



**NOAA**  
**FISHERIES**

# Saving the Southern Resident Killer Whales

A Project-Based Learning Unit for Middle School





# Saving the Southern Resident Killer Whales

A Project-Based Learning Unit for Middle School

July 2021

## Disclaimer

This resource is intended for use in middle school classrooms. Information within this curriculum should not be cited in scientific journals or other publications.

## About NOAA Fisheries

NOAA Fisheries is responsible for the stewardship of the nation's ocean resources and their habitat. We provide vital services for the nation: productive and sustainable fisheries, safe sources of seafood, the recovery and conservation of protected resources, and healthy ecosystems—all backed by sound science and an ecosystem-based approach to management.

To learn more, visit: [www.fisheries.noaa.gov](http://www.fisheries.noaa.gov).





## Author

Alicia Keefe, Education and Outreach Coordinator, NOAA Fisheries West Coast Region

## Supporting Writer

Mary Griffith, 2020-21 NOAA Hollings Scholar

## Subject Matter Expert Reviewers

*NOAA Fisheries West Coast Region*

Lynne Barre, Branch Chief, Protected Resources Division

Grace Ferrara, Natural Resource Management Specialist

Jeromy Jording, Fisheries Biologist

Laura E. Koehn, Ph.D., Fisheries Biologist

Megan M. Wallen, Ph.D., Marine Mammal Specialist

Amilee Wilson, Tribal Coordinator

## Educator Reviewers

Celeste Hanley, Education and Outreach Specialist, Pacific Islands Regional Office

Lisa Hiruki-Raring, Education Coordinator, Alaska Fisheries Science Center

## Copy Editor

Frances Pflieger, ECS

## Font

[OpenDyslexic](#) is a typeface designed against some common symptoms of dyslexia.

## Front Cover Credits

Top to bottom, left to right

NOAA Fisheries

Allison Shelley for EDUimages

Allison Shelley for EDUimages

Allison Shelley for EDUimages



# Dedication

---

*“If compassion were fish, the orcas would not be starving. If compassion were clean water, our orcas would not be suffering the effects of toxic contamination. If compassion were quiet waters, our orcas would once again be able to find their prey and communicate with each other.”*

- Southern Resident Orca Task Force co-chairs  
Les Purce and Stephanie Solien<sup>1</sup>

---

This resource is dedicated to you, our partners in Southern Resident recovery.

If you enjoy watching the J, K, and L pods breach in the Salish Sea, if you partake in Southern Resident ceremonies with your tribal elders, if you cherish memories of hearing the whales on a hydrophone for the first time, if you follow the news after the birth of a new calf, if you grieve the loss of an orca elder—you have been touched by this unforgettable species. You understand its link to the culture, economy, and environment of the Pacific Northwest. Because of this you play an indispensable role conserving Southern Residents for future generations.

Thank you for joining us on the road to Southern Resident recovery, doing your part to raise awareness, and helping restore and protect healthy ecosystems in which Southern Residents and all marine species can thrive. We could not make this journey without your steadfast contributions, commitment, and support.





# Table of Contents

## Front Matter

- [About this Unit](#)
- [Project-Based Learning](#)
- [Interdisciplinary Connections](#)
- [STEAM connections](#)
- [National Standards](#)
- [State Standards](#)

## Introduction to Southern Resident Killer Whales

- [What's in the news?](#)
- [Who are the Southern Residents?](#)
- [Where do they live?](#)
- [What do they eat?](#)
- [How do they communicate?](#)
- [Why are the whales at risk?](#)
- [Population over time](#)

## Activities

- [Scope and Sequence](#)
- [Activity 1: Making Connections](#)
- [Activity 2: Click, Whistle, Call](#)
- [Activity 3: Ripple Effects](#)
- [Activity 4: Threats and Solutions](#)
- [Activity 5: Community Mapping](#)
- [Activity 6: Who is Responsible?](#)
- [Activity 7: Orca Task Force](#)
- [Activity 8: Yes, We Can!](#)
- [Activity 9: Taking Action](#)

## Appendices

- [Pre/Post Assessment](#)
- [Glossary](#)
- [End Notes](#)



## About this Unit

In August 2018, footage of a grieving mother killer whale, Tahlequah (J35), put a global spotlight on the plight of Southern Resident killer whales (Southern Residents). Tahlequah carried her deceased newborn for 17 days and over 1,000 miles as the world watched her every move.



J35, or Tahlequah, pushed her dead calf for 17 days. Credit: [Taylor Shedd, Soundwatch \(taken under NMFS permit 21114\)](#)

This heartbreaking display served as a rallying cry for the critically-endangered Southern Residents, whose numbers stand at 75 as of July 28, 2021. Their population has decreased by about a quarter in the past 20 years, largely due to decreased prey availability, disturbance from vessels and noise, and contaminants in the environment.

This unit will engage your middle schoolers in authentic Southern Resident science and stewardship while building key success skills and meeting targeted NGSS and state sustainability standards. Through interdisciplinary research, discussions, and projects, students will understand:

- How Southern Residents are inextricably linked to the cultures, economies, and ecosystems of the Pacific Northwest.
- The major threats facing the Southern Residents.

- What individuals and collective groups can do to save this critically-endangered species.
- When we protect the Southern Residents, people and the wider ecosystem benefit.

By employing the principles of project-based learning, this unit empowers students to steer their own learning, to investigate the issues that are most important to them, and to design a meaningful public product that inspires their greater community in conservation and recovery.

## Project-Based Learning

Project-based learning (PBL) shifts classrooms from teacher-centered instruction toward student-directed learning. Rather than passively learning, students are given the opportunity to try their hand at coaching, facilitating, and co-learning. Southern Resident conservation and recovery are natural topics for PBL.

Throughout the entire unit, students will consider the driving question: **How can we make a meaningful difference for the critically-endangered Southern Resident killer whales?** This question is addressed throughout each of the 9 activities. From self-led research and simulations to participating in a mock Southern Resident Orca Task Force and designing their own action project, students are put in the shoes of researchers, policy makers, and conservationists. As students address this driving question, they synthesize their learning and share it with a public audience.

For additional support on PBL, see: [Edutopia](#), [The National Education Association](#), and [PBLWorks](#). These organizations provide curated lists of PBL basics, best practices, research, and project examples. [From Inquiry to Action](#) by Steven

Zemelman provides a foundation for implementing civic action and PBL in the classroom.

## Letter to Parents and Guardians

If your school or class is new to PBL, consider [sending a letter to parents and guardians](#) to describe the project and let them know how they can support the process.

## Resources for Peer Critique

Peer critique can be a powerful way to help students practice giving and receiving feedback. This unit presents multiple opportunities for students to practice their critique and revision skills.

For example protocols, see:

- [Critique Protocol](#) - Deeper Learning Competencies
- [Charrette Protocol](#) - School Reform Initiative
- [Peer Review Strategy Guide](#) - Read, Write, Think
- [Praise, Question, Suggest Critique Protocol](#) - EL Education

## Interdisciplinary Connections

When students apply connections between different subject areas, the material becomes more relevant and meaningful. Throughout this unit, students will be steeped in the cultural, environmental, and economic importance of Southern Residents and will discover how their own actions can support the conservation and recovery of these critically-endangered whales.

## Cultural Connections

Southern Residents are culturally and spiritually important to the Salish Sea and beyond. They are featured prominently in the stories, songs, dances, art, and ceremonies of the Coast Salish people. Some tribes believe the Southern Residents to be their ancestors. For example, the Lummi name for killer whale, Qwe 'lhol mechen, roughly means "our relatives that live under the water."

"THEY REMIND US OF OURSELVES,  
AND WE SEE OURSELVES IN THEM."<sup>2</sup>

- ADAM OLSEN, MEMBER OF THE TSARTLIP FIRST NATION

## Adaptations for Online Learning

To enhance online and blended learning, consider having students create their own website or blog to record their research and share their learning with the public. The following digital tools can help enhance this unit. For additional tools, visit [Edutopia](#) or [Common Sense Media](#).

- [Equity Maps](#)  
See data on talk time, the number of times a student talks, and patterns of who converses with each other
- [Flipgrid](#)  
Post discussion prompts and students can respond with short videos
- [Google Classroom](#)  
Streamline assignments, boost collaboration, and foster communication. To access the Google Classroom companion for this unit, email [wcr.education@noaa.gov](mailto:wcr.education@noaa.gov).
- [Nearpod](#)  
Make lessons interactive and use formative and summative assessment tools to assess progress
- [Screencastify](#)  
Record, edit, and share videos

In recent years, tribes from the region have hosted rallies and prayer ceremonies honoring Southern Residents who have died.<sup>3</sup> Some tribes, such as the Samish, hold naming ceremonies when new calves are born.<sup>4</sup> Native American Tribes and Nations are very much involved in Governor Inslee's Southern Resident Orca Task Force and in other areas such as Lummi Nation working with the National Oceanic and Atmospheric Administration and Washington Department of Fish and Wildlife to get medicines and food to the ailing Scarlet in 2018.

"LUMMI NATION IS JUST STEPPING UP TO DO THE RIGHT THING AND DO WHAT WE CAN TO HELP. WE ARE ANSWERING THE CALL OF XA XALH XECHNGING, OUR SACRED OBLIGATION."<sup>5</sup>  
- JAY JULIUS, LUMMI CHAIRMAN

Through cultural ceremonies, participation in the Southern Resident Orca Task Force, sustainability managing fisheries, and outreach campaigns, tribes in the Pacific Northwest are rallying to protect and recover their relatives from under the water.



Lawrence Solomon (second from left), secretary of the Lummi Nation's Business Council, announces a new Southern Resident name. Credit: [Parker Miles Blohm/KNKX](#)

## Environmental Connections

From the smallest microorganisms to the fiercest predator—every species plays a role in its ecosystem. In a healthy ecosystem, there is a subtle dance between predators and prey. This balancing act helps maintain healthy populations of plants and animals throughout the ecosystem.



A young resident killer whale chases a chinook salmon in the Salish Sea near San Juan Island, WA. Credit: [Holly Fearnbach/SR3](#) and [Lance Barrett-Lennard/Vancouver Aquarium](#)

Apex predators, such as killer whales, play an important role in structuring their ecosystem. Southern Residents seek out the oldest, largest Chinook. These Chinook provide more calories than smaller fish. If Southern Residents consume only large adult Chinook, adult female killer whales would consume up to approximately 13 Chinook per day and adult male killer whales would consume up to approximately 16 Chinook per day.<sup>6</sup> Depending on the population size, the J, K, and L pods must catch around 300,000 Chinook salmon a year. But these numbers depend a lot on the ages of the killer whales, as well as the species, size, and calorie content of their salmon prey. If fewer large, adult Chinook are available, the killer whales will have to eat more of the smaller fish to meet their caloric requirements.



“KILLER WHALES DON’T SHOW A LOT OF INTEREST IN CHINOOK UNTIL THEY REACH A CERTAIN SIZE, AND THEN THEY FOCUS INTENSELY ON THOSE INDIVIDUALS.”<sup>7</sup>

- JAN OHLBERGER, RESEARCH SCIENTIST, UNIVERSITY OF WASHINGTON

Chinook populations in the Salish Sea are facing many pressures including historical overfishing, passage barriers such as dams, and changing ocean conditions due to climate change and ocean acidification. As populations of seals, seal lions, and Northern Residents rebound, they place additional pressures on fragile salmon populations.

With all of these stresses, large and old Chinook are becoming more rare.<sup>8</sup> The reductions in size could have a long-term effect on the number of Chinook salmon. Smaller females carry fewer eggs. Over time the number of fish that hatch and survive to adulthood may decrease. Smaller and fewer fish means the Southern Residents will have to work extra hard to get enough to eat.



Winchester Dam and fish ladder on the North Umpqua River in Winchester, OR. Credit: [EWY Media/Shutterstock](#)

As indicator species, Southern Residents can tell us a lot about the health of their environment. Pollutants from the Southern Resident’s prey and environment become concentrated in their blubber. Some of these pollutants can cause disease or reproductive disorders. Pollutants are also passed from mothers to their calves. Since

the Southern Residents are in trouble, it likely means the Salish Sea is in trouble, too.

“ORCAS ARE CANARIES IN THE COAL MINE. WHAT HAPPENS TO THEM WILL AFFECT MANY OTHER SPECIES, AND ALSO AFFECT US. BY PROTECTING ORCAS, WE ALSO PROTECT OUR QUALITY OF LIFE IN THE NORTHWEST.”<sup>9</sup>

- STEPHANIE SOLIEN, VICE CHAIR OF PUGET SOUND PARTNERSHIP

Southern Residents are also considered to be an umbrella species. When we protect an umbrella species, we indirectly protect many other species that share the same habitat. Since many species are threatened or endangered, identifying umbrella species can make conservation decisions easier. It can also help species that are not as well known or popular—such as sea snails and eelgrass—gain much-needed protection.

## Economic Connections

Southern Residents are a very important economic driver for Washington State. In San Juan County alone, whale watching participants support over \$216 million worth of economic activity.<sup>10</sup> In turn, this activity generates more than \$12 million in state and local tax revenue and supports over 1,800 jobs.<sup>11</sup> Whale watching is a big business!

“PEOPLE AREN’T COMING HERE TO SEE HARBOR SEALS. IF THERE WERE NO MORE ORCAS, THIS ECONOMY WOULD COLLAPSE.”<sup>12</sup>

- JASON GUNTER, MANAGER OF DISCOVERY SEA KAYAK

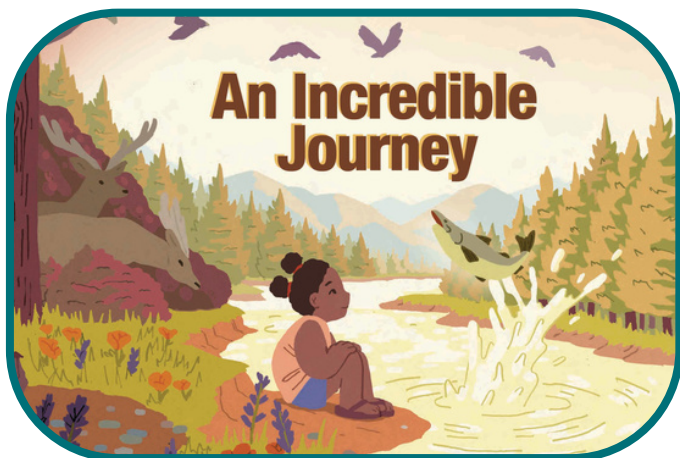
A 2019 study revealed that if the Southern Residents become extinct, 33% of non-local, boat-based whale watching participants would no longer choose to visit the Puget Sound region.<sup>13</sup> However, the commercial whale watching industry has grown in recent years despite the decreasing presence of Southern Residents in inland waters, likely due to the opportunity to view transient orcas and other whales. In another review of the whale watching industry, rules to limit viewing of Southern

Residents were not expected to pose a risk to the viability of the industry.<sup>14</sup>

Throughout the unit, students will grapple with the need to balance the recovery of the Southern Residents with economic considerations such as the cost of conservation and competing interests from industries. For example, a decrease in whale watching could help the whales find more salmon. However, the local economy greatly benefits from whale watching. When weighing pros and cons, students will have to balance social, economic, and environmental issues—just like the real scientists and policy makers.

