivers, the extent of floodplains was estimated using two different approaches:

1. The Federal Emergency Management Agency's (FEMA) 500-year floodplain extent (where there is 0.2 percent chance of a flood hazard every year; FEMA 1996, 2015).

2. The U.S. Geological Survey's floodplain assessment based on landform and water surface elevation (Konrad 2015).

PROGRESS SUMMARY:

In recognition of past and ongoing efforts to improve the condition of floodplains, progress toward the 2020 target is categorized as getting better. However, in order to report against the 2020 target, more information is needed to define function and degradation of floodplains and to evaluate the impact of floodplain restoration projects.

- A total of 39 projects were completed, amounting to 58 km^2, from Federal Fiscal Year 2011 to 2014.
- Using the regional land cover and change analysis available for 2011 from the National Oceanic and Atmospheric (NOAA) Coastal Change Analysis Program (C-CAP), human development in the two floodplain extents described above ranges from 787 km^2 (51 percent of the FEMA floodplain extent of 1,500 km^2) down to 535 km^2 (54 percent of the USGS floodplain extent of 1,000 km^2). Land development in floodplains is a cause of degradation of floodplain function. However, floodplain function can be degraded by features other than land development (for instance a levee disconnecting a portion of floodplain from the river's main stem). Thus, areas degraded by development do not represent the full potential for habitat restoration.

FOR MORE IN-DEPTH INFORMATION, PLEASE SEE:
www.psp.wa.gov/vitalsigns/flood_plains

ESTUARIES

INDICATOR: AREA OF ESTUARINE WETLANDS RESTORED TO TIDAL FLOODING

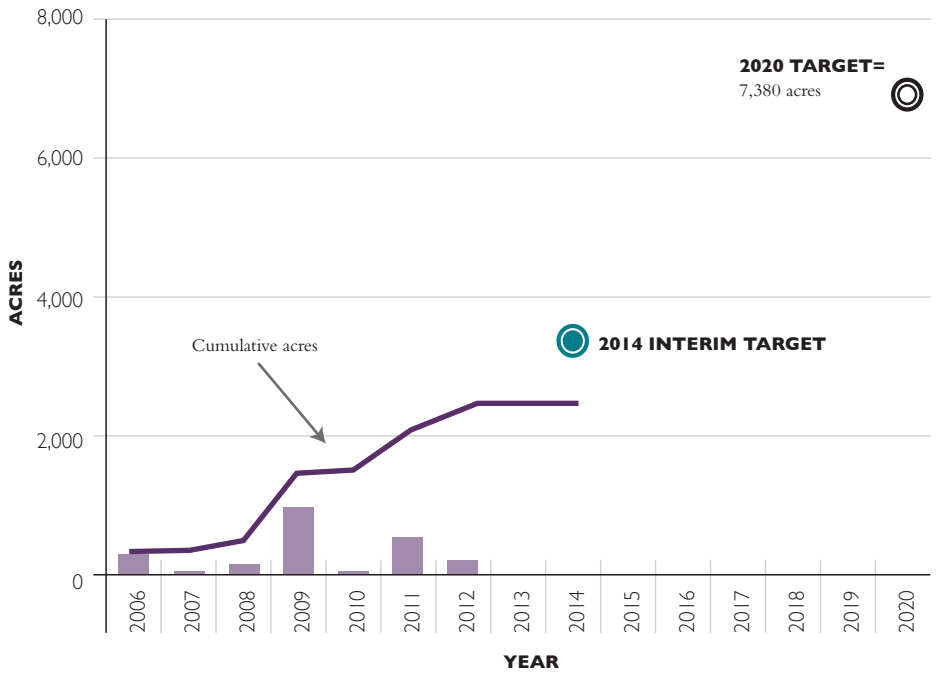
INDICATOR LEAD AND AFFILIATION:
Paul Cereghino, National Oceanic and Atmospheric Administration, Restoration Center and Alex Mitchell, Puget Sound Partnership

2020 TARGET: 7,380 quality acres of estuarine wetlands are restored basin-wide, which is 20 percent of total estimated restoration need.

PROGRESS:

GETTING BETTER

FIGURE 19. ESTIMATED AREA OF ESTUARINE WETLAND RESTORED TO TIDAL FLOODING
2006 – 2014



The numbers over the bars show the number of completed projects that reported activities to restore estuarine wetlands along 16 major rivers in Puget Sound. A total of 24 projects were completed between 2006 and 2014, amounting to 2,260 acres. Years represent Federal Fiscal Year (2006 refers to Oct. 2006 to Sep. 2007).

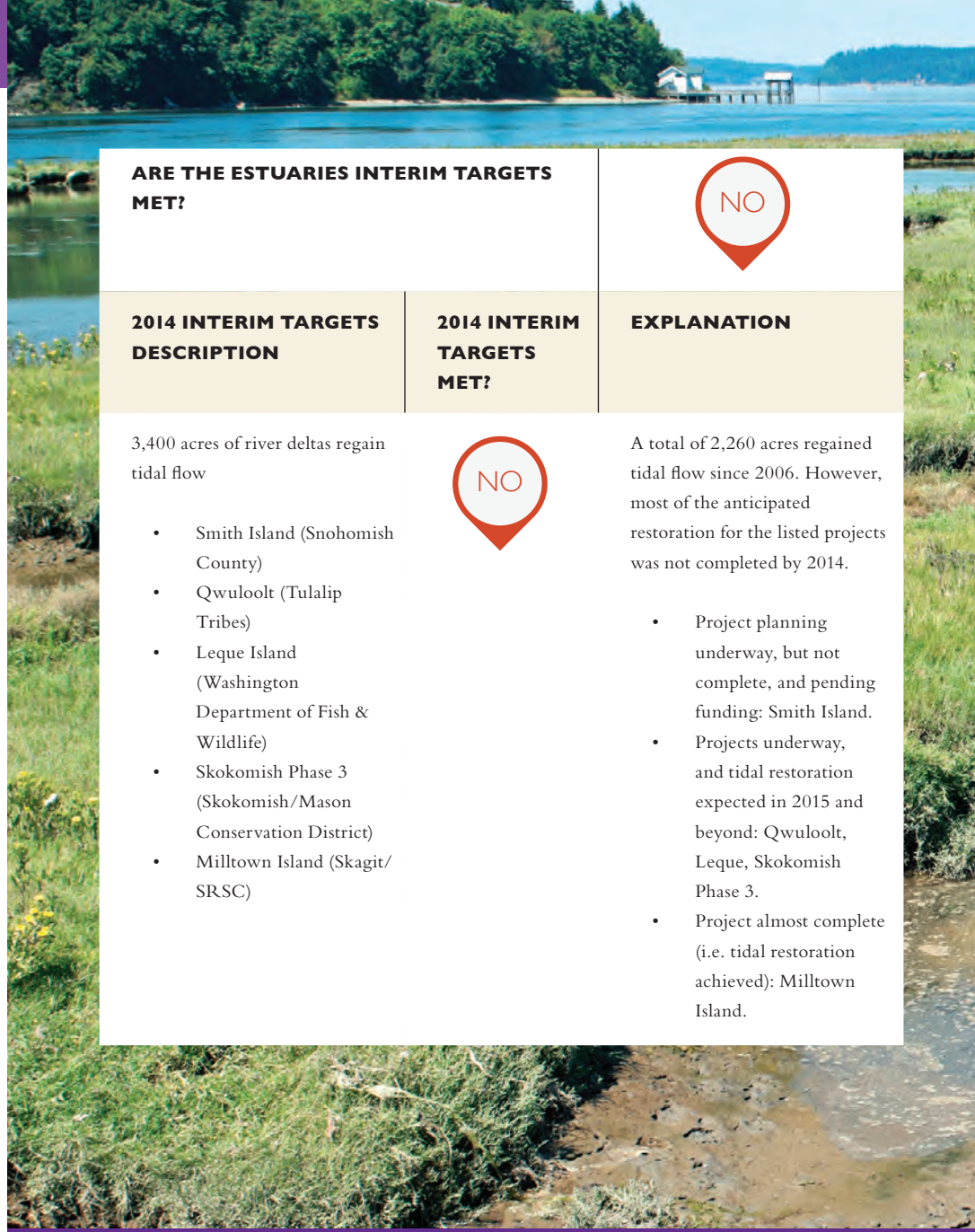
Source: Project Information System (PRISM), Washington State Recreation and Conservation Office

River delta estuaries form where rivers meet the sea, creating a unique and important environment where freshwater mixes with saltwater, and sediments collect. Estuaries provide important feeding and resting habitat for young salmon, migratory birds, and many other species that cannot find these unique benefits in any other place in the landscape.

This indicator tracks the amount of land returned to tidal flooding in the deltas (the landform that is formed at the mouth of a river where it meets Puget Sound) of Puget Sound's 16 major rivers.

PROGRESS SUMMARY:
There has been incremental progress in restoring river estuaries in Puget Sound since 2006. The interim target is not met, although projects are underway and some are close to complete. This indicator has made progress toward the 2020 target, but is behind expectations for restoration in certain areas.

- Approximately 2,260 acres of estuarine river delta wetlands have been restored to tidal flooding between 2006 and 2014.
- In 2013 and 2014, projects were underway to restore river deltas in Puget Sound, but none were officially documented as complete.



ARE THE ESTUARIES INTERIM TARGETS MET? NO

2014 INTERIM TARGETS DESCRIPTION	2014 INTERIM TARGETS MET?	EXPLANATION
3,400 acres of river deltas regain tidal flow • Smith Island (Snohomish County) • Qwuloolt (Tulalip Tribes) • Leque Island (Washington Department of Fish & Wildlife) • Skokomish Phase 3 (Skokomish/Mason Conservation District) • Milltown Island (Skagit/ SRSC)	NO	A total of 2,260 acres regained tidal flow since 2006. However, most of the anticipated restoration for the listed projects was not completed by 2014. • Project planning underway, but not complete, and pending funding: Smith Island. • Projects underway, and tidal restoration expected in 2015 and beyond: Qwuloolt, Leque, Skokomish Phase 3. • Project almost complete (i.e. tidal restoration achieved): Milltown Island.

FOR MORE IN-DEPTH INFORMATION, PLEASE SEE:
www.psp.wa.gov/vitalsigns/estuaries

ESTUARIES

INDICATOR: ESTUARY RESTORATION MEETING SALMON RECOVERY GOALS

INDICATOR LEAD AND AFFILIATION:
Stacy Vynne and Stephanie Suter, Puget Sound Partnership

2020 TARGET: By 2020, all Chinook salmon natal river deltas meet 10-year salmon recovery goals (or 10 percent of restoration need as proxy for river deltas lacking quantitative acreage goals in salmon recovery plans).

PROGRESS:

The shared goal for the salmon recovery community is to report on the following question: What is the historic, current, and desired amount of river delta area? Two indicators were identified to answer the question: functional estuary surface area and extent of shoreline armoring. The Puget Sound Partnership, as the regional organization for salmon recovery in Puget Sound, is working with the local salmon recovery community at the watershed scale to develop quantitative habitat goals and report out on a common set of indicators that reflect the highest priority monitoring needs across Puget Sound for Chinook salmon habitat. While the objective of the salmon recovery community is to be able to report progress consistently relative Vital Sign targets, watershed groups will continue to track indicators that measure different aspects of the ecosystem that are important for their locally relevant goals.

PROGRESS SUMMARY:

Currently, not all of the salmon recovery watersheds have quantitative 10-year or long-term goals for river deltas, and for those that do, some are in need of updating based on new science and information. In addition, salmon recovery watersheds are monitoring river delta health in different ways and reporting on different metrics. For example:

- The Chinook salmon recovery plan for the Elwha River watershed includes a goal to protect and restore estuary and nearshore habitats. The indicator to track progress toward this goal is the amount of submerged aquatic vegetation in the estuary that requires protection.
- The Chinook salmon recovery plan for the Snohomish River watershed includes a goal to preserve the estuary. The indicator to track progress toward this goal is the area of blind tidal channels.

FOR MORE IN-DEPTH INFORMATION, PLEASE SEE:
www.psp.wa.gov/vitalsigns/estuaries

SUMMER STREAM FLOWS

INDICATOR: SUMMER LOW FLOWS

INDICATOR LEAD AND AFFILIATION:
Paul Pickett, Washington State Department of Ecology

2020 TARGET: By 2020, meet the following river-specific target value as outlined in Table 10.

PROGRESS:

TABLE 3. LONG-TERM TRENDS IN SUMMER LOW FLOWS IN 13 MAJOR RIVERS IN PUGET SOUND AND STATUS RELATIVE TO THE 2020 TARGETS

1975–2011 vs 1975–2014

DESCRIPTION OF THE 2020 TARGET VALUE FOR EACH RIVER[1]	RIVER GAUGE STATION	SUMMER LOW FLOW TREND *(% change per year, 1975–2014)*	TREND CATEGORY *(1975–2014)*[2]	IS 1975–2011 REFERENCE TREND CONSISTENT WITH THE 2020 TARGET VALUE?	IS 1975–2014 TREND CONSISTENT WITH THE 2020 TARGET VALUE?
Maintain stable or increasing flows in these highly regulated rivers	Cedar River at Renton	+0.6%	STRONGLY INCREASING	YES	YES
	Green River near Auburn	+0.1%	WEAKLY INCREASING	YES	YES
	Nisqually River at Mckenna	+0.4%	STRONGLY INCREASING	YES	YES
	Skagit River near Mount Vernon	+0.3%	WEAKLY INCREASING	YES	YES
	Skokomish River near Potlatch	+1.0%	STRONGLY INCREASING	YES	YES
Maintain stable flows in these unregulated rivers that are currently stable	Dungeness River near Sequim	+0.5%	WEAKLY INCREASING	YES	YES
	Nooksack River at Ferndale	-0.1%	NO SIGNIFICANT TREND	NO	YES
	Puyallup River at Puyallup	+0.6%	STRONGLY INCREASING	YES	YES
Restore low flows from a weakly decreasing trend to no trend	Snohomish River near Monroe	-0.2%	NO SIGNIFICANT TREND	NO	YES
Restore low flows from a strongly decreasing trend to a weakly decreasing trend	Deschutes River near Rainier	-0.5%	WEAKLY DECREASING	NO	YES
	Issaquah Creek near mouth near Issaquah	-0.9%	STRONGLY DECREASING	NO	NO
	NF Stillaguamish River near Arlington	-0.9%	STRONGLY DECREASING	NO	NO
Monitor low flows after dam removal	Elwha	Monitoring occurring	Monitoring occurring	Not applicable, but river flow is monitored	Not applicable, but river flow is monitored

Low flows in rivers and streams occur during summer months when there is less rain and warmer weather. Low summer flows can affect salmon runs, wildlife, and water supply. Development that draws water away from streams can reduce flows even more. Pumps divert water, and new wells tap groundwater. New buildings, roads, and parking lots that prevent water from percolating into the ground can reduce the amount of water that would otherwise recharge summer streams. Shrinking snowpack and warmer summer temperatures can also reduce summer flows.

Summer low flow is measured as the annual minimum 30-day average water flow at river and stream gauging stations maintained by the U.S. Geological Survey from July through October.

PROGRESS SUMMARY:

Because the trend in summer low flow of some rivers remained consistent with the 2020 target or improved, the overall conclusion for progress is that the status improved. The drivers for this improvement have not been analyzed in detail, but several recent La Niña years produced intense winter storms with heavy snow and rain that may have contributed to higher flows.

- Based on the trend and information for the period 1975 to 2014, 11 of 13 rivers met their target value (including the Elwha). This represents an improvement; trends estimated for the period 1975 to 2011 indicated that only eight rivers met their target value.
- The summer low-flow trends improved in the Nooksack, Snohomish, and Deschutes rivers.
- The decreasing summer low flow trend in the Issaquah Creek and North Fork Stillaguamish River continue to be concerning. These same two rivers did not meet the 2014 interim target (and were the only ones that did not).

[1]**Status of indicator relative to 2020 target and reference**
Number of rivers whose trend is consistent with the 2020 target value in both time periods: 8
Number of rivers whose trend was inconsistent with the 2020 target value in both time periods: 2
Number of rivers whose trend changed to meet target: 3
Overall conclusion: Improved

[2] The trend category in summer low flows for each river reflects the slope of the trend and the significance found by two statistical tests.

ARE THE INTERIM TARGETS MET?		YES
2014 INTERIM TARGETS DESCRIPTION	**2014 INTERIM TARGETS MET?**	**EXPLANATION**
• Regulated rivers (Nisqually, Cedar, Skokomish, Skagit, Green) maintain flow conditions • Low flows in the Elwha are monitored • Unregulated rivers (Puyallup, Dungeness and Nooksack) maintain stable flows • Snohomish River, Deschutes River, North Fork Stillaguamish River, and Issaquah Creek: No change in flow condition	YES	All 13 rivers met their interim target values, by remaining in the same category or moving to an improved category, based on the comparison of the 1975 – 2011 trend and 1975 – 2014 trend.