## STEAM Connections

Through authentic explorations of Southern Resident science, conservation, and recovery, students will grapple with real-world science, technology, engineering, and math (STEM) challenges. At NOAA Fisheries, we recognize that the arts can both complement and advance our mission.<sup>15</sup> Throughout the unit, students are encouraged to use their own talents—from drawing and creating social media campaigns to mapmaking and storytelling—to support their own learning and to rally their communities around sustainability and conservation issues.



*An Incredible Journey* is one example of our partnerships with artists. Credit: [Anke Gladnick, Pacific Northwest College of Arts](#)

## Complementary Programs

The [NOAA Ocean Guardian School program](#) supports hands-on stewardship projects that are focused on current issues affecting the health of local watersheds and/or the ocean while promoting best environmental practices.

[NOAA Planet Stewards](#) supports educators' efforts to implement hands-on action-based projects that conserve, restore, and protect human communities and natural resources from environmental challenges monitored by NOAA.

[Teacher At Sea](#) program provides K-16 teachers hands-on, real-world research experience working at sea with world-renowned NOAA scientists.

## Complementary Resources

[An Incredible Journey](#) vividly details the perilous journey salmon make from their home stream to the ocean, sometimes navigating thousands of miles. The curriculum, children's book, board game, and animation help students understand the importance of salmon to our culture, our economy, and many different ecosystems.

The *Sea Stewards Handbook* ([English](#), [Spanish](#)) describes nine of the most serious issues facing our ocean today, such as runoff and marine debris. Each short summary describes how our daily actions can affect these issues and what individuals can do to make a meaningful difference. The handbook includes short profiles of ocean heroes from around the world and programs to engage schools in stewardship initiatives.

## Fund Your Projects

NOAA's Office of Education supports formal, informal, and non-formal education projects and programs through [competitively awarded grants and cooperative](#)

agreements. Student projects and comprehensive teacher professional development may be funded through these opportunities.

## Evolve This Unit

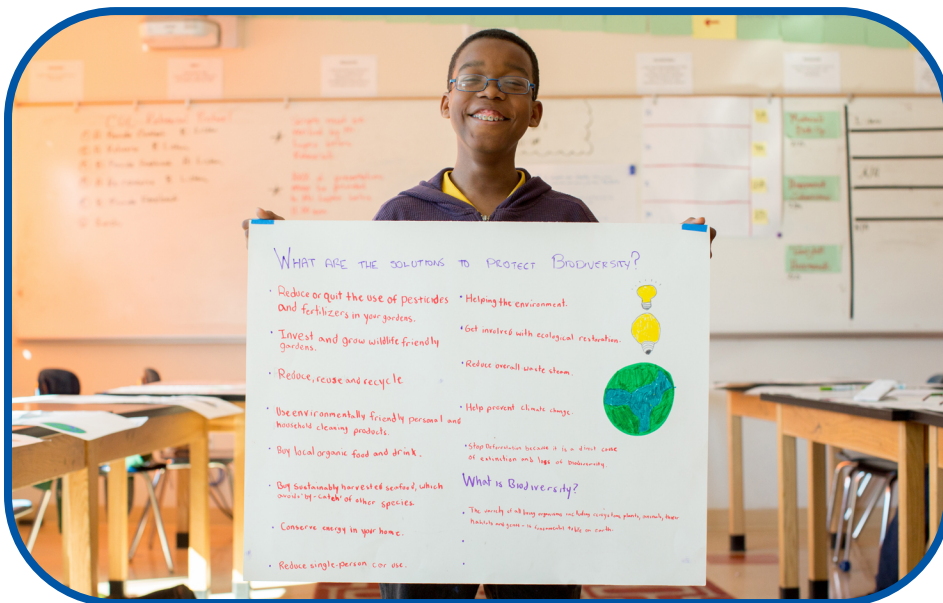
We strive to make our products and programming accessible and relevant to as many classrooms as possible. If you have suggestions for how to improve this unit, please let us know.

## Supporting Resources

Download the supporting slide decks and audio files at: <http://go.usa.gov/x6HBh>. For access to the Google Classroom companion, email [wcr.education@noaa.gov](mailto:wcr.education@noaa.gov).

## Additional Support

We want you to feel comfortable integrating this unit into your classroom. If you need additional support, please do not hesitate to contact [wcr.education@noaa.gov](mailto:wcr.education@noaa.gov). We can answer questions, provide links to additional resources, and connect you with local partners and opportunities.



A student shares his final project for the school's Celebration of Learning showcase. Credit: Allison Shelley/EDUimages

## Inspire Others

Help inspire Southern Resident conservation around the globe by sharing your experience with this unit. Tag photos, student work, and student quotes.



[@NOAAFisheriesWestCoast](https://www.facebook.com/NOAAFisheriesWestCoast)  
Facebook



[@NOAAFish\\_WCRO](https://twitter.com/NOAAFish_WCRO)  
Twitter



[@NOAAFisheries](https://www.instagram.com/NOAAFisheries)  
Instagram



## Key National Standards

This unit will help middle school classrooms address the following national educational standards:

### Next Generation Science Standards - Disciplinary Core Ideas

The Disciplinary Core Ideas all have broad importance within or across science or engineering disciplines, provide a key tool for understanding or investigating complex ideas and solving problems, relate to societal or personal concerns, and can be taught over multiple grade levels at progressive levels of depth and complexity.

- [LS2.A](#). Interdependent Relationships in Ecosystems
- [LS2.C](#). Ecosystem Dynamics, Functioning, and Resilience
- [LS4.D](#). Biodiversity and Humans
- [ESS3.C](#). Human Impacts on Earth Systems
- [ETS1.B](#). Developing Possible Solutions



Two middle school students collaborate on a science project. **Credit:** Allison Shelley for EDUimages

## Common Core State Standards (CCSS)

[CCSS](#) help students develop key success skills—the cognitive and socioemotional skills that students will need for success in college and throughout their careers. Through student-led research, analysis, and public projects, this unit advances the following success skills:

### Comprehension and Collaboration

Prepare for and participate effectively in a range of conversations and collaborations with diverse partners, building on others' ideas and expressing their own clearly and persuasively. ([CCSS.ELA-LITERACY.CCRA.SL.1](#); [CCSS.ELA-LITERACY.SL.6.1](#), [7.1](#), [8.1](#))

Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally. ([CCSS.ELA-LITERACY.CCRA.SL.2](#); [CCSS.ELA-LITERACY.SL.6.2](#), [7.2](#))

### Integration of Knowledge and Ideas

Integrate information presented in different media or formats (e.g., visually, quantitatively) as well as in words to develop a coherent understanding of a topic or issue. ([CCSS.ELA-LITERACY.RI.6.7](#))

### Presentation of Knowledge and Ideas

Present information, findings, and supporting evidence such that listeners can follow the line of reasoning and the organization, development, and style are appropriate to task, purpose, and audience. ([CCSS.ELA-LITERACY.CCRA.SL.4](#); [CCSS.ELA-LITERACY.SL.6.4](#), [7.4](#), [8.4](#))

Make strategic use of digital media and visual displays of data to express information and enhance understanding of presentations. ([CCSS.ELA-LITERACY.CCRA.SL.5](#); [CCSS.ELA-LITERACY.SL.6.5](#), [7.5](#), [8.5](#))

Adapt speech to a variety of contexts and tasks, demonstrating command of formal English when indicated or appropriate.

([CCSS.ELA-LITERACY.CCRA.SL.6](#); [CCSS.ELA-LITERACY.SL.6.6](#), [7.6](#), [8.6](#))

### Research to Build and Present Knowledge

Conduct short as well as more sustained research projects based on focused questions, demonstrating understanding of the subject under investigation. ([CCSS.ELA-LITERACY.CCRA.W.7](#); [CCSS.ELA-LITERACY.W.6.7](#), [7.7](#), [8.7](#))

Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration. ([CCSS.ELA-LITERACY.WHST.6-8.7](#))

Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration. ([CCSS.ELA-LITERACY.WHST.6-8.7](#))

### Science and Technical Subjects

Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions. ([CCSS.ELA-LITERACY.RST.6-8.2](#))

### Writing

Support claim(s) with logical reasoning and relevant, accurate data and evidence that demonstrate an understanding of the topic or text, using credible sources. ([CCSS.ELA-LITERACY.WHST.6-8.1.B](#))

Develop the topic with relevant facts, definitions, concrete details, quotations, or other information and examples.

([CCSS.ELA-LITERACY.W.6.2.B](#); [CCSS.ELA-LITERACY.W.6.2.B](#), [7.2B](#), [8.2B](#))

## College, Career, and Civic Life (C3) Framework

The [C3 Framework](#) aims to: enhance the rigor of the social studies disciplines; build critical thinking, problem solving, and participatory skills to become engaged citizens; and align academic programs to the Common Core State Standards for English Language Arts and Literacy in History/Social Studies.

### Civics

- D2.Civ.1.6-8.
- D2.Civ.10.6-8.

### Communicating and Critiquing Conclusions

- D4.3.6-8.

### Economics

- D2.Eco.1.6-8.
- D2.Geo.3.6-8.

### Sociology

- D2.Soc.3.9-12.
- D2.Soc.13.9-12.

### Taking Informed Action

- D4.6.6-8.
- D4.7.6-8.
- D4.8.6-8.

## Key State Standards

### California's Environmental Principles and Concepts

#### Principle 2. People Influence Natural Systems

- **Concept A.** Direct and indirect changes to natural systems due to the growth of human populations and their consumption rates influence the geographic extent, composition, biological diversity, and viability of natural systems.
- **Concept B.** Methods used to extract, harvest, transport, and consume natural resources influence the geographic extent, composition, biological diversity, and viability of natural systems.
- **Concept D.** The legal, economic, and political systems that govern the use and management of natural systems directly influence the geographic extent, composition, biological diversity, and viability of natural systems.

#### Principle 3. Natural Systems Change in Ways that People Benefit From and Can Influence

- **Concept C.** Human practices can alter the cycles and processes that operate within natural systems.

#### Principle 4. There are no Permanent or Impermeable Boundaries that Prevent Matter from Flowing Between Systems

- **Concept B.** The byproducts of human activity are not readily prevented from entering natural systems and may be beneficial, neutral, or detrimental in their effect.
- **Concept C.** The capacity of natural systems to adjust to human-caused alterations depends on the nature of the system as well as the scope, scale, and duration of the activity and the nature of its byproducts.

#### Principle 5: Decisions Affecting Resources and Natural Systems are Complex and Involve Many Factors

- **Concept A.** There is a spectrum of what is considered in making decisions about resources and natural systems and how those factors influence decisions.

### Oregon Environmental Literacy Plan

- **1a.** System structure
- **1b.** Habits of systems thinking
- **2b.** Structure, function, interaction and change in living systems
- **2c.** Structure, function and interconnectedness of human systems
- **3a.** Sense of place, region, nation and global community
- **3b.** Interrelationships between the environment and human activities
- **4a.** Rights and responsibilities of citizens
- **4b.** Sense of personal responsibility
- **5a.** Work with flexibility, creativity, openness and perseverance
- **5b.** Assess the accuracy and reliability of information sources
- **5c.** Identify and analyze strategies that address challenges and create desired futures.
- **5d.** Demonstrate effective decision-making and citizen action.

### WA State K-12 Integrated Environmental & Sustainability Education (ESE) Learning Standards

- **ESE Standard 1.** Ecological, Social, and Economic Systems.
- **ESE Standard 2.** The Natural and Built Environment
- **ESE Standard 3.** Sustainability and Civic Responsibility



## Introduction to the Southern Residents

Humans have a storied history with killer whales. Before they were revered as cultural icons of the Pacific Northwest, Southern Resident killer whales (Southern Residents) were perceived as a threat to lucrative salmon fisheries and were killed.<sup>16</sup> In the 1960s and 1970s, they were captured for display in zoos and aquariums.<sup>17</sup> Today, we appreciate these apex predators for their cultural and spiritual importance, complex social structure, and what may be demonstrations of animal grief (epimeletic behavior).<sup>18</sup>



Southern Residents in front of the Seattle, WA skyline. Credit: NOAA Fisheries

In 2005, the Southern Residents were listed as an endangered species. Despite community and governmental efforts to protect the Southern Residents, their population continues to decline due to starvation, pollutants, and vessel traffic and noise. As of July 2021, there are only 75 individuals remaining.

Communities, scientists, and policymakers are racing to protect and recover these treasured animals. Throughout this unit, students will learn how the Southern Residents are an integral thread of the environment, economy, and cultures of the Pacific Northwest and what they can personally contribute to the conservation and recovery of these animals.

## What's in the news?

- [“Despite recent births, ‘a long way to go’ to save Southern Resident orcas”](#) King5
- [“A mother orca’s dead calf and the grief felt around the world”](#) Seattle Times
- [“Pandemic gives Pacific Northwest whales a respite from din of underwater noise”](#) KUOW
- [“Orcas of the Pacific Northwest Are Starving and Disappearing”](#) New York Times

This unit aims to balance the overwhelming negative news by empowering individual students to support Southern Resident conservation and recovery efforts. Throughout this unit, students will have the opportunity to dive deeply into local issues, create products that educate their families and communities, and design a project that will make a meaningful difference for the Southern Residents.

## Who are the Southern Residents?<sup>19</sup>

Killer whales (*Orcinus orca*) are toothed whales related to pilot whales. They occur in all the world’s oceans.

There are three main ecotypes of killer whales in the North Pacific Ocean:

1. Residents (salmon eaters)
2. Offshores (shark and other fish eaters)
3. Transients (marine mammal eaters)

While most other killer whale populations are doing well, the Southern Residents are among the world’s most endangered marine mammals.

Killer whales are highly social. Most live in social groups called pods. Southern Residents travel in three distinct groups: J, K, and L pods. Within each pod there are several family units, each descended from a single female ancestor. These units, called matriline, are each typically composed

of an adult female, the matriarch, and her female and male offspring. Pods typically consist of a few to about 20 whales. Larger groups sometimes form a temporary “superpod” for social interaction, mating, or seasonal concentration of prey.

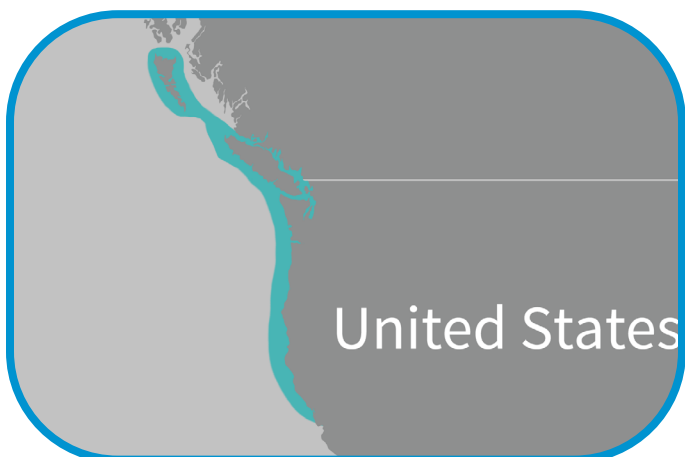
[DIVE DEEPER: A PRIMER ON THE ENDANGERED SOUTHERN RESIDENT KILLER WHALES, MEET THE WHALES, GRANDMOTHER ORCAS HELP THEIR GRAND-WHALES SURVIVE](#)



A Southern Resident and her calf. **Credit:** NOAA Fisheries

## Where do they live?

Southern Residents are found mostly off the coasts of British Columbia, Washington, and Oregon. Occasionally, they travel as far north as Southeast Alaska or as far south as California. They spend much of the summer in coastal waters of the Pacific Northwest and around the San Juan Islands following their main food source, Chinook salmon.