FOR MORE IN-DEPTH INFORMATION, PLEASE SEE:
www.psp.wa.gov/vitalsigns/summer_stream_flows

MARINE WATER QUALITY

INDICATOR: MARINE WATER CONDITION INDEX

INDICATOR LEAD AND AFFILIATION:
Christopher Krembs, Washington State Department of Ecology

2020 TARGET: There is no adopted target for this indicator.

PROGRESS:

GETTING WORSE

TABLE 4. MARINE WATER CONDITION INDEX SCORES FOR 12 REGIONS OF PUGET SOUND
1999 – 2014

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Admiralty Reach	20	13	8	4	0	-5	-3	-5	4	0	-3	-2	14	12	8	4
Georgia Basin	-2	14	13	1	-2	10	-2	-7	1	9	-9	7	16	-7	3	-6
South Hood Canal	16	7	9	3	-4	-9	-1	-11	6	10	-1	-14	-11	1	4	4
Central Basin	15	14	12	8	-1	-6	-8	-3	4	1	-7	-10	7	0	1	-1
Bellingham Bay	10	13	23	-3	1	6	-12	-8	7	2	-12	-14	7	-9	0	-20
Sinclair Inlet	8	16	13	1	-3	-6	-5	-11	4	1	3	-13	3	-4	-3	-6
Oakland Bay	16	13	14	-4	-7	-9	-5	1	4	-3	1	-6	1	-3	1	-12
South Sound	19	14	14	-2	2	0	-4	-2	3	0	-8	-12	9	6	8	-2
Elliot Bay	28	19	5	-3	-9	3	-15	-9	3	4	-8	-5	5	5	8	-2
Commencement Bay	17	8	13	-3	-5	0	-3	-1	7	-5	-8	-8	2	2	8	3
Whidbey Basin	11	8	8	-5	-2	-10	-1	1	9	7	-9	-14	-3	-3	-2	-6
Budd Inlet	8	14	17	1	-13	-9	-7	-1	8	5	3	-8	1	-6	0	-12

25 to 28
20 to 24
16 to 19
11 to 15
7 to 10
3 to 6
-2 to 2
-3 to 1
-7 to -4
-12 to -8
-16 to -13
-20 to -17

Green shades show improved marine water quality relative to the baseline reference, 1999–2008. Orange to red shades indicate worse conditions. Yellow shows scores between -1 and 1 represent little to no change. The maximal range of the index scores spans from -50 to +50, indicating that monthly measured variables are falling either above or below the expected baseline.

Source: Washington State Department of Ecology, Environmental Assessment Program, Marine Monitoring Unit

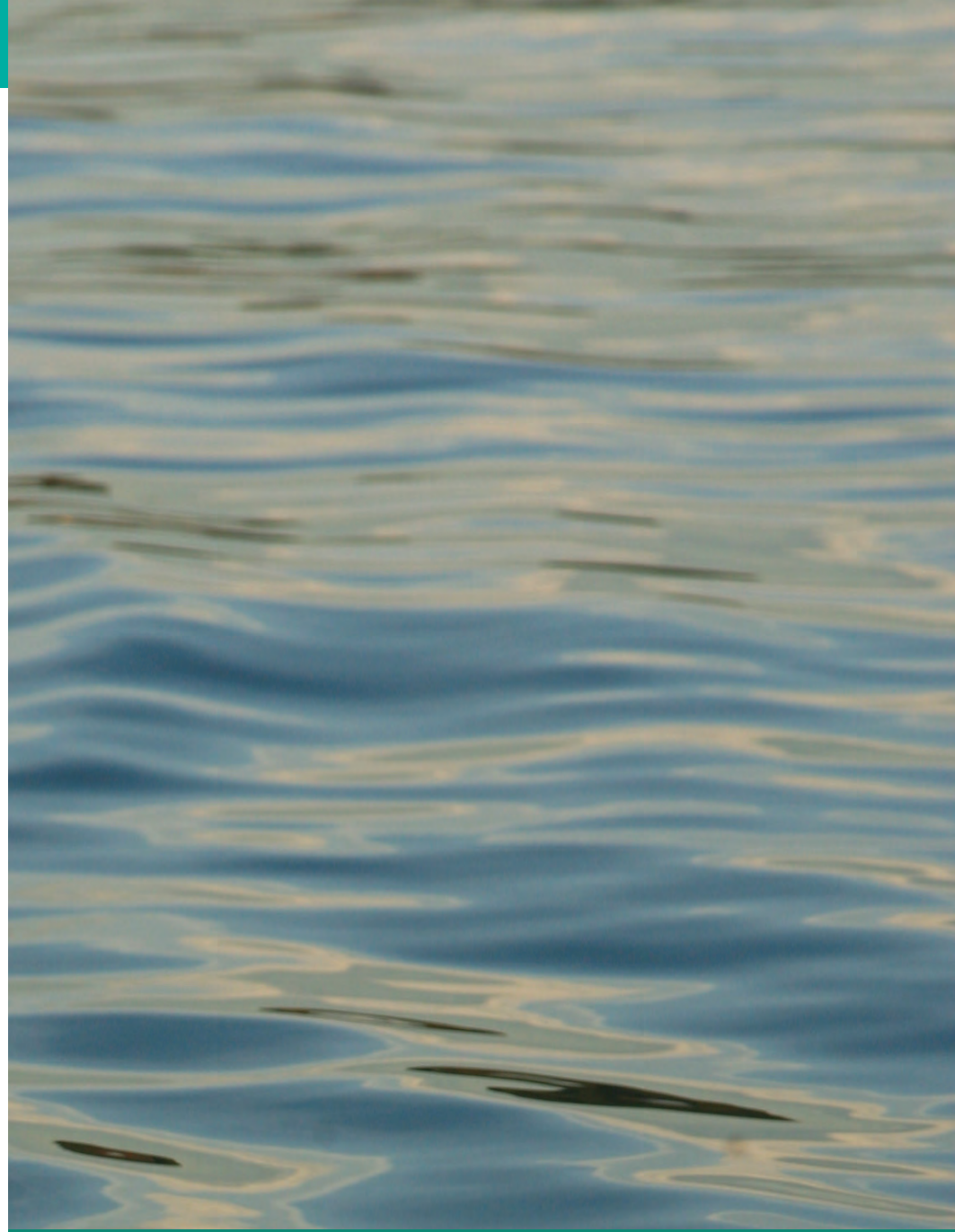
The opportunity to swim, fish, or dig clams in Puget Sound relies on good water quality. The marine waters of Puget Sound are affected by many different factors including weather and climate, inflow from rivers and streams, discharges from wastewater treatment plants and industries, offshore ocean conditions, stormwater runoff, and even groundwater. Excess pollution can force beach closures and shellfish harvesting restrictions, and may cause excessive algae blooms that eventually deplete oxygen levels leading to fish kills.

The Marine Water Condition Index measures change in water quality against a baseline reference. The index integrates 12 variables that each describe an important aspect of water quality conditions, such as temperature, salinity, nutrient balance, algae biomass, and dissolved oxygen. The baseline reference is calculated for the time period 1999 – 2008. Positive values of the index indicate relatively improved marine water quality, and negative values indicate worse marine water quality relative to the baseline.

PROGRESS SUMMARY:

Over the long-term, Marine Water Condition Index scores have generally declined. The decline is illustrated in the table by 1) a shift in the past 16 years from green in the early years to shades of orange and red in the later years, and 2) more negative scores. These results indicate that marine water quality is poorer than before.

- Marine water quality was generally lower in Puget Sound in 2014 compared to the baseline.
- Bellingham Bay stood out in 2014 for a record low index value. In the short-term, water quality in Puget Sound has been bouncing around between slightly improved or slightly worse values over the last 4 years.



FOR MORE IN-DEPTH INFORMATION, PLEASE SEE:

www.psp.wa.gov/vitalsigns/marine_water_quality

MARINE WATER QUALITY

INDICATOR: DISSOLVED OXYGEN

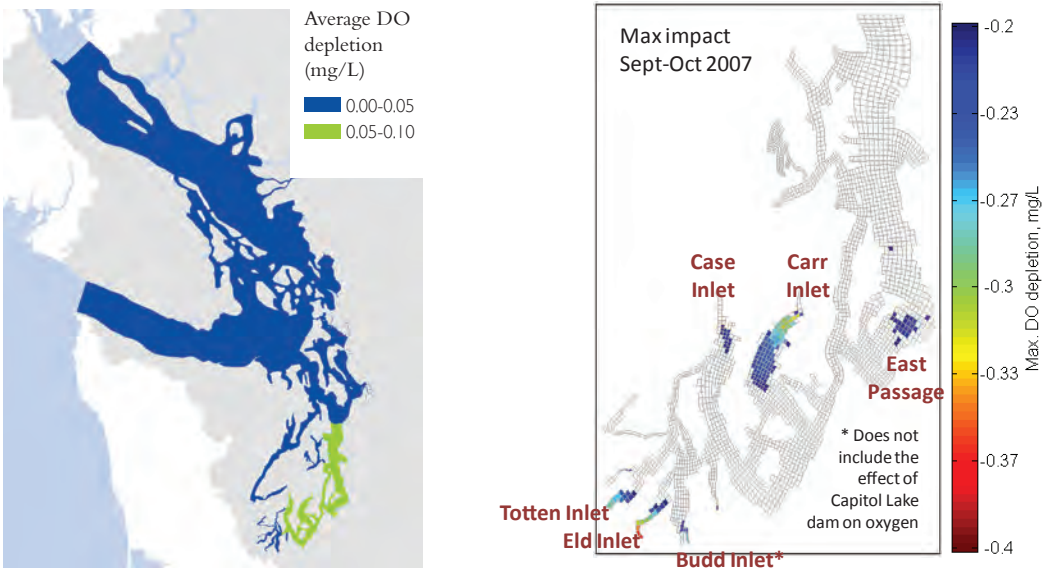
INDICATOR LEAD AND AFFILIATION:
Mindy Roberts, Washington State Department of Ecology

2020 TARGET: Human-related contributions of nitrogen do not result in more than 0.2 mg/L reductions in dissolved oxygen levels anywhere in Puget Sound.

PROGRESS:

NO DATA

FIGURE 20. MODELED OXYGEN DEPLETION IN PUGET SOUND
2006



Left-hand panel: Salish Sea model results for the impacts from current (2006) local human nutrient sources from wastewater treatment plants and watersheds. Results are expressed as the average oxygen depletion in September and October in deep waters of the Salish Sea. Overall, current human sources from wastewater treatment plants and watersheds cause less than 0.2 mg/L of Dissolved Oxygen depletion on average at the large scale.

Source: Roberts, M., T. Mohamedali, B. Sackmann, T. Khangaonkar, and W. Long. 2014. Puget Sound and the Straits Dissolved Oxygen Assessment: Impacts of Current and Future Human Nitrogen Sources and Climate Change through 2070. Washington State Department of Ecology, Olympia, WA Publication No. 14-03-007.

Right-hand panel: South and Central Puget Sound model results for the impacts from current local human nutrient sources from wastewater treatment plants and watersheds. Results are based on the maximum oxygen depletion for September anywhere in the water column. In the ends of several inlets in South Puget Sound, as well as East Passage, human nutrient inputs are causing minimum oxygen levels to fall by about 0.2 mg/L.

Source: Ahmed, A., G. Pelletier, M. Roberts, and A. Kolosseus. 2014. South Puget Sound Dissolved Oxygen Study: Water Quality Model Calibration and Scenarios. Washington State Department of Ecology, Olympia, WA. Publication No. 14 -03-004.

Low dissolved oxygen in marine waters can create significant problems, such as extensive fish kills. Inputs of nutrients from human activities are often suspected of creating, or exacerbating, the conditions that lead to low oxygen in Puget Sound. Nitrogen can fuel algae blooms, which decompose and draw down oxygen. The human sources of nutrients include wastewater treatment plants, failed septic systems, and fertilizers that reach Puget Sound.

PROGRESS SUMMARY:

Using modeling to assess the human-related contributions of nitrogen, the model results for 2006 show that the 2020 target value is not met. Updates to the model are underway and will be used to re-evaluate whether the 2020 target is met.

The latest models show mixed results for human contribution to the low oxygen problem.

- Throughout most of Puget Sound, the modeled oxygen depletion resulting from of human-related inputs to Puget Sound is below the target value of 0.2 mg/L.
- However, in local areas, including South and Central Puget Sound, the oxygen depletion caused by nutrient inputs from humans slightly exceeds or is at the target value of 0.2 mg/L. Areas with limited flushing generally are most sensitive to inputs of nutrients like nitrogen by humans.

FOR MORE IN-DEPTH INFORMATION, PLEASE SEE:

www.psp.wa.gov/vitalsigns/marine_water_quality

FRESHWATER QUALITY

INDICATOR: WATER QUALITY INDEX

INDICATOR LEAD AND AFFILIATION:
Markus Von Prause, Washington State Department of Ecology

2020 TARGET: At least half of all monitored stations should score 80 or above on the Water Quality Index.

PROGRESS:

NOT CHANGING

TABLE 4. WATER QUALITY INDEX
2000 – 2013

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	AVERAGE
Duckabush River near Brinnon	93	95	94	90	74	94	89	85	88	96	86	89	97	95	90
Skokomish River near Potlach	95	95	94	85	70	67	92	89	89	94	86	70	88	93	86
Snohomish River at Snohomish	92	91	89	81	74	75	89	75	81	85	79	77	90	88	83
Elwha River near Port Angeles	86	88	83	76	73	74	86	67	66	81	81	76	64	61	76
Cedar River at Logan St/Renton	87	76	60	78	72	84	81	79	79	81	77	75	85	76	78
Skagit River at Marblemount	87	86	59	85	64	81	84	75	75	81	56	77	76	75	76
Skagit River near Mount Vernon	89	91	71	76	61	73	77	77	75	76	74	73	77	86	77
Nisqually River at Nisqually	40	60	79	79	69	71	74	75	91	74	83	86	86	83	75
Deschutes River at East St Bridge	62	72	70	73	61	83	88	88	83	76	74	60	84	78	75
Stillaguamish River near Silvana	81	60	44	72	55	67	71	69	75	75	71	59	81	79	69
Green River at Tukwila	82	73	66	67	75	49	72	68	60	69	63	68	75	70	68
Samish River near Burlington	86	75	32	49	34	71	67	74	59	80	63	52	78	86	65
Nooksack River at Brennan	65	68	58	57	52	54	61	51	60	69	56	55	62	61	59
Puyallup River at Meridian St	60	58	57	55	51	58	59	58	61	49	62	56	71	52	58

80 OR ABOVE | 70-79 | 40-69 | 39 OR LESS

Annual Water Quality Index scores for monitoring stations near the mouth of 14 major rivers. Scores are calculated for each water year from October 1st to September 30th. Higher numbers indicate better water quality.

Source: Statewide Water Quality Monitoring Network, Washington State Department of Ecology; Stream and River Water Quality Monitoring, King County

Clean freshwater is vital to people and to fish and wildlife populations. When rivers and streams pick up pollutants, toxic contaminants, or excessive sediments and nutrients, the health of watersheds, marine waters, swimming beaches, and shellfish beds is adversely affected.

The Water Quality Index for rivers and streams combines eight measures of water quality. Four of the component measures, dissolved oxygen, pH, temperature, and fecal coliform bacteria, are tied to the state's Water Quality Standards for protecting aquatic life and contact recreation. The other four measures, nitrogen, phosphorus, suspended sediment, and turbidity, do not have numeric standards, although they are related to general ecosystem function. A higher number is indicative of better water quality.

PROGRESS SUMMARY:

Results suggest that the water quality for rivers and streams throughout Puget Sound has essentially remained unchanged for at least the past 10 years.

- Only 27 percent of monitored stations were at or above the target value of 80, on average, from 2009 to 2013. This result is a few percentage points lower compared to the baseline reference established for the 2004–2008 period (31 percent), but the difference is not significant.
- Five river systems—Deschutes, Nisqually, Green, Cedar, Samish—showed some improvements, but not enough to significantly sway the overall scores.

FOR MORE IN-DEPTH INFORMATION, PLEASE SEE:

www.psp.wa.gov/vitalsigns/fresh_water_quality

FRESHWATER QUALITY

INDICATOR: FRESHWATER IMPAIRMENTS

INDICATOR LEAD AND AFFILIATION:
Patrick Lizon, Washington State Department of Ecology

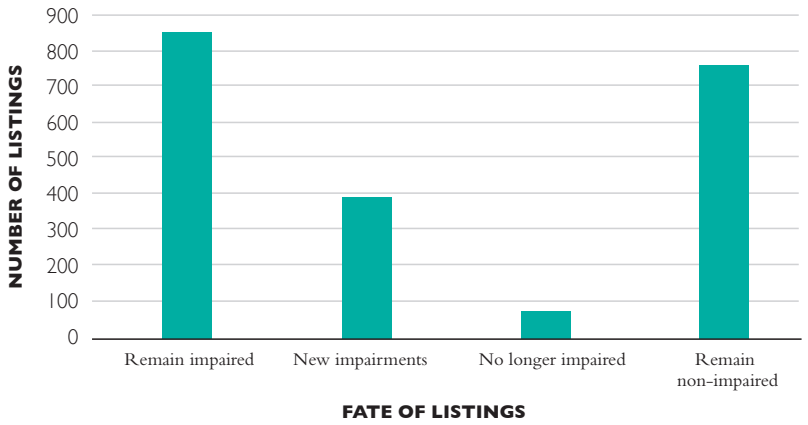
2020 TARGET: Reduce the number of "impaired" waters.

PROGRESS:

NO DATA

FIGURE 21. FATE OF LISTINGS FOR PUGET SOUND RIVERS, STREAMS AND LAKES, BASED ON THE WATER QUALITY ASSESSMENT 303(d) LISTS

2004 assessment vs 2014 assessment



Source: Washington State Department of Ecology, Water Quality Program

Cool, clean water is a key ingredient for a healthy Puget Sound. When lakes and streams cannot support native species and human uses, then they are listed as impaired. Impaired waters are segments of streams, rivers, or lakes that do not meet Washington State's Water Quality Standards for bacteria, dissolved oxygen, temperature, toxics, or other pollutants.