The Southern Residents' range. **Credit:** Marine Mammal Commission

## What do they eat?

The whales prey almost exclusively on Chinook salmon when they are available in the summer. However, they diversify their diet the rest of the year to include species such as skates, halibut, and lingcod, as well as steelhead, chum, and coho salmon. Most of the salmon the whales consume in winter and spring come from three large river systems: the Columbia, Sacramento, and rivers entering Puget Sound.<sup>20</sup>

Southern Residents seek out the largest, oldest Chinook. How does a Southern Resident find and hunt down these Chinook while ranging across more than 15,000 square miles? This vast expanse is occupied by hundreds of other fish species, including five other species of salmon whose populations are often far more abundant than Chinook salmon.

The whales hunt with echolocation, which is the use of sound waves and echoes to locate objects. When hunting, a killer whale sends out a series of clicks, called a [click train](#). These clicks spread through the water like a flashlight beam of sound. If the sound waves hit an object, echoes bounce back to the whale. Echolocation allows killer whales to detect fish at distances of up to 500 feet, much farther than they could see in the dark water.

[DIVE DEEPER: ORCAS & SALMON, HUNTING WITH THE SOUTHERN RESIDENTS](#)

## How do they communicate?

Killer whales rely on underwater sound to feed, communicate, and navigate. Pod members use clicks, known as echolocation, to find prey and communicate with each other through whistles and pulsed calls. Each pod possesses a unique set of calls that are learned and culturally transmitted among individuals. These calls maintain group cohesion and serve as family badges. They also use these calls to coordinate hunting

strategies and work as a team to catch prey.

DIVE DEEPER: [ORCA COMMUNICATION](#)

## Why are the whales at risk?

The Southern Resident population is closely tied to the overall health of the ecosystem. These whales are among the most at-risk marine mammals in the world. Historically, the populations have suffered from capture for aquariums. Presently, scarcity of their preferred food—Chinook salmon—chemical contaminants, and noise and crowding by boat traffic pose serious threats to this endangered population. Evidence of inbreeding, which poses additional risk, has recently been discovered in the population.

DIVE DEEPER: [HOSTILE WATERS: ORCAS IN PERIL](#)

## Historical Capture

From 1962-1977, approximately 300 whales of several species were captured in Washington and British Columbia primarily for aquariums all over the world. The Southern Residents were the most heavily affected population with 36 whales captured and at least 11 dying in the process—nearly half of the population.

DIVE DEEPER: [HOW A GENERATION OF KILLER WHALES WAS TAKEN FROM PUGET SOUND](#)



Southern Residents were herded into Penn Cove off Whidbey Island, WA. Credit: Wallie Funk/Associated Press

## Limited Prey

Southern Residents, it turns out, are picky eaters. While they will eat a variety of prey—including a variety of salmon species, sole, cod, herring, and squid—their preferred diet is Chinook salmon. They even appear to select the oldest, largest Chinook, when they are available. Unfortunately, this preference may be hurting them in the long run.



A young resident killer whale chases a Chinook salmon near San Juan Island, WA. Credit: Holly Fearnbach (SR3: SeaLife Response, Rehabilitation and Research) and Lance Barrett-Lennard (Vancouver Aquarium's Coastal Ocean Research Institute).

On the West Coast, some Chinook populations in places such as the Columbia River are growing. Other populations like Puget Sound Chinook and Sacramento River winter run Chinook are struggling due to issues such as climate change, passage barriers, habitat loss, and water pollution. As of 2019, two populations of Chinook salmon on the West Coast are listed as endangered and seven are listed as threatened under the Endangered Species Act.<sup>21</sup>

Ocean-type Chinook prefer coastal waters, meaning they spend most of their lives relatively close to shore, or in protected inland marine waters like Puget Sound. This can expose them to industrial discharge, urban drainage, wastewater from treatment plants, and agricultural runoff—all sources of harmful chemical contaminants.

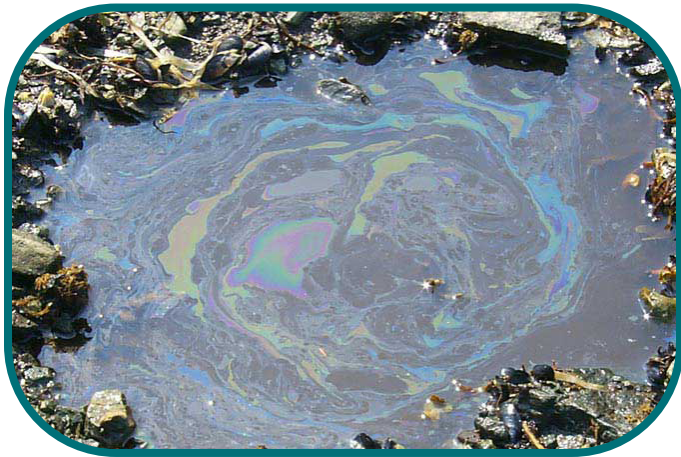


This is one reason why Southern Residents are more polluted than other killer whale subgroups: they eat prey that are highly polluted themselves.

DIVE DEEPER: [WASHINGTON'S ORCAS ARE HUNGRY](#)

## Pollution

Southern Residents accumulate pollutants from the fish they eat in their blubber, making the whales among the most contaminated marine mammals in the world. Pollutants include pesticides, industrial coolants and lubricants, flame retardants, motor oil, and chemicals from other household products that enter Puget Sound and the Pacific Ocean when it rains.



Motor oil and other oil-based chemicals can be recognized by a characteristic rainbow-colored sheen. **Credit:** National Ocean Service

In a process known as biomagnification, pollutants become more concentrated as they move up the food chain. Killer whales, being top-level predators, accumulate more of these harmful chemicals than other animals in the ocean. Scientists are still learning the full extent of what this is doing to the Southern Residents' health.

Studies suggest that when the whales do not get enough to eat their bodies break down and expose them to pollutants stored in their blubber. This can compromise their immunity and reproductive success, leaving them more vulnerable to disease and

making it tougher for them to rebuild their numbers.

Pollutants can affect fetuses and nursing calves too. A killer whale mother's milk is partially produced from her blubber.<sup>22</sup> When nursing, she transfers a percentage of her load of pollutants to her offspring, potentially causing changes in their metabolism, growth rates, and future fertility. Pollutants can even slow learning and impair memory, challenging a young whale's ability to forage for food and interact with others in its pod.

DIVE DEEPER: [TOXIC KILLER WHALES](#)

## Boat Traffic and Noise

Hunting salmon is hard work for the Southern Residents. Underwater noise from nearby boats makes it more difficult for the whales to detect the echoes from their hunting clicks. This ultimately reduces the distance from which they can detect fish.

Boat traffic within 400 yards of Southern Residents interrupts their foraging.<sup>23</sup> Female whales often stop feeding altogether. This can have cascading effects on her ability to meet the energy requirements to support reproduction.

Boat traffic can also disrupt prey sharing. Since lactating mothers have higher energy requirements, prey sharing is especially important for them and their offspring.

DIVE DEEPER: [UNDERWATER NOISE AND MARINE LIFE](#)

## Inbreeding

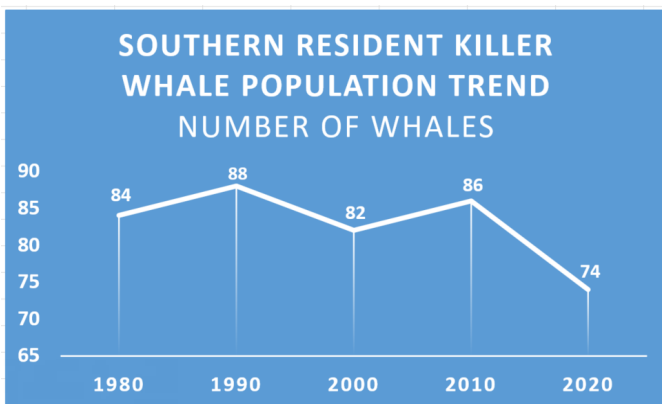
Many wild species maintain diversity by leaving their family groups to mate. Many animals often join or form new family groups. Southern Residents do not follow this strategy. Instead, the whales stay with their mothers and their families throughout their lives. While we do not know the exact reason, scientists hypothesize that the whales may stick with their families because their mothers continue to help them hunt salmon. The drawback is that

it puts the population at greater risk of inbreeding.

A 2018 study found that four of the whales are already highly inbred. That includes offspring of a father-daughter and mother-son pair. Many additional whales may be inbred to a lesser degree. More than half of Southern Resident calves die before or shortly after birth; a genetic analysis from 2018 suggested that inbreeding could be a factor.

DIVE DEEPER: [KILLER WHALE GENETICS RAISE INBREEDING QUESTIONS](#)

## Population Over Time



Southern Resident population trends from 1980-2020.

From 1973 to 2016, the Southern Resident population showed periods of both growth and decline. When the first census was conducted in 1973, 66 whales were sighted. Their population increased by 48% to a high of 98 in 1995, then dropped 16% to 82 individuals between 1995 and 2003, prompting NOAA Fisheries to list them as an endangered species. As of July 2021, there are 75 individuals.

DIVER DEEPER: [SOUTHERN RESIDENT ORCA POPULATION](#)

## All Hands on Deck

Every single day we make choices that affect the Southern Residents, their prey, and their habitat. NOAA Fisheries alone cannot save the Southern Residents. The recovery of these iconic whales depends on government, industry, and community partnerships and active, informed individuals. It will take all of us working together to save the Southern Residents.



While students are not responsible for the state of the Southern Residents, they can be a real force for change—especially when they work together. It is important for us to help students understand the limitations of individual action and the benefits of collective action, governmental regulations, and social norms. When we deploy these approaches together, we can make lasting systemic changes that benefit the Southern Residents, the greater marine environment, and human health.

DIVE DEEPER: [INDIVIDUAL VS. COLLECTIVE ACTION, COLLECTIVE ACTION PROBLEMS, SOLVING COLLECTIVE ACTION PROBLEMS, SOCIAL CHANGE ECOSYSTEM MAP](#)

Are you and your students ready to take action for the Southern Residents?

Then let's dive in!

# Scope and Sequence

Each of the activities in this unit can stand alone. When using multiple activities or the complete unit, we recommend following the sequence below.

## 1

### Making Connections

After watching a media-rich slideshow featuring sounds, images, and video clips related to the Southern Residents and their environment, students draw connections to discover what they will be learning about throughout this unit. Students then brainstorm what they need to know in order to answer the unit's driving question: How can we make a difference for the critically endangered Southern Resident killer whales?

## 2

### Click, Whistle, Call

Students describe the various sounds in their neighborhood and how noise pollution affects them personally. After learning how Southern Residents communicate, students participate in a simulation to experience how Southern Residents are being disturbed by human activities.

## 3

### Ripple Effects

During a graphics-heavy slide show, students learn about the ripple effects of various plant and animal extinctions around the world. Afterward, a jigsaw activity guides students through the potential cultural, economic, and environmental effects of Southern Resident decline and extinction.

## 4

### Threats and Solutions

The activity opens with a quick brainstorm about what animals need to survive. Students then conduct scaffolded research to dive deeper into the major threats facing the Southern Residents: starvation, contamination, and vessel noise and then research potential solutions to these threats. During a reflection, students identify the potential barriers and side benefits of implementing these solutions.



## 5

### Community Mapping

After making observations about different community characteristics, students brainstorm a list of community features that might benefit or harm the Southern Residents. In small groups, students create a neighborhood map and identify local issues that might affect the Southern Residents. The class then identifies ways that the schoolyard and/or community can be improved to benefit the Southern Residents, their prey, and their habitat.

## 6

### Who is Responsible?

This activity opens with a general poll about responsibility for socio-political issues. Afterward, students discuss who should be responsible (i.e., governments, industries, communities, individuals) for the threats facing the Southern Residents. The activity helps students understand that a single entity alone cannot solve these issues—it will take all of us working together to save them. The activity wraps up with a discussion around the limitations and benefits to different types of action (i.e., individual, collective, governmental).

## 7

### Orca Task Force

Students take on the perspectives of various groups (e.g., commercial fishers, tribes, taxpayers, etc.) to evaluate measures designed to save the Southern Residents. During a mock meeting, groups weigh the pros and cons of each measure and decide whether or not their group would support it. Groups are then faced with a budget crisis and must decide how they would reprioritize each measure.

## 8

### Yes, We Can!

A series of short case studies highlight how human passion and ingenuity can overcome seemingly insurmountable problems. Students then complete a skills and interests assessment to determine how they can use their talents and interests to help the Southern Residents.

## 9

### Taking Action

Students work in small groups to design an action project for the Southern Residents that demonstrates their learning and supports their personal interests and talents. Projects can be scaled to your timeline and students' interests.



Photo credit: photographer name photographer name

## Activity 1: Making Connections

After watching a media-rich slide show featuring sounds, images, and video clips related to the Southern Residents and their environment, students draw connections to discover what they will be learning about throughout this unit. Students then brainstorm what they need to know in order to answer the unit's driving question: How can we make a difference for the critically endangered Southern Resident killer whales?

### Key Student Questions

- What is the connection between the sounds, videos, images, and graphs?
- What future do you want to see for the Southern Residents?
- What do you need to know to answer the driving question?

## Key National Standards

### NGSS

- [LS2.A](#): Interdependent Relationships in Ecosystems
- [ESS3.C](#): Human Impacts on Earth Systems

### CCSS

- CCSS.ELA-LITERACY.RI.[6.7](#)
- CCSS.ELA-LITERACY.CCRA.[SL.2](#); CCSS.ELA-LITERACY.SL.[6.2](#), [7.2](#)

## Keywords

**Endangered species**—Animals or plants that are in danger of becoming extinct.

**Extinct**—Animals or plants that have died out completely.

**Pollutant**—Any substance introduced to the environment that adversely affects the health of an organism, the health of an ecosystem, or the usefulness of a resource.

## Supporting Vocabulary

**Bioaccumulation**—An increase in the concentration of a chemical in a biological organism over time, compared to the chemical's concentration in the environment. The source of the chemical can be from the water, soil, sediment, or air the organism interacts with or from the food it eats.

**Biomagnification**—A process that results in the accumulation of a chemical in an organism at higher levels than are found in its food. It occurs when a chemical becomes more and more concentrated as it moves up through a food chain.