The Washington State Department of Ecology (Ecology) reviews data from a variety of sources to identify impairments relative to strict standards. Each freshwater listing is a unique combination of an assessment unit (a segment of river), medium (water, tissue, or sediment), and parameter (temperature, bacteria, or dissolved oxygen). Monitoring multiple parameters at several stations along the length of shoreline typically results in multiple assessment units, each of which will have a listing developed for each monitored parameter. The possible outcomes of the water quality assessment under the Clean Water Act 303(d) section are:

- Category 1: Meets Water Quality Standards
- Category 2: Water of Concern
- Category 3: Insufficient Data
- Category 4A: Total Maximum Daily Loads have been established for the identified impairment
- Category 4B: Impaired but an alternative pollution control plan is in place
- Category 4C: Impaired by non-pollutant
- Category 5: Impaired by a pollutant or an unidentified cause

Since 1988, water quality has been assessed in approximately 10 percent of the waters of Washington State. The 2014 assessment report contains 10,175 listings for freshwaters in the Puget Sound region. Of these 1,694 listings (about 17 percent) are in Category 5, per the Candidate 303(d) list. An additional 741 listings also do not meet water quality standards but are in Categories 4A and 4B because they have an established cleanup plan. However, most listings (4,583) have insufficient data to determine the water quality status. These are unofficial results and are pending approval by the U.S. Environmental Protection Agency.

PROGRESS SUMMARY:

- To examine the change in listing rates over time, a subset of listings whose water quality status was reported on in both the 2004 and 2014 assessments was used (a total of 2,071 listings). The status of 68 listings changed category from impaired (Categories 5, 4A, or 4B) to non-impaired (Category 1). For most of these de-listings, the improvement in water quality is the result of the successful implementation of pollution control practices; in particular, efforts to reduce fecal bacteria pollution.
- Another sign of progress is that since 2004, pollution control plans have been developed for 236 of the new or ongoing 303(d) listings in efforts to restore water quality.
- However, a greater number of listings (392) have moved from a non-impaired status to an impaired status between assessments. Most of these new 303(d) listings are due to additional data that have improved the characterization of water quality conditions rather than indicating worsening water quality.
- The fate of the majority of listings was unchanged and remained impaired (852). An absence of change in category between assessments may be due to following: newer data verifying no water quality change; newer data that are insufficient to justify a category change; or no new data collected since 2004 (a category carries through time until newer data justifies a category change). Data about water quality are not systematically collected and submitted for each body of water with a listing. The assessments were not designed to answer questions about the status and trends of water quality. Therefore, reporting meaningfully on the progress of this indicator is not possible at this time.

FOR MORE IN-DEPTH INFORMATION, PLEASE SEE:
www.psp.wa.gov/vitalsigns/fresh_water_quality

FRESHWATER QUALITY

INDICATOR: BENTHIC INDEX OF BIOTIC INTEGRITY

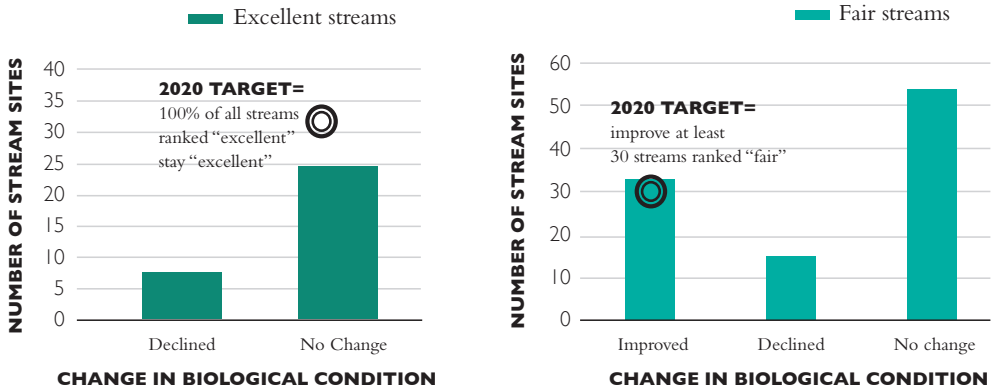
INDICATOR LEAD AND AFFILIATION:
Jo Wilhelm, King County

2020 TARGET: Part 1 (Protect): 100 percent of Puget Sound lowland stream drainage areas ranked as excellent retain excellent scores for the Benthic Index of Biotic Integrity for biological condition; **Part 2 (Restore):** Improve and restore at least 30 streams ranked fair so their scores become good.

PROGRESS:

MIXED RESULTS

FIGURE 22. CHANGE IN THE BIOLOGICAL CONDITION OF STREAMS IN PUGET SOUND, BASED ON THE BENTHIC INDEX OF BIOTIC INTEGRITY
2006 – 2009 vs 2011 – 2014



Left panel: Results address Part 1 of the target; i.e., retain all streams ranked as excellent as excellent. Right panel: Results address Part 2 of the target; i.e., improve fair streams.

Source: Puget Sound Stream Benthos

The Benthic Index of Biotic Integrity (B-IBI) describes the biological condition of stream sites and their surrounding habitat based on the diversity and relative abundance of the benthic (bottom dwelling) macroinvertebrates living there, such as mayfly larvae, stonefly larvae, caddisfly larvae, worms, beetles, snails, dragonfly larvae, and many others.

Ten measures of biological condition are scored and summarized as the B-IBI. The B-IBI scale ranges from a score of 0, indicating very poor stream condition, to 100, indicating excellent condition. A total of 398 streams were assessed for biological condition.

PROGRESS SUMMARY:

Overall, biological condition at some sites is declining, improving at others, and not changing at most. Because the B-IBI results indicate degradation in some streams ranked as excellent, but yet a net improvement in the biological condition of streams previously ranked fair by the B-IBI, there is mixed progress toward the 2020 target.

- Only 76 percent of streams previously ranked as excellent maintained their excellent ranking (Part 1 of the target).
- The B-IBI results also indicate that more fair stream sites improved to good or excellent than declined to poor or very poor during 2011-2014 compared to 2006–2009 (Part 2 of the target).

FOR MORE IN-DEPTH INFORMATION, PLEASE SEE:

www.psp.wa.gov/vitalsigns/fresh_water_quality

MARINE SEDIMENT QUALITY

INDICATOR: SEDIMENT QUALITY TRIAD INDEX

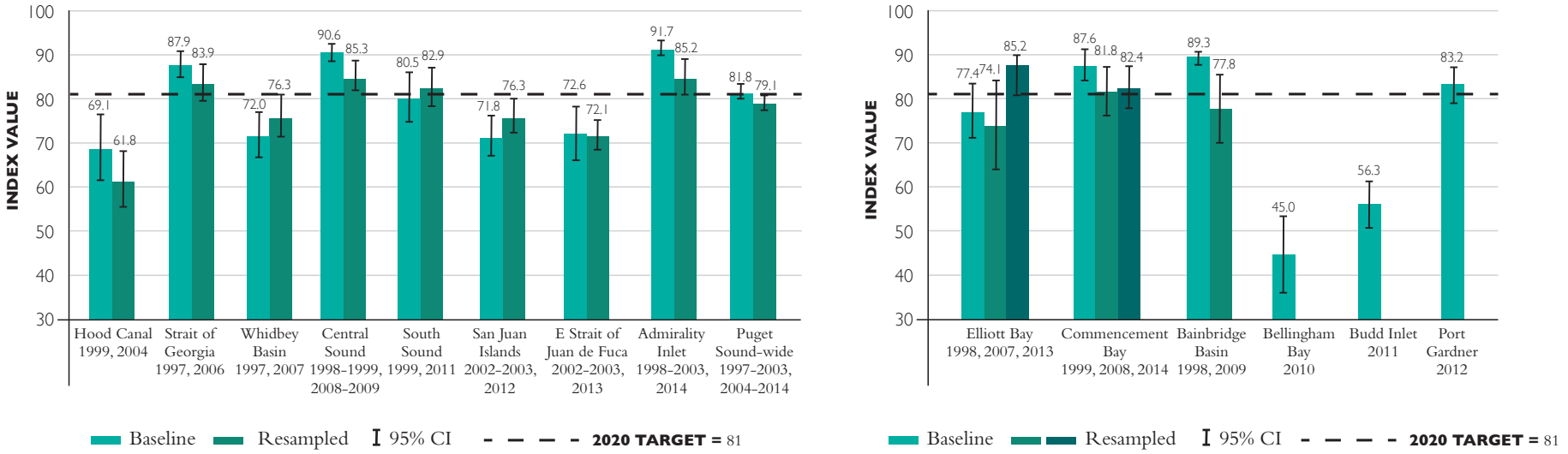
INDICATOR LEAD AND AFFILIATION:
Maggie Dutch, Washington State Department of Ecology

2020 TARGET: All Puget Sound regions and bays, as characterized by ambient monitoring, achieve the following: Sediment Quality Triad Index (SQTI) scores reflect unimpacted conditions (i.e., SQTI values >81).

PROGRESS:

MIXED RESULTS

FIGURE 23. SEDIMENT QUALITY TRIAD INDEX VALUES
1997 to 2014, time period varies



Left panel: Marine Sediment Quality Triad Index values for eight Puget Sound regions
Right panel: Marine Sediment Quality Triad Index values for six Puget Sound urban bays
Source: Washington State Department of Ecology, Marine Sediment Monitoring Team

Much of the floor of Puget Sound is covered with sediments—the gravel, sand, silt, and clay that has accumulated over years, decades, centuries, and even millennia. High-quality sediments support a diverse and important biological community.

Three aspects of sediment quality are monitored in Puget Sound, including the following: 1) chemical contamination, described for the Sediment Chemistry Index, 2) toxicity of the sediments to marine life, which measures the combined (synergistic) effects of those chemicals and other sediment characteristics on laboratory test organisms, and 3) diversity of the benthos, which measures the total number of organisms and total number of species of small invertebrates living in the sediments and reflects the actual biological condition of the sediments as a response to all possible human-caused and natural stressors, measured or not. These three measures are combined into the Sediment Quality Triad (SQTI). Higher index values indicate higher quality sediments.

PROGRESS SUMMARY:
Sediment Quality Triad Index results suggest a mixed portrait of Puget Sound sediment quality.

- While five of eight regions and four of six urban bays sampled since 1997 currently have mean SQTI scores that statistically meet the target value of 81, three regions and two bays do not meet the target value.
- Among eight regions and three bays that were re-sampled from 2004 – 2014, SQTI scores improved in Whidbey Basin, South Sound, and the San Juan Islands, but declined in the other eight areas. This decline in SQTI values is primarily due to declines in the number and types of benthic invertebrates, resulting in lower SQTI scores. Two bays, Bellingham Bay and Budd Inlet, for which baseline sampling was first conducted in 2010 and 2011, respectively, also did not meet the SQTI target value due to low numbers and types of benthic invertebrates.
- A third round of sampling was conducted in Elliott Bay in 2013 and Commencement Bay in 2014. On a positive note, the SQTI scores improved and exceeded the target value in both cases. As a result, the interim targets are all met.

ARE THE MARINE SEDIMENT QUALITY INTERIM TARGETS FOR THE SEDIMENT QUALITY TRIAD ALL MET?		YES
2014 INTERIM TARGETS DESCRIPTION	**2014 INTERIM TARGETS MET?**	**EXPLANATION**
SQTI conditions in Elliott Bay improved relative to 2007	YES	Elliott Bay improved between 2007 and 2013 and is even above the target value in 2013.
Target conditions in Commencement Bay met in 2014	YES	Commencement Bay met the target condition value in 1999, 2008, and 2014.

FOR MORE IN-DEPTH INFORMATION, PLEASE SEE:
www.psp.wa.gov/vitalsigns/marine_sediment_quality

MARINE SEDIMENT QUALITY

INDICATOR: SEDIMENT CHEMISTRY INDEX

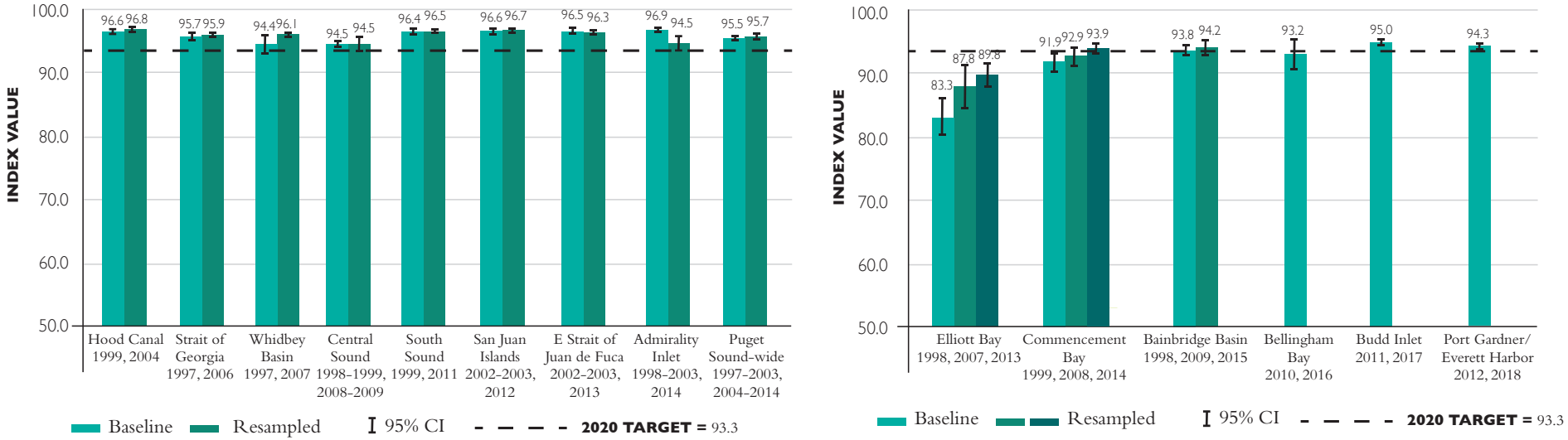
INDICATOR LEAD AND AFFILIATION:
Maggie Dutch, Washington State Department of Ecology

2020 TARGET: By 2020, all Puget Sound regions and bays achieve chemistry measures reflecting "minimum exposure" with Sediment Chemistry Index (SCI) scores >93.3.

PROGRESS:

NOT CHANGING

FIGURE 24. MARINE SEDIMENT CHEMISTRY INDEX VALUES
1997 to 2014, time period varies



Left panel: Marine Sediment Chemistry Index values for eight Puget Sound regions

Right panel: Marine Sediment Chemistry Index values for six Puget Sound urban bays

Source: Washington State Department of Ecology, Marine Sediment Monitoring Team

The Sediment Chemistry Index (SCI) is one component of the Sediment Quality Triad Index (SQTI). It combines data on the concentrations of a variety of chemicals for which state Sediment Quality Standards Chemical Criteria have been set into an overall index of chemical exposure. Contaminants measured as part of the SCI include metals, polychlorinated biphenyls (PCBs), polynuclear aromatic hydrocarbons (PAHs), chlorinated pesticides, phthalates, some solvents, and various other pollutants. Higher index values indicate less exposure to chemicals and thus, healthier sediments.

PROGRESS SUMMARY:

Overall, sediments in Puget Sound have been and continue to be in generally good condition with regard to the measured set of chemicals, except in Elliott Bay near Seattle. Because all the regions and Commencement Bay met their target values, except for Elliott Bay, which did not improve enough, the interim targets are only partly met.

- Sediment Chemistry Index scores for all regions, and most bays either meet or exceed the target value.
- Since 1997, all of the eight sampled regions and five of six urban bays met the Sediment Chemistry Index (SCI) target value, and index values in most areas changed little since the late 1990s.
- Conditions have improved significantly in Elliott Bay since 1998, but not enough to reach the target value. Although the index value is slightly higher in 2013 than in 2007 in Elliott Bay, the difference is not statistically significant.
- The value measured for Admiralty Inlet dropped significantly when resampled in 2014, but still remained above the target value.
- The values for Commencement Bay increased slightly between 2008 and 2014, and the target value is not met.

ARE THE MARINE SEDIMENT QUALITY INTERIM TARGETS FOR SEDIMENT CHEMISTRY MET? MIXED RESULTS

2014 INTERIM TARGETS DESCRIPTION	2014 INTERIM TARGETS MET?	EXPLANATION
All regions meet marine sediment targets for SCI	YES	All regions met the target values for SCI in their last round of sampling, and all those prior.
SCI conditions in Elliott Bay improved relative to 2007	NO	Elliot Bay index value improved slightly in 2013, but the change was not significant. Also, the current index still does not meet target value.
Target conditions in Commencement Bay met in 2014	YES	Commencement Bay met the target value in 2014.