**Marine mammals**—Warmblooded animals that live in marine waters and breathe air directly. These include porpoises, dolphins, whales, seals, and sea lions.

## Introduction

1. Ask students to close their eyes and envision what it might feel like to see the Pacific Ocean for the first time. What might they hear, smell, or see? What might they be thinking? What kind of energy might they be feeling?



## Materials

- **Slide deck**  
*Making Connections*
- **Worksheet**  
[Making Connections](#)  
Pg 26-27  
1 per student
- A large sheet of paper or dedicated white-board space for the driving question



2. Ask for a few students to share their thoughts.
3. Share with the class that they are about to embark on a quest to learn about one of the Pacific Northwest's marine icons.

**Note:** We will be referring to the Canadian province of British Columbia and the U.S. states of Washington, Idaho, Oregon, and Northern California as the "Pacific Northwest."

## Activity

1. Arrange students into groups of 3-4.
2. Give each student a copy of the [Making Connections](#) worksheet and walk through the directions as a class.
3. Project the *Making Connections* slide deck.
4. Use the speaker's notes to guide the activity. The slide deck is broken out into seven sections, which correspond to the worksheet.

### Listen (Slide 2)

During the Listen portion, students will listen to five audio recordings. Play each clip no more than two times. Give students a minute or two to complete the "Listen" portion of the handout. Give students 1-2 minutes to share their thoughts with their group. At this point, do NOT debrief as a class.

### Look (Slides 3-6)

During the Look portion, students will be shown four groups of images. Briefly show each slide and then give students a minute to complete the "Look" section of their worksheet. Give students 1-2 minutes to share their thoughts with their group. At this point, do NOT debrief as a class.

### Learn (Slides 7-9)

During the Learn portion, students will be shown three figures. The titles have been omitted as to not influence the students' answers. Briefly show each slide and then give students a minute to complete the "Learn" section of their worksheet. Give students 1-2 minutes to share their thoughts with their group. At this point, do NOT debrief as a class.

### Link (Slides 10-11)

During the Link portion, students will review their notes from the activity. They will try to determine the thread that ties all of the data, photos, videos, and sounds together (i.e., Southern Residents). Give students a few minutes to complete the "Link" section of their worksheet independently. Afterward, give small groups a few minutes to discuss their ideas. One representative from the group should be ready to summarize their group's thoughts with the class.

### Reveal (Slides 12-20)

During the Reveal portion, use the speaker's notes to describe the data, photos, videos, and sounds that were presented in the Listen, Look, and Learn portions of the presentation.

### Looking Ahead (Slide 21)

During the Driving Question, students will review the proposed driving question and brainstorm what information they need to know to answer the question. Write down student responses on a large sheet of paper or dedicated whiteboard space. Keep these questions accessible for the remainder of the unit.

5. Bring the class back together.
6. Share that as of July 2021 only 75 Southern Residents remain. These charismatic creatures are critically endangered.

**Note:** For the most current population count, visit: [www.whaleresearch.com/orca-population](http://www.whaleresearch.com/orca-population).

- In popcorn format, ask the class why small population sizes might be a problem. *Inbreeding, a new disease could harm or kill the entire population, a catastrophe such as an oil spill could wipe out the entire population, etc.*
- Tell students that they will spend the next \_\_\_\_ classes studying Southern Residents. They will learn about their life history, why their population has declined, and what people can do to make a meaningful difference. At the end of the unit, students will use their newfound knowledge and passion to design a campaign or stewardship project to help the Southern Residents.

## Discussion Questions

- What are your initial impressions about the Southern Residents? How do you feel after learning a little bit about them?
- People have a storied past with killer whales. They used to be killed by non-tribal fishers for competing with fisheries. Until relatively recently, they were captured for display in zoos and aquariums. Why might public perception have changed?
- The capture of Southern Residents contributed to their population decline. Could there be any benefits to keeping some Southern Residents in captivity? *Studying their behavior, raising awareness of the population, building empathy for marine mammals, etc.*
- If someone lives inland (i.e., not on the coast), should they still care about marine life? Why or why not?
- How are you connected to the Southern Residents?

## Share Your Students' Work

Help inspire Southern Resident conservation around the globe by sharing your experience with this unit. Tag photos, student work, and student quotes.

- Facebook: [@NOAAFisheriesWestCoast](https://www.facebook.com/NOAAFisheriesWestCoast)
- Twitter: [@NOAAFish\\_WCRO](https://twitter.com/NOAAFish_WCRO)
- Instagram: [@NOAAFisheries](https://www.instagram.com/NOAAFisheries)



## Additional Resources



[Article: The Hunger Games: Two Killer Whales, Same Sea, Different Diets](#)

The Salish Sea's resident killer whales are in trouble, but transient killer whales traveling the same waters seem to be doing fine.

[Blog: Southern Resident Connections](#)

Join NOAA Fisheries in exploring the ecological connections that tie this system together, and the ways we are protecting and working to recover the whales we care so much about.

[Video: Inside the killer whale matriarchy \(5:03\)](#)

Each killer whale family is able to survive thanks mainly to one member, its most knowledgeable hunter: the grandmother. These matriarchs can live 80 years or more and their expertise can mean the difference between life and death for their families.

[Video: Spotighting Southern Resident Killer Whales \(3:01\)](#)

Learn how NOAA research advances an intense effort to understand, provide new data, and minimize threats to them.

Name: \_\_\_\_\_ Date: \_\_\_\_\_ Class: \_\_\_\_\_

# Making Connections, Page 1



## Part I: Listen

**Directions:** Listen carefully to each sound. Describe what might be making each sound.

Sound 1: \_\_\_\_\_

Sound 2: \_\_\_\_\_

Sound 3: \_\_\_\_\_

Sound 4: \_\_\_\_\_

Sound 5: \_\_\_\_\_



## Part II: Look

**Directions:** Look carefully at each image. Describe what might be shown in each image.

<p><b>Group 1</b></p> <p>1</p> <p>2</p> <p>3</p>	<p><b>Group 2</b></p> <p>4</p> <p>5</p>
<p><b>Group 3</b></p> <p>6</p> <p>7</p> <p>8</p>	<p><b>Group 4</b></p> <p>9</p> <p>10</p>





### Part III: Learn

Directions: Describe what might be shown in each figure.

Figure 1	Figure 2	Figure 3



### Part IV: Link

Directions: Review the Listen, Look, and Learn sections. Compare and contrast the sounds, images, and figures. What might be the common thread that links all of these together?

---

---

---



### Part V: Looking Ahead

1. Write the driving question below:

---

---

---

2. What do you need to know to answer the driving question?

---

---

---

3. What future do you want to see for these iconic animals?

---

---

---



Credit: Bryan Pollard/Shutterstock

## Activity 2: Click, Whistle, Call

Students describe the various sounds in their neighborhood and how noise pollution affects them personally. After learning how Southern Residents communicate, students participate in a simulation to experience how Southern Residents are being disturbed by human activities.

### Warning

This activity may not be suitable for students who experience sensory overload. If your students experience sensory overload, consider using the audio clips at a low volume or only use the introduction to this activity.

### Key Student Questions

- How are people affected by noise pollution?
- What are the purposes of the Southern Resident's clicks, whistles, and calls?
- How are the Southern Residents affected by noise pollution?

## Key National Standards

### NGSS

- [ESS3.C](#): Human Impacts on Earth Systems
- [ETS1.B](#): Developing Possible Solutions

### Keywords

**Communication**—The act or process of using words, sounds, signs, or behaviors to express or exchange information or to express your ideas, thoughts, feelings, etc., to someone else.

**Echolocation**—The sonar-like system used by some animals to detect and locate objects by emitting usually high-pitched sounds that reflect off the object and return to the animal’s ears or other sensory receptors.

**Noise pollution**—Unwanted or excessive sound that can harm human health, wildlife, or environmental quality.

### Supporting Vocabulary

**Calls**—Pulsed signals which have discrete patterns that can be recognized by ear and by spectrogram. They are the main component of the orca communication repertoire.

**Clicks**—Part of the whale’s sonar and are used for echolocation: for finding and locating food sources, for defining other objects in the ocean and locating the whale in its environment.

**Whistles**—Continuous tone emissions that may last for many seconds.

### Preparation

1. Cut out the Pod Letters.
2. Download the Underwater Noise audio files and have them readily available on your device.

### Introduction

1. Ask students to close their eyes and to think about their neighborhood. What does it look like? What does it smell like? What does it sound like?



## Materials

- Audio files:**  
Underwater Noise
- Speaker** to play the audio files
- Timer**
- Driving Question poster** from Activity 1



2. Give students a few minutes to write down all of the sounds that they might hear while walking around their neighborhood. *Vehicles driving and honking, dogs barking, birds chirping, airplanes overhead, police or ambulance sirens, leaf blowers, lawn mowers, trains, etc.*
3. In Think-Pair-Share, free write, or popcorn format, have students respond to the following prompts:
  - What might it feel like if these noises were quieter or stopped all together?
  - What might it feel like if these noises suddenly became much louder?
  - What might it feel like if a loud, unrecognizable sound emerged?
4. Ask a few students to share their responses.
5. Share the following excerpt with the class:<sup>24</sup>

Noise pollution is an invisible danger. There are many sounds in our environment, from rustling leaves (20 to 30 decibels) to a thunderclap (120 decibels) to the wail of a siren (120 to 140 decibels). Sounds that reach 85 decibels or higher can harm a person's ears. Noise pollution impacts millions of people on a daily basis. The most common health problem it causes is hearing loss.

Exposure to loud noise can also cause high blood pressure, heart disease, sleep disturbances, and stress. These health problems can affect all age groups, especially children. Many children who live near noisy airports or streets have been found to suffer from stress and other problems, such as impairments in memory, attention level, and reading skill. Noise pollution also impacts the health and well-being of wildlife.

6. Ask for a volunteer to recall how killer whales communicate. *Echolocation or*

*clicks, whistles, and calls.*

**Option:** Play examples of clicks, whistles, and calls from [Orca Sound](#).

7. Share the following excerpt:

Killer whales rely on underwater sound to feed, communicate, and navigate. Pod members use clicks, known as echolocation, to find prey. They communicate with each other through whistles and pulsed calls. Each pod possesses a unique set of calls that are learned and culturally transmitted. These calls maintain group cohesion and serve as family badges. They also use these calls to coordinate hunting strategies and work as a team to catch prey.

8. Ask students to hypothesize how Southern Residents might be affected by noise pollution.

## Activity

1. On the board, draw the following table:

Round	Time	Sound	Feelings/ Observations
1			
2			
3			
4			
5			
6			

2. Explain that the class will participate in a simulation to better understand how noise pollution affects the Southern Residents.
3. Have students move their desks to the side to create a big open space in the middle of the classroom.

4. Review the following directions with the class and/or write them on the board:

- Everyone will receive a letter. This letter corresponds to the letter of your pod (i.e., J, K, or L).
- Do not share this letter with anyone.
- When the activity starts, you will close your eyes and try to find the other members of your pod by repeating the name of your pod (i.e., J, K, or L) in a normal volume. We are closing our eyes to simulate swimming in deep water, where visibility is reduced.
- When you find your pod, stay together.
- We will repeat this exercise a few different times.

5. Give each student a pod letter.

6. Repeat the following steps for rounds 1-3 of the activity:

- Play the sound corresponding to each round.
  - **Round 1:** Light rain
  - **Round 2:** Large commercial ship
  - **Round 3:** Submarine
- Ask students to begin finding their pod.
- Start the timer.
- Once all students have found their pod, stop the timer and the noise.
- Record the time in the corresponding column on the whiteboard.
- Ask a few students to record their thoughts or feelings on the board.
- Ask students to trade their card with someone outside of their pod.
- Repeat these steps until Round 3 has been completed.

7. Share the following excerpt:

Now that you have a sense of how hard it is to communicate with noise pollution, you will try and hunt for Chinook salmon. A few students will be salmon instead of Southern Residents. These salmon will quietly say salmon while the rest of the class makes a click or whistle. To catch a salmon, a Southern Resident will gently tap the salmon on the shoulder. The salmon will move

## Additional Resources



### Audio Files

#### [Discovery of Sound in the Sea](#)

Listen to different natural and human-made sounds in the ocean.

### Articles

#### [Communication and Echolocation](#)

This article describes different killer whale sounds and their purposes.

#### [Noise Pollution](#)

This National Geographic article highlights the sources and dangers of noise pollution in urban environments.

#### [Ocean Noise](#)

This brief tutorial describes sources and effects of natural and human-made noise pollution.

#### [Sound Waves - Listening to Orcas](#)

This article highlights underwater noise and killer whale communication research near San Juan Island in WA.

outside of the game area to indicate it has been caught.

8. Ask the class to close their eyes.
9. Secretly give a few students a salmon card.
10. Repeat the following steps for rounds 4-6 of the activity:
  - a. Play the noise corresponding to each round.
    - **Round 4:** Lightning
    - **Round 5:** Sonar
    - **Round 6:** Tanker
  - b. Ask students to close their eyes and find their prey.
  - c. Start the timer.
  - d. Once all of the salmon have been hunted, stop the timer and the noise.
  - e. Record the time in the corresponding column on the whiteboard.
  - f. Ask a few students to record their thoughts or feelings on the board.
  - g. Repeat these steps until Round 6 has been completed.
11. Collect the J, K, L, and salmon cards.
12. Have students return their desks to their original locations.
13. If desired, repeat the sounds and have students guess what they might be. Otherwise, simply write the sounds on the table:

Round	Time	Sound	Feelings/ Observations
1		Light Rain	
2		Large Commercial Ship	
3		Submarine	
4		Lightning	
5		Sonar	
6		Tanker	

14. Have the class brainstorm how chronic noise pollution might affect the Southern Residents, beyond their ability to communicate.

15. Share the following excerpt:

Because water is denser than air, sound travels very efficiently underwater. Sound in the ocean travels 25 times faster than it does on land. Animals in the ocean have evolved over hundreds of millions of years to make use of this acoustic environment. Humans have rapidly evolved marine acoustics with tankers, submarines, cruise ships, sonar, and seismic exploration. This noise pollution can impair marine mammals' ability to find prey, avoid danger, communicate, rest, reproduce, and navigate.<sup>25</sup> This can result in changed behaviors, hearing loss, increased stress levels, moving to quieter waters, injury, or death.<sup>26</sup>

16. Lead a brainstorm, free write, or Think-Pair-Share activity about potential solutions to noise pollution.



## Driving Question

Review the list of questions from Activity 1. Cross off any questions that were answered in today's activity. Add additional questions that may have arisen.

## Discussion Questions

1. How does noise pollution in your community make you feel?
2. How would the size, speed, and design of a boat affect the amount of noise pollution it produces?
3. How do individuals, even those without boats, contribute to marine noise pollution? Encourage students to think about where products come from and how they arrive at their local store or home (e.g., products shipped from overseas).
4. How could companies work together to reduce marine noise pollution?
5. How could individual boaters and paddlers reduce their impact on marine mammals?