FOR MORE IN-DEPTH INFORMATION, PLEASE SEE:
www.psp.wa.gov/vitalsigns/marine_sediment_quality

MARINE SEDIMENT QUALITY

INDICATOR: PERCENT OF CHEMICAL MEASUREMENTS EXCEEDING SEDIMENT QUALITY STANDARDS

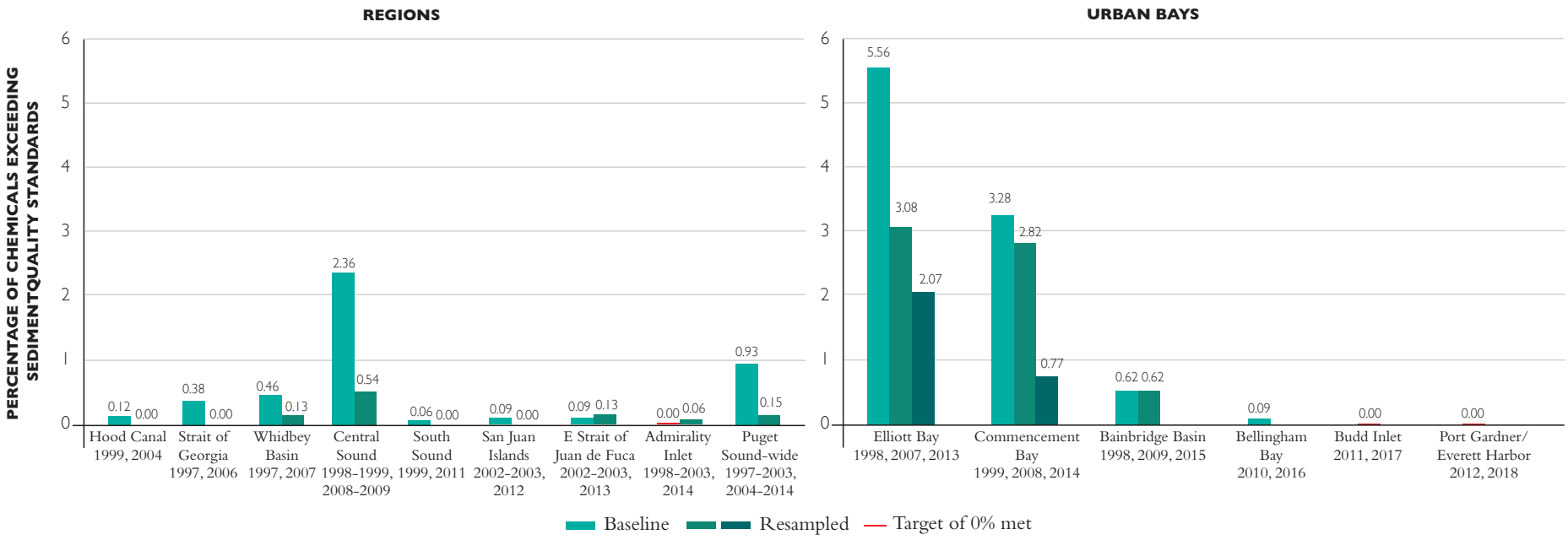
INDICATOR LEAD AND AFFILIATION:
Maggie Dutch, Washington State Department of Ecology

2020 TARGET: Have no sediment chemistry measurements exceeding the Sediment Quality Standards (SQS) set for Washington State.

PROGRESS:

GETTING BETTER

FIGURE 25. PERCENT OF CHEMICALS EXCEEDING SEDIMENT QUALITY STANDARDS
1997 – 2014, time period varies



Left panel: Marine Sediment Quality Triad Index values for eight Puget Sound regions; right panel: Marine Sediment Quality Triad Index values for six Puget Sound urban bays

Source: Washington State Department of Ecology, Marine Sediment Monitoring Team

This indicator is the percent of individual chemical measurements that exceed the Washington Sediment Quality Standards (SQS). This indicator relates to the Sediment Chemistry Index. Sediment Quality Standards values have been determined for a total of 47 chemicals in Puget Sound. Of those, 39 are included in the SCI and evaluated for this indicator.

PROGRESS SUMMARY:

Although the target is not fully met across all of Puget Sound, recent improvements suggest progress toward the 2020 target.

- The percent of individual chemicals that exceeded SQS since 1997 is typically small (mostly less than 1 percent) except for Central Sound, Elliott Bay, and Commencement Bay, where the number was higher but still never exceeded 6 percent.
- Fewer chemicals exceeded state SQS in the second round of sampling, with four regions dropping to zero, now meeting the target value in those areas.
- Budd Inlet and the Port Gardner/Everett Harbor urban embayments are also at zero.

FOR MORE IN-DEPTH INFORMATION, PLEASE SEE:

www.psp.wa.gov/vitalsigns/marine_sediment_quality

TOXICS IN FISH

INDICATOR: PERSISTENT TOXIC CHEMICALS IN PACIFIC HERRING

INDICATOR LEAD AND AFFILIATION:
Jim West, Washington Department of Fish and Wildlife

2020 TARGET: Part 1: By 2020, contaminant levels in fish will be below health effects thresholds (levels considered harmful to fish health, or harmful to the health of people who consume them).

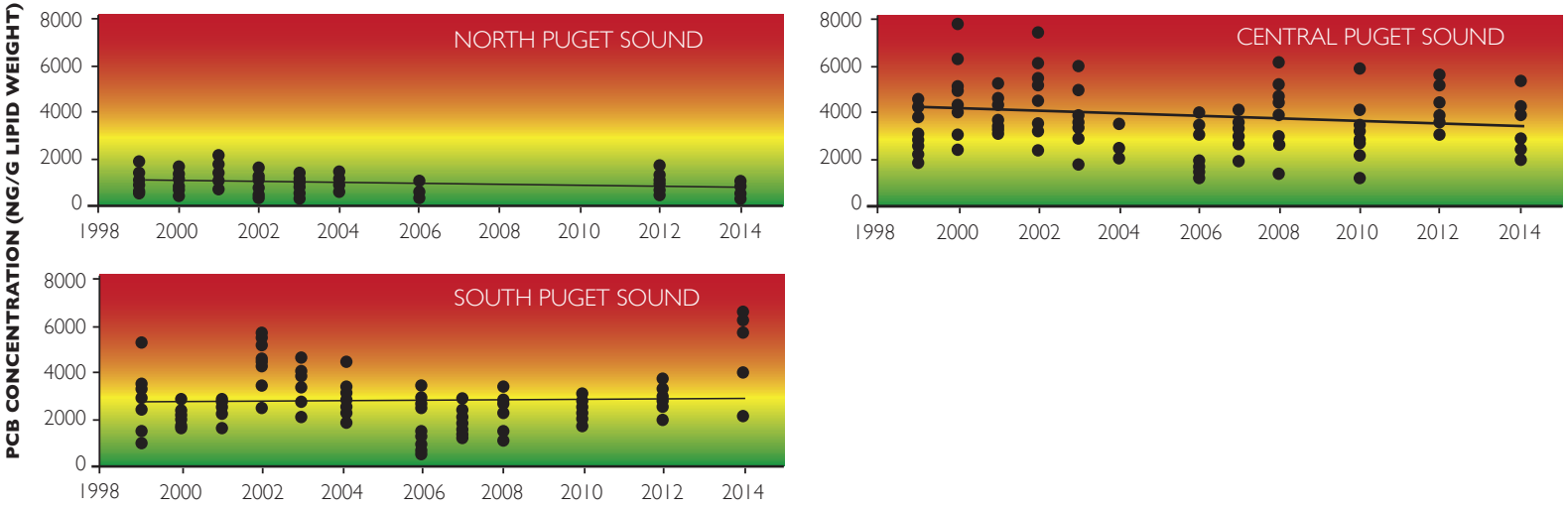
Part 2: By 2020, contaminant-related disease or impairments in fish are reduced to background levels.

PROGRESS:

PCBs: NOT CHANGING

PBDEs: GETTING BETTER

FIGURE 26. PCB (POLYCHLORINATED BIPHENYLS) LEVELS THROUGH TIME IN PACIFIC HERRING FROM THREE BASINS IN PUGET SOUND
1999 – 2014



Each dot represents a mixed-composite sample of 10 whole, individual herring. The red and yellow zones indicate PCB levels where lethal and sublethal effects are predicted. The green zone indicates PCBs at levels below health effects thresholds, and represent measurements that lie within the 2020 target. The solid line shows the trend over time.

Source: Washington State Department of Fish &Wildlife

PCBs

The production of certain dangerous chemicals, such as PCBs (polychlorinated biphenyls), was banned more than 30 years ago. Although PCB levels in Puget Sound fish today are probably 10 times lower than they were in the 1970s, they have not declined in the past 20 years in a number of marine species. Levels are still high enough in Pacific herring to suspect the fish are subject to multiple negative health effects, including slowed growth, impaired ability to resist disease, impaired functioning of the thyroid gland, and increased mortality.

To meet the 2020 target for toxics in Pacific herring, contaminant levels must be below health effects thresholds (levels considered harmful to fish health). For PCBs, the fish-health threshold is approximately 2,400 ng/g lipid.

PROGRESS SUMMARY:

There was no significant decline in PCB levels in Pacific herring from 1999 – 2014 in any stock, and thus no progress toward meeting the 2020 target.

- All of the herring tracked over a 15-year period from 1999 to 2014 from the North Puget Sound region (represented by the Semiahmoo stock) had PCB concentrations below threshold levels, suggesting that PCBs have historically posed little risk to this population. They met the target value.
- 86 percent of the Central Puget Sound population (represented by the Port Orchard/Port Madison stock) and 63 percent of the South Puget Sound population (represented by the Squaxin stock) fell above the threshold, indicating that the majority of the fish sampled during this 15-year period had a higher risk of PCB-related health problems.
- The most current data (2014) show that all fish samples from Central Puget Sound and a majority of samples in South Puget Sound were at moderate to high risk.

ARE THE TOXICS IN FISH INTERIM TARGETS FOR PCBs IN HERRING MET?

MIXED RESULTS

INTERIM TARGETS DESCRIPTION	2014 INTERIM TARGETS MET?	EXPLANATION
• Improve 20% from 1999 – 2010 conditions in herring from Central and South Sound	NO	The first part of the target was not met, as the trend was flat between 1999 and 2014 and thus no improvement.
• Meet targets for North Sound herring	YES	However, all North Sound samples were below the health effects threshold and thus the target is met for that stock.

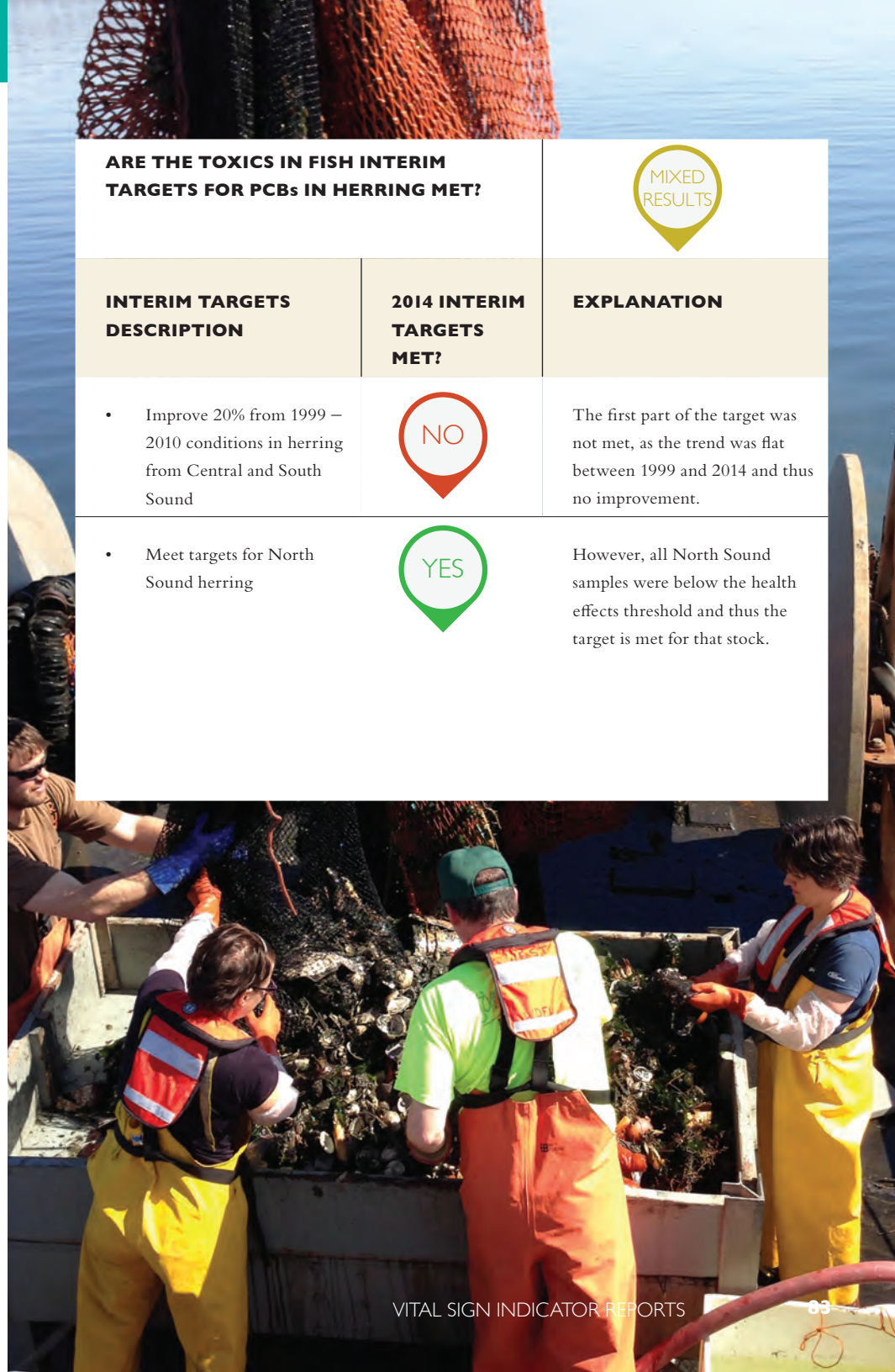
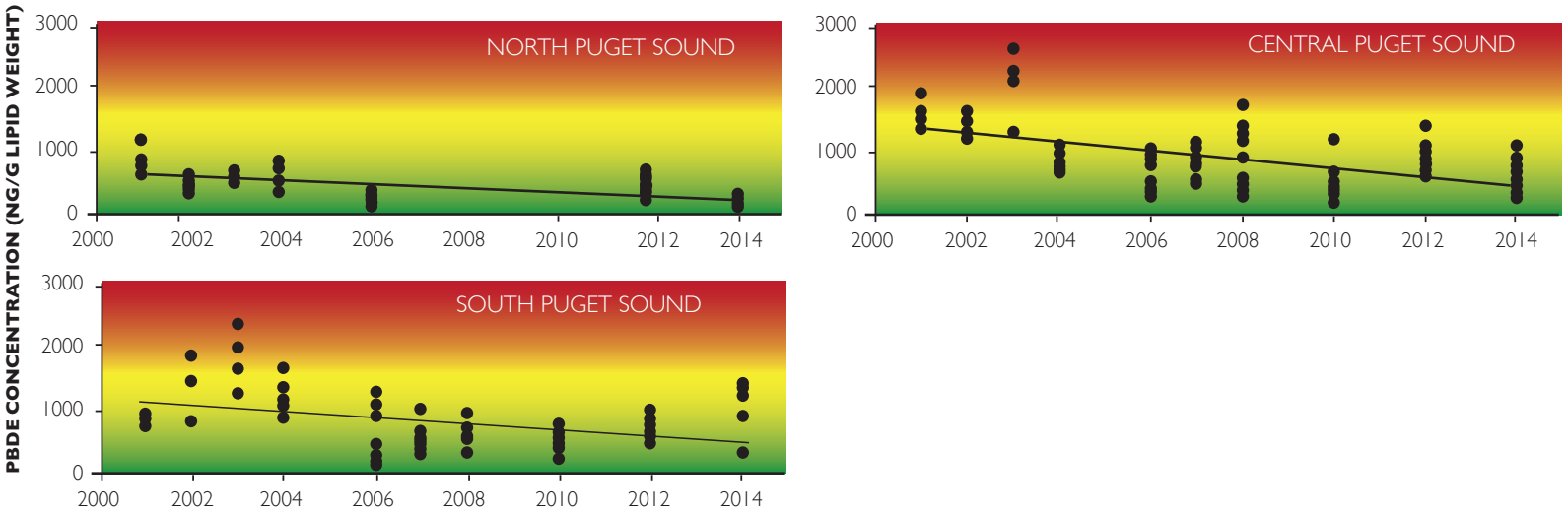


FIGURE 27. FLAME RETARDANTS (POLYBROMINATED DIPHENYL ETHERS, OR PBDE) LEVELS THROUGH TIME IN PACIFIC HERRING FROM THREE BASINS IN PUGET SOUND
1999 – 2014



Each dot represents a single composite sample of 10 whole, individual herring. The red and yellow zones indicate PBDE levels where lethal and sublethal effects are predicted. The green zone indicates PBDEs at levels below health effects thresholds, and represent measurements that lie within the 2020 target. The solid line shows the trend over time.

Source: Washington State Department of Fish and Wildlife

PDBEs

The danger of flame retardants, or polybrominated diphenyl ethers (PBDEs), was recognized more recently than PCBs, and source controls have been imposed only in the past 11 years. Actions taken include EPA rules and Washington State legislation to encourage voluntary reduction in the import production of some PBDEs and a ban on the use of others.

The health effects threshold for this contaminant is 1,400 ng/g lipid.

PROGRESS SUMMARY:

The indicator has made significant progress toward the 2020 target.

- PBDE levels in herring from all three sampled regions declined from the early 2000s to the present. Levels dropped from moderate/high risk, down to a condition where the 2020 target value was met for all but a few samples in the South Puget Sound region.

ARE THE TOXICS IN FISH INTERIM TARGETS FOR PBDES IN HERRING MET?		YES
INTERIM TARGETS DESCRIPTION	**2014 INTERIM TARGETS MET?**	**EXPLANATION**
Improve 50% from 1999-2010 conditions for herring from Central and South Puget Sound	YES	Although there is some variability in the data, PBDEs declined overall, with the majority of all samples below the effects thresholds in all three regions from 2010 through 2014, thus meeting the target value.

FOR MORE IN-DEPTH INFORMATION, PLEASE SEE:
www.psp.wa.gov/vitalsigns/toxics_in_fish

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