## Public Product Option

To help build empathy for marine mammals who are grappling with noise pollution, students can write a journal entry from the perspective of a Southern Resident about what it is like to live with noise pollution. Alternatively, students can create a comic or advertisement to depict these issues. The journey entries and artwork can be used as part of a boater education campaign.

## Engineering Extension

Researchers estimate that ocean noise being produced by commercial ships could double between 2016 and 2030.<sup>27</sup> Students can research and design ways to dampen ocean noise and then test out their designs. Students could consider modifying propellers, creating bubble curtains, designing devices that slow ship speeds around marine mammals, etc. [RoboNation](#), [International Quiet Ocean Experiment](#), and [NOAA's Ocean Noise Strategy Roadmap](#) are great starting points.

## Maps

### [Listen to How Loud the Sea Is](#)

This interactive sound map explores the busy marine soundscape, from kayaks to cruise ships.

### [MarineTraffic](#)

This map displays near real-time positions of ships worldwide.

## Videos

### [Do Whales Communicate In Different Accents?](#)

(3:56)

Whales have a complex system of speech that even includes regional dialects. This video highlights how these dialects work.

### [Marine Noise and Southern Resident Killer Whales](#)

(10:21)

This TEDx talk focuses on how vessel noise affects the lives of Southern Residents and highlights the impact vessels are having on this endangered population of marine mammals.









Credit: Allison Shelley/EDUimages

### Activity 3: Ripple Effects

During a graphics-heavy slide show, students learn about the ripple effects of various plant and animal extinctions around the world. Afterward, a jigsaw activity guides students through the potential cultural, economic, and environmental effects of Southern Resident decline and extinction.

#### Key Student Questions

- Does it matter if one single species goes extinct?
- How can the extinction of a species cause ripple effects throughout cultures, economies, and ecosystems?
- How are the Southern Residents an integral part of cultures, economies, and ecosystems?

## Key National Standards

### NGSS

- [LS2.A](#): Interdependent Relationships in Ecosystems
- [LS2.C](#): Ecosystem Dynamics, Functioning, and Resilience
- [LS4.D](#): Biodiversity and Humans
- [ESS3.C](#): Human Impacts on Earth Systems

### CCSS

- CCSS.ELA-LITERACY.RI.[6.7](#)
- CCSS.ELA-LITERACY.W.[6.2.B](#); CCSS.ELA-LITERACY.W.[6.2.B](#), [7.2B](#), [8.2B](#)
- CCSS.ELA-LITERACY.RST.[6-8.2](#)

### Keywords

**Culture**—The behaviors, beliefs, arts, and products (things) of a community or group of people.

**Economy**—The system of production, distribution, and consumption of goods and services.

**Ecosystem**—A community of organisms (plant, animal, and other living organisms) and the abiotic parts of their environment.

**Environment**—The physical surroundings in which we live, including living (biotic) and nonliving (abiotic) factors.

**Ripple effect**—A situation in which one event causes a series of other events to happen.

### Supporting Vocabulary

**Apex predator**—A predator that, as an adult, has no natural predators in its ecosystem.

**Indicator species**—A species whose presence, absence, or relative well-being in a given environment is a sign of the overall health of its ecosystem.

**Secondary extinction**—Once one species goes extinct it may cause other extinctions.

**Systems**—A collection of parts that have some influence on one another and the whole.

**Time immemorial**—Very old or ancient. From a time so long ago that it cannot be remembered.



## Materials

- **Slide deck:**  
*Ripple Effects*  
Project the presentation or print the slides and speaker's notes for a jigsaw or gallery walk.
- **Handout:**  
[Ripple Effects](#)  
Pg 40-41  
1 per student
- **Handout:**  
[Southern Resident Ripples](#)  
Pg 42-44  
1 per student
- **Driving Question Poster**  
from Activity 1



**Umbrella species**—Species that are selected for conservation-related decisions because the conservation and protection of these species indirectly affects the conservation and protection of other species within their ecosystem.

## Preparation

1. The Introduction can be completed in several different formats, such as a presentation, gallery walk, or jigsaw. Decide how you would like the class to complete the [Ripple Effects](#) handout and set up the room accordingly.

## Introduction

1. Give students a minute or two to reflect on the following question: Does it really matter if one single species goes extinct?
2. Ask students to put their thumbs up if they agree and their thumbs down if they disagree with the statement.
3. Have a few students from each side to explain their rationale.
4. Share the following excerpt with the class:

When a species becomes extinct, there are often disruptions to food webs, ecosystems, cultures, and economies. These disruptions are called ripple effects. Ripple effects can be so great that they can lead to secondary extinctions. In this activity, we will take a look at a few examples of ripple effects around the world. After this activity, we will research the ways cultures, economies, and the environment could be affected if the Southern Residents become extinct.

5. Give each student a copy of the [Ripple Effects](#) handout.

6. Instruct the class how to complete the handout (i.e., by listening to the *Ripple Effects* presentation, working in jigsaw format, or conducting a gallery walk).
7. Lead a short discussion or Think-Pair-Share exercise and have students respond to the following prompts:
  - What did you notice about the ripple effects?
  - Is it possible to predict all of the effects of a single species extinction? Why or why not?
  - Why do the extinctions of some species have bigger consequences than others?

## Activity

1. Share the following excerpt:

The Southern Residents are an integral thread woven into the fabric of the environment, economy, and cultures of the Pacific Northwest. Their extinction would have major consequences for both people and the environment. Next, we will read a short passage about the ways Southern Residents are connected to cultures, economies, and ecosystems of the Pacific Northwest. We will then discuss the potential ripple effects of their extinction.

2. Give each student a copy of the [Southern Resident Ripples](#) handout. This handout can be completed individually, in pairs, or in jigsaw format. Instruct students how you would like them to complete the handout. If you would like students to complete more independent research, only give them the worksheet.
3. Give students about 20 minutes to complete the handout.

4. Call the class back together and ask for volunteers to share their responses.

## Driving Question

Review the list of questions from Activity 1. Cross off any questions that were answered in today's activity. Add additional questions that may have arisen.

## Discussion Questions

1. Beyond extinctions, what other actions might produce ripple effects?
2. How might people better predict or understand potential ripple effects of their actions?
3. How could some actions produce positive ripple effects?
4. How do communities benefit when we protect the Southern Residents and their habitat?
5. How could a loss of tax revenue from whale watching tourists affect communities in the Pacific Northwest?

## Public Product Option

By examining the potential ripple effects of an extinction, students can practice systems thinking. [LOOPY](#) is a free, web-based application that allows students to model and visualize the components of complex systems. Have students create their own model to show how the decline and extinction of the Southern Residents can impact the wider ecosystem in addition to cultures and economies in the Pacific Northwest.

## Share Your Students' Work

Help inspire Southern Resident conservation around the globe by sharing your experience with this unit. Tag photos, student work, and student quotes.

- Facebook: [@NOAAFisheriesWestCoast](#)
- Twitter: [@NOAAFish\\_WCRO](#)
- Instagram: [@NOAAFisheries](#)



## Additional Resources



### Articles

[For Coast Salish communities, the race to save southern resident orcas is personal](#)

This article describes how the plight of the Southern Resident killer whales is bringing together a coalition of state and tribal leaders, scientists, and grassroots communities.

[Salmon enhancement helps restore our economy](#)

This opinion column describes how the restoration economy works to create good jobs in local communities.

### Lesson

[Why is biodiversity so important?](#)

In this TED-Ed lesson, Kim Preshoff explains the importance of biodiversity to different ecosystems.

### Report

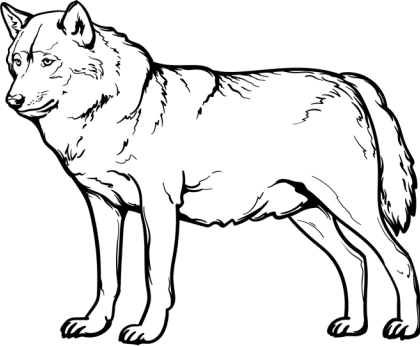

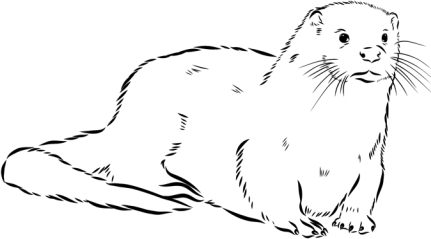
[The Economic Impact of Killer Whales in the Salish Sea](#)


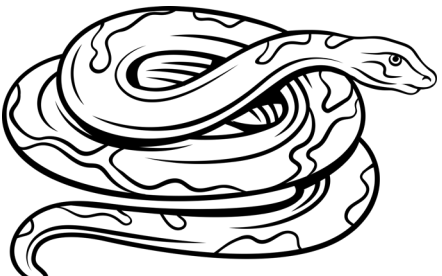
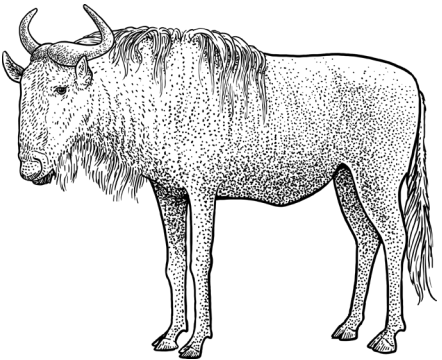
This report shows the economic impact of whale watching in the Puget Sound Region.



Name: \_\_\_\_\_ Date: \_\_\_\_\_ Class: \_\_\_\_\_

# Ripple Effects - Page 1

Species	Primary Problem	Ripple Effect(s)
 <p><b>Grey Wolf</b> <i>Canis lupus</i></p>		
 <p><b>Northern Long-Eared Bat</b> <i>Myotis septentrionalis</i></p>		
 <p><b>Southern Sea Otter</b> <i>Enhydra lutris nereis</i></p>		

Species	Primary Problem	Ripple Effect(s)
 <p data-bbox="194 619 446 693"><b>Mangrove</b> <i>Rhizophora spp.</i></p>		
 <p data-bbox="178 1165 462 1239"><b>Brown Tree Snake</b> <i>Boiga irregularis</i></p>		
 <p data-bbox="138 1711 503 1785"><b>Blue Wildebeest</b> <i>Connochaetes taurinus</i></p>		

# Southern Resident Ripples - Page 1

Like us, Southern Residents are intelligent, curious, and long-lived. They also have a similar life history—they produce one offspring at a time, feed their young milk, and form tight-knit communities. These apex predators have been the focus of public interest, scientific curiosity, and awe—perhaps because they remind us of ourselves. The Southern Residents are much more than a study or news headline; they are the lifeblood of the Pacific Northwest. They are inextricably tied to the health of the region’s cultures, economies, and ecosystems.

## Cultural Connections

Since time immemorial, Southern Residents have been part of the cultural and spiritual fabric of indigenous communities in the Pacific Northwest. Some communities feature Southern Residents in their beliefs, stories, symbols, and art. Others consider the whales to be ancestors, protectors of humankind, and family members. The Lummi people call the orcas qwe ‘lhol mechen, which roughly translates to “our relatives that live under the water.”

Indigenous communities around the Pacific Northwest gather to mourn deaths, celebrate births, and empathize with the struggles of the Southern Residents. Drumming, prayers, wooden spirit boards, and ceremonial

feedings are just a few of the ways that these beloved creatures are honored.

**“WE HAVE A CONTINUING SPIRITUAL CONNECTION, THAT’S WHAT THAT CEREMONY’S ABOUT, IS HONORING THAT SPIRITUAL RELATIONSHIP BETWEEN THE ORCAS AND US AS HUMAN BEINGS.”**

- Reuben George, Tsleil-Waututh First Nation<sup>28</sup>



In recent years, indigenous communities have been important advocates for the Southern Residents. They have called on local, state, and federal agencies to take bold actions to recover Southern Residents. Indigenous communities have lived in harmony with Southern Residents and have used their marine resources sustainably for millennia. It is important that we call upon their experience, expertise, and wisdom when developing conservation and recovery plans and actions.

**“THE SOUTHERN RESIDENT KILLER WHALES ARE LIKE US: THEY DEPEND ON THESE WATERS FOR THEIR SURVIVAL, FOR THEIR WELL-BEING, FOR FOOD AND RECREATION, FOR THEIR SPIRITUALITY AS WELL. WHAT THEY NEED IS MORE SALMON, MORE CLEAN WATER, LESS VESSEL TRAFFIC. THEY’RE ASKING FOR THE SAME THINGS THAT WE’VE BEEN ASKING FOR.”**

- Leonard Forsman, Chairman of Suquamish Tribe<sup>29</sup>

## Economic Connections

People from around the world travel to the Pacific Northwest in the hopes of seeing the J, K, and L Pods. Tourists watch the whales from shore, aboard commercial boats, and



while paddling kayaks and canoes. Beyond whale watching tours, many companies benefit from whale watching tourists, including hotels, coffee shops, restaurants, souvenir shops, and more. In Washington State whale watching activities generate approximately \$216 million in economic activity, \$12 million in tax revenue, and 1,800 jobs.<sup>30</sup>

**“PEOPLE AREN’T COMING HERE TO SEE HARBOR SEALS. IF THERE WERE NO MORE ORCAS, THIS ECONOMY WOULD COLLAPSE.”**

- Jason Gunter, manager of Discovery Sea Kayak<sup>31</sup>

San Juan County, where many Southern Resident tourists visit, relies on whale watching. Whale watching supports more than 1,400 (13%) jobs in the County.<sup>32</sup> From tour operators to restaurant staff, many people’s livelihoods could be impacted by the extinction of the Southern Residents.

## Ecosystem Connections

From the smallest microorganisms to the fiercest predator—every species plays a role in its ecosystem. In a healthy ecosystem, there is a subtle dance between predators and prey. This balancing act helps maintain healthy populations of plants and animals throughout the ecosystem.

Apex predators, such as killer whales, play an important role in structuring their ecosystem. Southern Residents seek out the oldest, largest Chinook salmon. These Chinook provide more calories than smaller fish. If Southern Residents consume only



large adult Chinook, adult female killer whales would consume up to approximately 13 Chinook per day and adult male killer whales would consume up to approximately

16 Chinook per day.<sup>33</sup> Depending on the population size, the J, K, and L pods must catch around 300,000 Chinook salmon a year. But these numbers depend a lot on the ages of the killer whales, as well as the species, size, and calorie content of their salmon prey. If fewer large, adult Chinook are available, the killer whales will have to eat more of the smaller fish to meet their caloric requirements.

**“KILLER WHALES DON’T SHOW A LOT OF INTEREST IN CHINOOK UNTIL THEY REACH A CERTAIN SIZE, AND THEN THEY FOCUS INTENSELY ON THOSE INDIVIDUALS.”**

- Jan Oehlberger, research scientist at the University of Washington<sup>34</sup>

Chinook populations in the Salish Sea are facing many pressures including historical overfishing, passage barriers such as dams, and changing ocean conditions due to climate change and ocean acidification. As populations of seals, seal lions, and Northern Residents have rebounded, they place additional pressures on fragile salmon populations.

With all of these stresses, large and old Chinook are becoming more rare.<sup>35</sup>

The reductions in size could have a long-term effect on the number of Chinook salmon. Smaller females carry fewer eggs.

Over time the number of fish that hatch and survive to adulthood may decrease. Smaller and fewer fish means the Southern Residents will have to work extra hard to get enough to eat.

As indicator species, Southern Residents can tell us a lot about the health of their environment. Pollutants from the Southern Resident’s prey and environment become concentrated in their blubber. Some of these pollutants can cause disease or





## Supporting Vocabulary

**Apex predator**—A predator that, as an adult, has no natural predators in its ecosystem.

**Inextricably**—Impossible to separate.

**Indicator species**—A species whose presence, absence, or relative well-being in a given environment is a sign of the overall health of its ecosystem.

**Lifeblood**—An important part.

**Time immemorial**—Very old or ancient. From a time so long ago that it cannot be remembered.

**Umbrella species**—Species that are selected for conservation-related decisions because the conservation and protection of these species indirectly affects the conservation and protection of other species within their ecosystem.

# Southern Resident Ripples - Page 3

reproductive disorders. Pollutants are also passed from mothers to their calves. Since the Southern Residents are in trouble, it likely means the Salish Sea is in trouble, too.

Southern Residents are also considered to be an umbrella species. When we protect an umbrella species, we indirectly protect many other species that share the same habitat. Since many species are threatened or endangered, identifying umbrella species can make conservation decisions easier. It can also help species that are not as well known or popular—such as sea snails and eelgrass—gain much-needed protection.

---

***“Orcas are canaries in the coal mine. What happens to them will affect many other species, and also affect us. By protecting orcas, we also protect our quality of life in the Northwest.”***

- Stephanie Solien, vice chair of Puget Sound Partnership<sup>36</sup>

---

## Summary

We know that cultures, economies, and ecosystems of the Pacific Northwest will be greatly impacted if the Southern Residents become extinct. However, we cannot predict all of the potential ripple effects. What would a world without the Southern Residents look, feel, and sound like?



Name: \_\_\_\_\_ Date: \_\_\_\_\_ Class: \_\_\_\_\_

## Culture

The behaviors, beliefs, arts, and products (things) of a community or group of people.



1. How are the Southern Residents part of human cultures?

---



---



---

2. How might cultures be affected by the extinction of the Southern Residents?

---



---



---

3. Imagine you are a member of the Lummi tribe. Ever since you were a child, you spent springtime eagerly awaiting the return of the Southern Residents. Seeing the pods for the first time each year fills your heart with happiness. You have heard your parents and grandparents tell stories about these majestic whales. Write at least two sentences to describe how you might feel if the Southern Residents become extinct.

---



---



---

## Economy

The system of production, distribution, and consumption of goods and services.



1. How are the Southern Residents part of the economy?

---



---



---

2. How could economies be affected by the extinction of the Southern Residents?

---



---



---

3. Imagine you are a naturalist working on a whale watching boat. You have spent the last 10 years of your life helping people view marine mammals in their natural habitat and educating them about the Southern Residents. You have watched people cry tears of joy, hug one another, and cheer when they see the Southern Residents. Write at least two sentences to describe how you might feel if the Southern Residents become extinct.

---

---

---

## Ecosystem

A community of organisms (i.e., plants, animals, and other living organisms) and the abiotic (nonliving) parts of their environment (e.g., temperature, light, water, salinity, etc.).



1. How are Southern Residents connected to their ecosystem?

---

---

---

2. How could the ecosystem be affected by the extinction of the Southern Residents?

---

---

---

3. What could the health of Southern Residents tell us about the broader ecosystem?

---

---

---

## Summary

Write at least two sentences in response to the following statement question: Should we care that the Southern Residents are facing extinction? Why or why not?

---

---

---

---





Credit: Pavlo Glazkov/Shutterstock

## Activity 4: Threats and Solutions

The activity opens with a quick brainstorm about what animals need to survive. Students then conduct scaffolded research to dive deeper into the major threats facing the Southern Residents: starvation, contamination, and vessel noise and then research potential solutions to these threats. During a reflection, students identify the potential barriers and side benefits of implementing these solutions.

### Key Student Questions

- What is the difference between surviving and thriving?
- What are the major threats facing the Southern Residents?
- What are some potential solutions to these threats?

## Key National Standards

### NGSS

- [LS2.A](#): Interdependent Relationships in Ecosystems
- [ESS3.C](#): Human Impacts on Earth Systems

### CCSS

- CCSS.ELA-LITERACY.CCRA.[W.7](#); CCSS.ELA-LITERACY.W.[6.7](#), [7.7](#), [8.7](#)
- CCSS.ELA-LITERACY.W.[7.2.B](#), [8.2.B](#)
- CCSS.ELA-LITERACY.RST.[6-8.2](#)
- CCSS.ELA-LITERACY.WHST.[6-8.1.B](#)

## Keywords

**Survive**—To remain alive.

**Threat**—Something that could cause trouble or harm.

**Thrive**—To grow or develop successfully.

## Introduction

1. In Think-Pair-Share, free write, or popcorn format, have students respond to the following prompts:
  - a. What do living things need to survive? *Food, water, shelter, oxygen, etc.*
  - b. What do Southern Residents need to survive? *Clean water, prey/Chinook salmon, space and quiet to hunt and rear their young, etc.*
  - c. What might happen if an animal does not have everything they need to survive? *Death, disease, starvation, decreased fertility, miscarriages, decreased quality of life, shorter lifespan, etc.*
  - d. What is the difference between surviving and thriving? *Surviving is simply remaining alive. Thriving means growing or developing successfully.*



## Materials

- **Handout:**  
[Threats and Solutions](#)  
Pg 52-53  
1 per student
- **Computers with internet access** or printed copies of the articles from the [Recommended Resources for Research](#)  
1 per student or group of 2-3
- **Answer Key:**  
[Threats and Solutions](#)  
Pg 54-55  
1 copy
- **Driving Question Poster** from Activity 1



## Activity

1. Share the following excerpt with the class:

Today we will be conducting research to better understand the threats facing the Southern Residents and to discover potential solutions to these challenges. Since there are only 75 Southern Residents remaining as of July 2021, it will take all kinds of people working together to protect and recover these iconic animals. The information we learn today will help shape your final product, which will raise awareness of the plight of these animals and help individuals understand how they can make a difference.

2. Give each student a copy of the [Threats and Solutions](#) handout.
3. This activity can be completed in a variety of formats (e.g., individually, in pairs, in small groups, or in jigsaw format). Instruct the class how to complete the handout.
4. Give students about 30 minutes to complete the handout.
5. Call the class back together and review the answers provided in [Threats and Solutions](#) answer key. Direct students to fill in any missing information on their worksheet.

**Note:** The answer key contains more information than students will be able to synthesize in a class period. If desired, this additional information can be used to guide a more robust discussion.

6. Ask students to complete Part II of the handout individually.
7. In Think-Pair-Share or popcorn format, ask for a few students to share their responses to Part II.
8. Assess how students are feeling about our ability to save the Southern

Residents by conducting a Fist to Five poll with the following prompt: Can we, as a society, save the Southern Residents?

9. Ask for a few volunteers to share their thoughts.
10. Share the following excerpt with the class:

While the Southern Residents are facing many challenges, there are still many reasons to be hopeful. Individuals, communities, industries, and governments are all working together to protect and recover the Southern Residents. In the upcoming activities, we will learn more about how groups are working together to make meaningful, long-term change.

11. Collect the [Threats and Solutions](#) handouts and save them for Activity 6.

## Driving Question

Review the list of questions from Activity

1. Cross off any questions that were answered in today's activity. Add additional questions that may have arisen.

## Discussion Questions

1. Even if we live far from the coast, how can our actions affect the Southern Residents?
2. How are people also affected by the threats facing the Southern Residents?
3. Many of the problems facing the Southern Residents were created before your generation existed. Does your generation have a role in fixing these issues? Why or why not?
4. Do we have a collective responsibility to ensure that species thrive? Why or why not?

5. How can we better manage common resources? Common resources belong to everyone. Examples include air, water, or ocean resources.

### Public Product Option

Have students create a public service announcement, advertisement, or meme that shows how the Southern Residents might feel about not having enough food to feed their families, living in water polluted by humans, or having boats zipping through their habitat.

For examples, see:

- [Public Service Announcements \(PSA\)](#) - World Wildlife Federation
- [What Goes into the Ocean, Goes Into You](#) - Surfrider Foundation
- [Horrible vs. More Horrible](#) - DDB
- [Save the Rhino](#) - Stick

### Share Your Students' Work

Help inspire Southern Resident conservation around the globe by sharing your experience with this unit. Tag photos, student work, and student quotes.

- Facebook: [@NOAAFisheriesWestCoast](#)
- Twitter: [@NOAAFish\\_WCRO](#)
- Instagram: [@NOAAFisheries](#)



## Additional Resources



### App

#### [Model My Watershed](#)

This app models storm-water runoff and water quality. It also compares how different conservation or development scenarios can affect runoff and water quality.

### Competition

#### [Future City](#)

In this project-based learning challenge, middle schoolers imagine, research, design, and build cities of the future.

### Lesson

#### [Urban Runoff](#)

This lesson introduces students to the problem of urban runoff and a variety of nature-based design ideas and solutions.

### Video

#### [Water: The source of life](#)

This video shows how water travels across our planet, connects all living things, and what it encounters throughout its journey.



Name: \_\_\_\_\_ Date: \_\_\_\_\_ Class: \_\_\_\_\_

## Threats and Solutions - Page 1

**Part I:** Research

**Directions:** Research the causes of the major threats facing the Southern Residents and potential solutions to these threats. Then complete the table below.

Threat	Summary	Causes	Potential Solutions
 Limited Prey			
 Vessel Noise and Traffic			
 Contamination/ Pollutants			

**Part II: Reflect**

**Directions:** Reflect upon the table on Page 1 and then answer the following questions.

1. Which issue most interests you?

---

2. As a society, do you think we can solve this issue? Why or why not?

---



---



---



---

3. What might be some barriers to implementing the solutions?

---



---



---



---

4. What are some side benefits of implementing these solutions? In other words, how might communities or the broader ecosystems benefit from addressing this issue?

---



---



---



---

## Recommended Resources for Research

- Saving the Southern Residents: Turning the Tide for the West Coast's Beloved Killer Whales  
<https://arcg.is/1HzrbC>
- Southern Resident Killer Whales  
[www.epa.gov/salish-sea/southern-resident-killer-whales](http://www.epa.gov/salish-sea/southern-resident-killer-whales)
- Impossible Choices: The Complicated Task of Saving Both Orca and Salmon  
[www.courthousenews.com/impossible-choices-the-complicated-task-of-saving-both-orca-and-salmon/](http://www.courthousenews.com/impossible-choices-the-complicated-task-of-saving-both-orca-and-salmon/)
- Take Action :: Orca Action Month  
[www.orcamonth.com/actions](http://www.orcamonth.com/actions)
- Orcas of the Pacific Northwest Are Starving and Disappearing  
[www.nytimes.com/2018/07/09/science/orcas-whales-endangered.html](http://www.nytimes.com/2018/07/09/science/orcas-whales-endangered.html)

## Threats and Solutions - Answer Key

### Threat: Limited Prey

Since Chinook populations have dramatically declined, at times the whales may not have enough prey. Five populations of Chinook the whales depend on are listed as threatened and a sixth is endangered. Not only are there fewer fish, but they are 10% smaller since the late 1970s.



### Causes

- Dams block salmon from migrating
- Chinook populations have been over-fished in the past
- Seal and sea lion populations have increased and they are eating more salmon
- Hatchery salmon outcompete wild salmon for food
- Hatchery salmon dilute the genes of wild salmon
- Habitats have been degraded by development and pollution

### Potential Solutions

- Help fish get around dams; remove problem dams
- Limit Chinook fishing
- Minimize Chinook bycatch (fish caught accidentally)
- Cull (kill) problem seals and sea lions
- Restore salmon habitat
- Buy US-caught, sustainable seafood
- Manage the impact of hatchery fish
- Protect and restore habitat

### Threat: Vessel Noise and Traffic

Noise from vessels can interfere with the echolocation abilities of Southern Residents as they search for food. The speed of motor-powered boats is the main factor in how much noise the whales experience, faster boats mean more noise.



When vessels are present, the whales hunt less and travel more, swim in more erratic paths, and increase surface activity with more breaches and tail slaps. They also increase the loudness of their calls when noise levels in their environment are high. The energy cost of these altered behaviors is being studied.

### Causes

- Boats driving too fast near the whales
- Boats getting too close to the whales
- Too many boats near the whales
- Boats using devices like echo sounders and fish finders that interfere with echolocation

### Potential Solutions

- Require boats to stop using echo sounders and fish finders when not in use
- Encourage whale watching from shore
- Support responsible whale watching companies
- Create and enforce regulations that keep boats a safe distance from the whales
- Create a sanctuary/no-go zone for boats in key Chinook and Southern Resident habitats
- Create and enforce speed limits for boats near the whales
- Suspend viewing of Southern Residents

## Threat: Contamination/Pollutants

Southern Residents accumulate pollutants from the fish they eat in their blubber. If Southern Residents do not get enough prey to eat they have to survive on their fat stores, where toxins concentrate.



This can increase circulation of toxins and compromise their immunity and reproductive success, leaving them more vulnerable to disease and making it tougher for them to rebuild their population.

If a pregnant whale draws from her toxic fat stores to feed her growing fetus, the offspring will likely be born with significant problems like immunosuppression.

In some cases, the youngest whales have the highest levels of pollutants in their systems. This is because nursing moms can pass contaminants to their calves through their milk.

Southern Residents are some of the most contaminated marine mammals in the world.

## Causes

Prey and water are contaminated with:

- Pesticides
- Industrial coolants and lubricants
- Flame retardants
- Motor oil
- Chemicals from household products
- Pharmaceuticals including prescription and over-the-counter drugs
- Recreational and illegal drugs

Pollutants enter waterways from many sources, such as:

- Runoff from roads and parking lots
- Wastewater treatment plants

- Sewer outfalls
- Pesticide application

## Potential Solutions

- Properly dispose of hazardous waste, unused medicine, and chemicals
- Install rain gardens
- Maintain vehicles and lawnmowers; fix leaks as soon as possible
- Bike, walk, and use public transportation whenever possible
- Promote organic farming and gardening methods
- Filter urban runoff from roadways
- Support regulations that ban discharging and dumping of pollutants
- Enforce discharge and dumping laws





Credit: Allison Shelley for EDUimages.

## Activity 5: Community Mapping

After making observations about different community characteristics, students brainstorm a list of community features that might benefit or harm the Southern Residents. In small groups, students create a neighborhood map and identify local issues that might affect the Southern Residents. The class then identifies ways that the schoolyard and/or community can be improved to benefit the Southern Residents, their prey, and their habitat.

### Key Student Questions

- What are characteristics of a healthy schoolyard and/or community?
- How could features of our schoolyard and/or community harm the Southern Residents?
- How can we improve our schoolyard and/or community to benefit the Southern Residents?

## Key National Standards

### NGSS

- [ESS3.C](#): Human Impacts on Earth Systems

### C3

- [D2.Geo.3.6-8](#).

## Keywords

**Community**—A group of people that share some commonality, often based on where they live, what they do, a shared social characteristic, or shared interests.

**Map**—A drawing of a particular area such as a city, a country, or a continent, showing its main features as they would appear if you looked at them from above.

**Schoolyard**—The area next to or surrounding a school where students typically play.

## Preparation

1. Use [Google Earth](#), [My Maps](#), or your favorite mapping tool and zoom in on your desired area of study (i.e., schoolyard and/or surrounding community).
2. Divide the map into sections to accommodate groups of 3-4. The areas of study can be scaled to the amount of time available.

**Option:** If students need extra supervision, the entire class can study the same area. Individual students or small groups can be assigned to look for different elements within the area of study.

3. Label each section with a number or letter.

## Introduction

1. Ask students to create a t-chart with the headings Beneficial and Harmful.
2. Project Slide 1 of the *Beneficial or Harmful?* Slide deck.
3. On their t-charts, have students list items that might benefit or harm the Southern Residents, salmon, or waterways. Ask students to include the corresponding photo number next to their examples.



## Required Materials

- **Slide deck:** *Beneficial or Harmful?*  
Project the presentation or print the slides for a gallery walk
- **Map:** A digital map of the schoolyard and/or surrounding community
- **Kraft or poster paper**  
1 large sheet per group of 3-4
- **Markers or colored pencils**  
1 set per group of 3-4
- **Driving Question**  
Poster from Activity 1

## Optional Materials

- Cameras or cell phones
- Magazines for collaging
- **Map Key**  
Pg 60-63  
1 per group of 3-4
- **Chaperones**  
1 per group of 3-4



4. Ask for a few volunteers to share their observations.
5. For a more robust discussion, walk students through the remainder of the slides or conduct a gallery walk with printed slides. For students with a solid grasp of the issues or classes short on time, this step can be omitted.
6. Lead a short discussion using one or more of the following prompts:
  - How did the images make you feel?
  - How does the community around our school compare?
7. Tell the class that once they are outside, they will note potentially beneficial and harmful characteristics on their map. This should simply be a rough sketch. Groups will have additional time to work on their maps once they return to the classroom.
8. Students may bring along their t-chart from the introduction to help identify beneficial and harmful characteristics. For groups that might need additional support, provide a hard copy of the Map Key.
9. If desired, give each group a camera or cell phone to take pictures of the characteristics they are recording.

## Activity I

1. In popcorn format, have students share different purposes of maps and map keys. Encourage students to think about non-traditional maps, such as climate, resource, time zone, and hazard maps.
 

**Option:** Display examples of different maps, such as the [Air Quality Flag Program](#), [Sea Level Rise Viewer](#), or [Natural Hazards Viewer](#).
2. Tell the class they will be creating a map of their schoolyard and/or community to identify attributes that might benefit or harm the Southern Residents, their prey, and their habit.
3. Break students into groups of 3-4.
4. Give each group a piece of butcher paper and a set of markers or colored pencils.
5. Project the map and assign each group an area of study.
6. Give each group a few minutes to sketch a rough perimeter of their assigned area. The perimeters do not need to be highly accurate but should define the group's area of study and highlight major physical features.

10. Each group may assign roles such as navigator, photographer, mapmaker, key reader, timekeeper, etc.
11. Explain any safety precautions and boundaries before heading outside.
12. Let the class know how long they will have to complete their map.
13. Once outside, monitor the groups as they collect information and draw their maps.
14. After their designated time, call the students back to the classroom.
15. Give groups time to finish up their drawings.
16. Give each group a few minutes to explain what they discovered and show their maps to the rest of the class. As groups are presenting, make a note of the beneficial and harmful features on the board.
17. Ask for a few students to share their observations about the process and the presentations.

## Activity II

1. Have each group pick one problem from their map that they feel is most pressing. This might include increasing a positive feature or minimizing a negative feature.

2. Ask groups to brainstorm or research at least three solutions to this problem.
3. Give each group a few minutes to share their issue and potential solutions.
4. After each presentation, ask the rest of the class:
  - What they like about the proposed solutions.
  - To identify any potential problems with the proposed solutions.
5. After all of the groups have presented, do a fist to five poll about the following questions:
  - Is it possible for our class to make a difference on these issues?
  - Is it possible for our class to implement any of these solutions?
6. Let the class know that even though the Southern Residents are facing many large-scale and pressing issues, there are many ways that kids are making a big difference. At the end of this unit, students will have the opportunity to share what they have learned and to implement a solution that will help the Southern Residents.

**Option:** Display [positive news headlines about youth making change](#).

## Driving Question

Review the list of questions from Activity 1. Cross off any questions that were answered in today's activity. Add additional questions that may have arisen.

## Discussion Questions

1. How is our schoolyard/community connected to the Southern Residents?
2. How can we strengthen the beneficial aspects of our schoolyard/community?

3. How can we minimize the harmful aspects of our schoolyard/community?
4. As a class, how can we drive positive changes in our school and greater community?
5. How do improvements for the Southern Residents benefit our greater community?

## Extension

Environmental justice is the fair treatment and meaningful involvement of all people with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. We need environmental justice because people of color and low-income communities are disproportionately exposed to pollutants. Students can use the EPA's [environmental justice mapping and screening tool \(EJSCREEN\)](#) to identify and better understand environmental and health burdens in their communities. These issues can then be added to the students' maps.

## Additional Resources

[Asphalt to Ecosystems](#)  
Green Schoolyards America

[Community, Culture, and the Environment: A Guide to Understanding a Sense of Place](#) U.S. EPA

[Greening Schoolyards](#)  
Children and Nature Network

[A Watershed Approach to Education](#)  
Stroud Water Research Center





# Map Key

## Category: Groundcover



### Beneficial Features

#### Forests and Parks

When rain falls in undeveloped areas, the water is absorbed and filtered by soil and plants. Trees and plants also help anchor soil, reducing erosion. In turn, this makes flooding and landslides less severe.

#### Gardens and Urban Farms

Gardens and urban farms provide communities with local, healthy food options and they help reduce erosion and urban runoff.

#### Rain Gardens

These special sidewalks, roads, and parking lots allow water to pass through pores and enter the ground. This reduces runoff and helps filter pollutants.

#### Permeable Pavement

These special sidewalks, roads, and parking lots allow water to pass through pores and enter the ground. This reduces runoff and helps filter pollutants.

#### Bioswales

Bioswales are landscape features that collect polluted stormwater runoff, soak it into the ground, and filter out pollution. They are similar to rain gardens but capture more runoff coming from larger areas, such as roofs, streets, and parking lots. They have layers of engineered soil and gravel, pipes, and drains to help handle runoff from bigger storms.

### Harmful Features

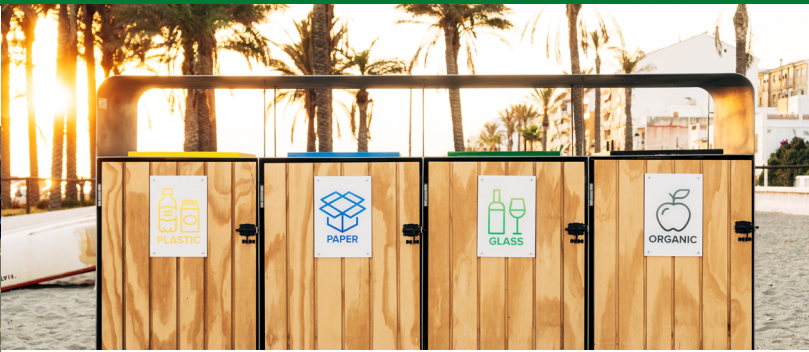
#### Pavement and Parking Lots

Stormwater runoff is a major cause of water pollution. When rain falls on roofs, streets, and parking lots, the water cannot soak into the ground as it should. Runoff carries trash, bacteria, heavy metals, and other pollutants into storm drains and it is eventually discharged into nearby waterways.

#### Lawns

When pesticides and fertilizers are used on lawns, they runoff into local waterways. They can harm aquatic life and cause harmful algae blooms. Gasoline-powered lawn mowers and leaf blowers are a major source of air pollution, noise pollution, and gasoline leaks.

## Category: Waste



### Beneficial Features

#### Compost, Recycling, and Trash Bins

When people have easy access to waste disposal, they are more likely to do the right thing. It is important for waste bins to have lids so that the trash does not blow away and animals cannot easily get inside and carry away the trash.

#### Pet Waste Stations

Stations with pet waste bags and trash cans help remind pet owners to pick up after their pets.

#### Hazardous Waste Collection

Facilities that collect hazardous waste, such as batteries, paints, and fertilizers, properly dispose of this waste. This means that it is less likely to contaminate soil and water.

### Harmful Features

#### Litter

When litter makes its way into waterways, it becomes marine debris. Marine debris can tangle animals and cause them to suffocate, starve, and/or drown.

#### Cigarette Butts

Cigarette butts are the most abundant form of plastic waste in the world. Chemicals that leach from cigarette butts can be lethal to aquatic species.

#### Pet Waste

Pet waste contains parasites and bacteria, which can make people and animals sick. It also contains phosphorus and nitrogen. When too many of these nutrients are carried into waterways, they can cause harmful algae blooms and sicken aquatic species.

#### Hazardous Waste

Batteries, paints, pesticides, and certain light bulbs can contain hazardous ingredients and require special disposal. When these items are dumped illegally, they can leach pollutants into soil and water.



## Category: Pollution



### Beneficial Features

#### Storm Drain Reminders

People often assume that storm drains lead to wastewater treatment plants. Instead, most lead to waterways. Some clubs, individuals, and communities have installed “no dumping” reminders next to storm drains. This helps remind people that litter and pollutants that enter storm drains can end up in our waterways.

### Harmful Features

#### Point Source Pollution

Some factories, sewage treatment plants, farms, and other industries discharge pollutants directly into waterways. Some of the chemicals discharged are harmless, but others are toxic to people and wildlife.

## Category: Water Use



### Beneficial Features

#### Commercial Car Washes

Commercial car washes use less water than washing a car by hand. The water is also treated before it is discharged. This means that oil, heavy metals, and other harsh chemicals that come off the car do not go into storm drains.

#### Drip Irrigation and Spot Watering

Drip irrigation and watering plants by hand uses much less water than sprinklers. When we conserve water, we leave more water for salmon—the Southern Residents’ favorite food.

#### Rain Barrels

Rain barrels capture water from a roof and hold it watering plants. Rain barrels conserve water, reduce flooding, protect waterways from erosion, and keep pollutants from entering waterways.

### Harmful Features

#### Washing Cars by Hand

Washing cars by hand wastes a lot of water. The water becomes contaminated with oil, heavy metals, and other harsh chemicals. From your driveway, this water often flows untreated directly into waterways where it can harm and kill aquatic life.

#### Sprinklers

Sprinklers are a very inefficient way to water, and can waste 300 gallons of water an hour. Wasting water means there is less available in streams and rivers for salmon.

#### Leaky Hoses, Faucets, and Irrigation Systems

In a single household, leaky hoses, faucets, and irrigation systems can waste thousands of gallons of water each year.

## Category: Transportation



### Beneficial Features

#### Bike Lanes and Parking

Bike lanes, bike rentals, and plenty of bike parking helps encourage people to bike to work or school. This translates into fewer people driving.

#### Safe Sidewalks

When people feel safe walking, they are more likely to do so.

#### Public transportation and carpooling networks

When more people take public transportation or carpool, there are fewer cars on the road.

#### Support for Hybrid and Electric Vehicles

Hybrids and electric vehicles produce less emissions over their lifetime than conventional (internal combustion engine) vehicles. When communities support these vehicles through tax incentives and charging stations, they can help more people make the switch from conventional vehicles.

### Harmful Features

#### Single Occupancy Vehicles

Vehicles leave oil, antifreeze, grease, and heavy metals on streets, where they wash into waterways. When people drive alone, they create more air and water pollution than if they had biked, walked, carpoled, or used public transportation.

#### Smogy Vehicles

Some vehicles, such as SUVs, trucks, and sports cars, emit more pollutants than others. The pollutants eventually fall back to the earth and are transported by runoff and groundwater into waterways.

#### Leaky Vehicles

Oil and other vehicle fluids from cars are toxic. When it rains, stormwater runoff carries these fluids into our waterways. The toxic mix can kill salmon and bioaccumulate in the Southern Residents.





Credit: SeventyFour/Shutterstock

## Activity 6: Who is Responsible?

This activity opens with a general poll about responsibility for sociopolitical issues. Afterward, students discuss who should be responsible (i.e., governments, industries, communities, individuals) for the threats facing the Southern Residents. The activity helps students understand that a single entity alone cannot solve these issues—it will take all of us working together to save them. The activity wraps up with a discussion around the limitations and benefits to different types of action (i.e., individual, collective, governmental).

### Key Student Questions

- How do different groups (i.e., governments, industries, communities, individuals) have different responsibilities for sociopolitical issues?
- How can individual actions be limiting? How can they be beneficial?
- How can systemic actions be limiting? How can they be beneficial?

## Key National Standards

### CCSS

- [CCSS.ELA-LITERACY.WHST.6-8.1.B](#)

### C3

- [D2.Civ.1.6-8.](#)
- [D4.6.6-8.](#)
- [D4.7.6-8.](#)

## Keywords

**Collective action**—People working together to achieve a common objective.

**Individual action**—Actions taken by one individual person, acting based on their personal decisions.

**Responsibility**—Something that you should do because it is morally right, legally required, etc.

**Sociopolitical**—Involving both social and political factors.

**Systemic change**—Change that leads to sustainable and large-scale impacts.

## Supporting Vocabulary

**Single-action bias**—Individuals responding to a threat are likely to rely on one action, even when it provides only incremental protection or risk reduction and may not be the most effective option.

**Social**—Relating to people or society in general.

**Political**—Relating to politics or government.

## Introduction

1. Give students a few minutes to free write about their position on the following statement: **Who is responsible for solving problems in our society?**
2. Project the [Who is Responsible?](#) display copy.
3. Ask for a volunteer to explain the purpose of a Venn diagram. *A Venn diagram is an illustration that uses circles to compare and contrast information and/or illustrate relationships among two or more topics. Overlapping circles represent commonalities.*



## Required Materials

- **Display copy:**  
[Who is Responsible?](#)  
Pg 68
- **Handout:**  
[Who is Responsible?](#)  
Pg 70-71  
1 per student
- **Driving Question**  
Poster from Activity 1

4. Point out a few overlapping areas and provide a few examples that are relevant to your students.
5. Give students a minute to think about where their personal opinion falls on the Venn diagram in response to the question: Who is responsible for solving problems in our society?
6. Ask for a few students with different perspectives to explain their thinking.
7. Ask the class to think about who is responsible for protecting and recovering the Southern Residents.
8. Have each student mark their initials on the Venn diagram to indicate their opinion.
9. Ask for a few students with different perspectives to explain their thinking. Do not erase these marks until the end of the lesson.
7. Project the [Who is Responsible?](#) Venn Diagram.
8. Have each student mark their initials on the Venn diagram to indicate who should be responsible for solving their selected issue.
9. Ask for a few students to explain their thinking and how their views may have changed throughout the activity.
10. Lead a class discussion, Think-Pair-Share, or free write using the following prompts:
  - How can individual action be beneficial? How can it be limiting?
  - How can governmental action be beneficial? How can it be limiting?
11. Share the following excerpt with the class:

In the face of a challenge as massive as saving the Southern Residents, it can be daunting to try to figure out what you as an individual should do to help. Should you focus your efforts on getting your family to buy greener cleaning supplies? Or ride public transit? Or volunteer for habitat restoration events? While individual efforts are important, changes in government policies and industry practices are necessary to enact the large-scale changes that the Southern Residents need.

In our next lesson, we will have the opportunity to balance the needs of Southern Residents, community members, and the economy by acting as different members from the Orca Task Force. This Task Force includes government officials, members of various industries, and different community groups. Together, these groups will advance the recovery and conservation of Southern Residents by leveraging their expertise and resources.

## Activity

1. Return the [Threats and Solutions](#) handouts from Activity 4. If you did not complete this activity, ask students to brainstorm a list of the threats to Southern Residents and possible solutions to these threats. Use the [Threats and Solutions](#) answer key to round out the student-generated list.
2. Give each student a copy of the [Who is Responsible?](#) handout.
3. Have each student or small group select a different threat from the [Threats and Solutions](#) handout. Instruct students to write their selection at the top of their [Who is Responsible?](#) handout.
4. Give the class about 20 minutes to complete the worksheet.
5. Call the class back together.
6. Ask for a few students to share their thoughts.



## Driving Question

Review the list of questions from Activity 1. Cross off any questions that were answered in today's activity. Add additional questions that may have arisen.

## Discussion Questions

1. How can individual action lead to large-scale (i.e. systemic) impacts?
2. How can consumers influence companies to make their practices more sustainable?
3. How does the conservation and recovery of Southern Residents rely on individual participation?
4. How does the conservation and recovery of Southern Residents rely on collective participation?
5. How are power and responsibility connected?

## Share Your Students' Work

Help inspire Southern Resident conservation around the globe by sharing your experience with this unit. Tag photos, student work, and student quotes.

- Facebook: [@NOAAFisheriesWestCoast](#)
- Twitter: [@NOAAFish\\_WCRO](#)
- Instagram: [@NOAAFisheries](#)



## Additional Resources



### Articles

[Focusing on how individuals can stop climate change is very convenient for corporations](#)

This article highlights the importance of systemic change in preventing the catastrophic effects of climate change.

[Individual Action, Collective Change: Six Ways Individuals Can Create Environmental Change](#)

This article describes collective actions and their role in creating environmental change.

[Individual vs. Collective Action](#)

This module explains the difference between individual action and collective action.

### Video

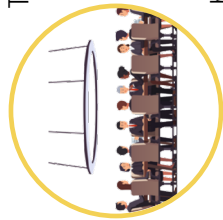
[How to understand power](#)

In this TED-Ed series, Eric Liu describes the six sources of power and explains how understanding them is key to being an effective citizen.



# Who is Responsible?

## GOVERNMENT

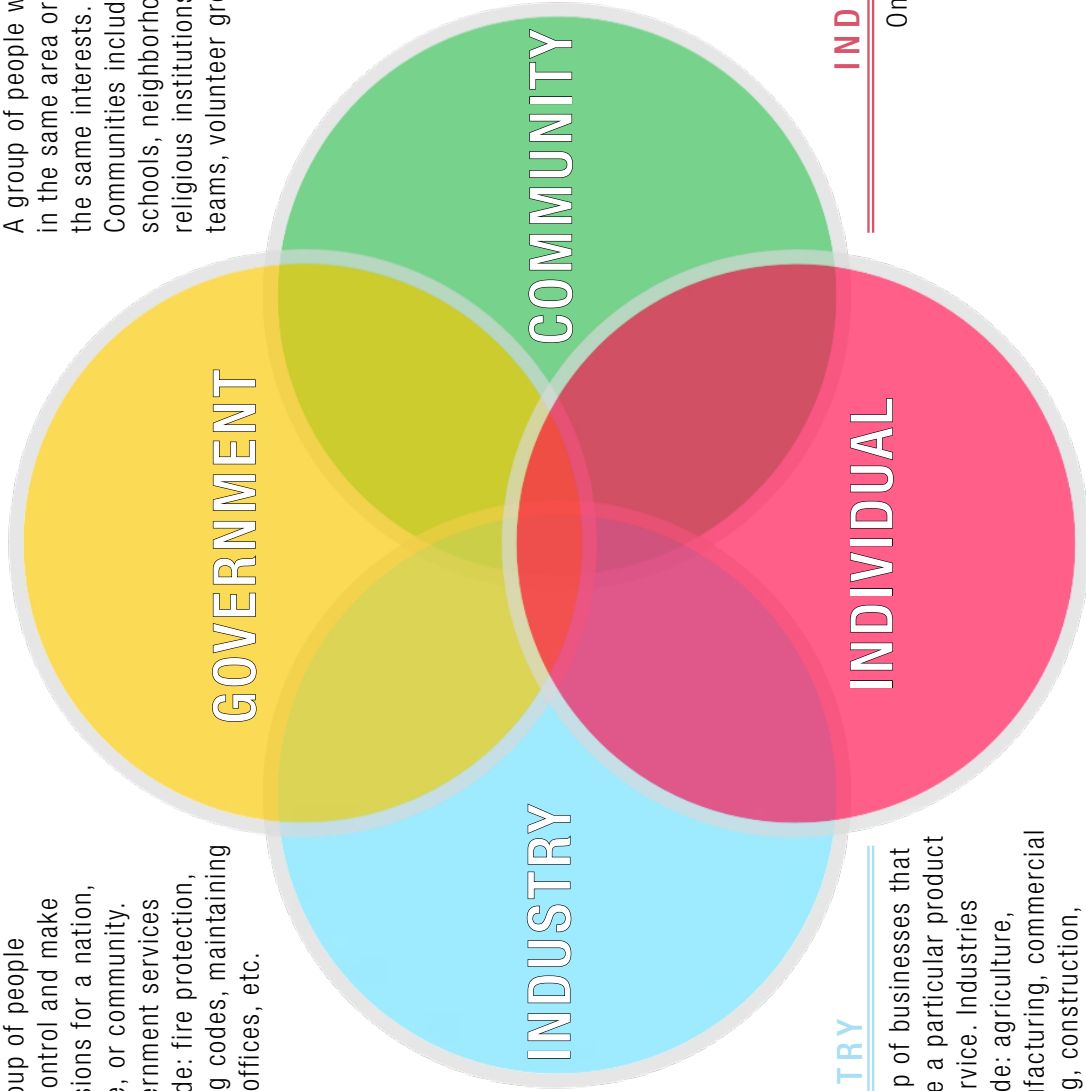


The group of people who control and make decisions for a nation, state, or community. Government services include: fire protection, building codes, maintaining roads, establishing post offices, etc.

## COMMUNITY



A group of people who live in the same area or have the same interests. Communities include: schools, neighborhoods, religious institutions, sports teams, volunteer groups, etc.

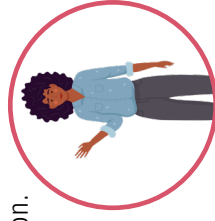


## INDUSTRY



A group of businesses that provide a particular product or service. Industries include: agriculture, manufacturing, commercial fishing, construction, restaurants, etc.

## INDIVIDUAL

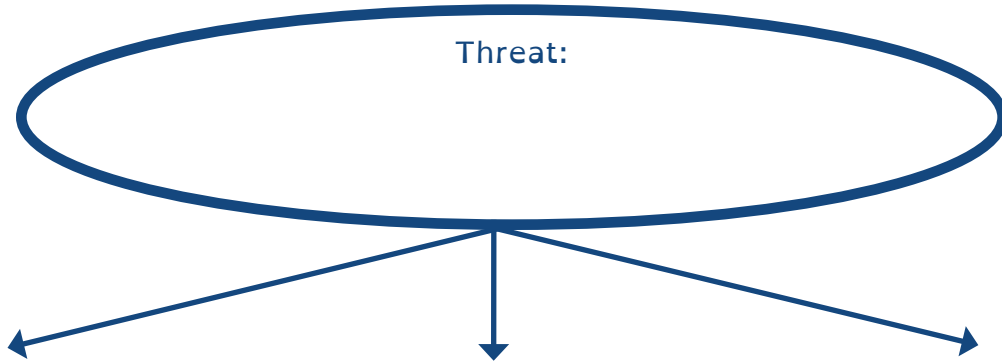


One person.



Name: \_\_\_\_\_ Date: \_\_\_\_\_ Class: \_\_\_\_\_

## Who is Responsible?



1. How are individuals, communities, industries, and/or governments connected to this issue?

---

---

---

---

2. How can these groups be part of the solution?

---

---

---

---

3. Which group(s) might have the greatest effect on the problem? How so?

---

---

---

---

4. Which group(s) might be most equipped to solve the problem? How so?

---

---

---

---

5. What advantages does this group/these groups have over the others?

---

---

---

---

**Reflect**

1. Given that there are so many other people whose actions are affecting the Southern Residents, what difference do your own individual actions make?

---

---

---

2. What responsibilities do you have to society?

---

---

---

3. What responsibilities do industries have to society?

---

---

---

4. What responsibilities do governments have to society?

---

---

---





Credit: Allison Shelley / EDUimages

## Activity 7: Orca Task Force

Students take on the perspectives of various groups (e.g., commercial fishers, tribes, taxpayers, etc.) to evaluate measures designed to save the Southern Residents. During a mock meeting, groups weigh the pros and cons of each measure and decide whether or not their group would support it. Groups are then faced with a budget crisis and must decide how they would reprioritize each measure.

The issues and profiles presented in this activity have been simplified and generalized for classroom use and do not fully represent the complexities and delicacies of the real Orca Task Force. See the [Southern Resident Orca Task Force Report and Recommendations](#) from November 16, 2018 for the real recommendations.

### Key Student Questions

- How can groups with competing interests work together to solve a challenging problem?
- How can we balance society's economic needs with the needs of the Southern Residents?
- As a society, how should we decide which conservation projects to fund?

## Key National Standards

### CCSS

- CCSS.ELA-LITERACY.CCRA.[SL.1](#); CCSS.ELA-LITERACY.SL.[6.1](#), [7.1](#), [8.1](#)
- CCSS.ELA-LITERACY.CCRA.[SL.4](#); CCSS.ELA-LITERACY.SL.[6.4](#), [7.4](#), [8.4](#)
- CCSS.ELA-LITERACY.CCRA.[SL.6](#); CCSS.ELA-LITERACY.SL.[6.6](#), [7.6](#), [8.6](#)

### C3

- [D2.Eco.1.6-8.](#)
- [D2.Soc.3.9-12.](#)
- [D2.Soc.13.9-12.](#)

## Keyword

**Task force**—A group of people who deal with a specific problem.

## Supporting Vocabulary

**Co-manager**—A person who manages something jointly with one or more other people.

**Policymaker**—A person responsible for making policy, especially in government.

**Naturalist**—A person who studies plants and animals as they live in nature.

**Natural resource manager**—Someone charged with protecting natural resources such as land, water, soil, plants and animals.

**Stakeholder**—A person with an interest or concern in something.

**Subsistence**—Harvesting food to feed one's family or community; not for profit.

## Optional Student Prework

1. Divide the class into 6 groups.
2. Assign each group a different [Orca Task Force Profile](#) (e.g., commercial fisher, environmentalist, etc.).



## Required Materials

- **Handout:**  
[Orca Task Force Profiles](#)  
Pg 78-89  
6 different profiles for 6 groups of students  
1 per student
- **Handout:**  
[Task Force Scenario](#)  
Pg 92-93  
6 copies
- **Slide deck:**  
Orca Task Force
- **Handout:**  
[Priorities](#)  
Pg 94-95  
6 copies
- **Driving Question**  
Poster from Activity 1



3. Give each student in the group a copy of the profile to read and complete before the activity.

## Preparation

If you do not have a lot of experience facilitating debate in your classroom, consider reviewing one or more of the following resources:

- [Civil Discourse in the Classroom](#), Learning for Justice
- [How to Teach Controversial Topics and Civil Debate](#), Civics Renewal Network
- [Teaching About Controversial Issues: A Resource Guide](#), Choices Program

## Introduction

1. Share the following excerpt with the class:<sup>37,38</sup>

In 2018, Washington Governor Jay Inslee announced the creation of the Orca Task Force. This team of experts represents members of the Legislature, the Government of Canada, tribal, federal, local and other state governments, and the private and non-profit sectors. The Task Force has been charged with developing longer-term recommendations for Southern Resident recovery.

This team of 45 experts have widely diverging interests—ranging from tour boat operators to fishers and environmental organizations to hydropower operators. They will need to deliver actions that are politically feasible, fundable, and create real change. The task force members will need to come to consensus on dozens of possible actions meant to target the three main problems facing the whales: limited prey, vessel traffic and noise, and contamination.

**Note:** This activity is not designed to

recreate the Task Force. It is designed to stimulate classroom discussion around real-world issues.

2. Explain to the class that they are going to participate in a mock Orca Task Force. Students will represent various groups whose lives are connected to or affected by the Southern Residents. During this meeting, the Task Force will attempt to reach a consensus about six key proposals. Attempting to reach consensus will be important and challenging since the groups have different perspectives and needs.

## Activity - Part I

1. Seat each of the Task Force groups (e.g., commercial fishers, environmentalists, taxpayers, etc.) together.
2. Have students retrieve their completed [Orca Task Force Profile](#). If this was not assigned as prework/homework, give students about 20 minutes to complete it independently.
3. Give groups a few minutes to confer on their answers.
4. Give each group a copy of the [Task Force Scenario](#) and give them about 15 minutes to complete it.
5. As students are working, write the following table on the board:

Task Force Group	Concerns	Proposed Solutions
------------------	----------	--------------------

6. After groups complete their scenario, have them record their responses in the table.
7. To better facilitate the conversation, have students create a circle in the middle of the room. Students may move their desks or sit on the floor, but groups should remain together.

8. Instruct each group to write their group name (e.g., commercial fishers, environmentalists, taxpayers, etc.) on a sheet of paper. They should fold the paper like a tent and place it in front of their group so others know who they represent.
9. Give each group a minute to introduce themselves to the rest of the Task Force. As groups are introducing themselves, listeners should fill in a short description on Page 1 of the *Orca Task Force Scenario* under the Participants heading.
10. Give the class a few minutes to review the information in the table.
11. Ask the class to identify any common ground or areas that might cause conflict.

### Activity - Part II

1. Remind the class that the goal of the Task Force is to come to consensus on six key proposals. Attempting to reach consensus will be challenging. Conflicts may arise because different groups have different needs, histories, and perspectives. Despite these differences, each group should do their best to be active listeners and respond respectfully.
2. As a class, create ground rules for the discussion. Write these rules on the board. Examples include:
  - Everyone must speak at least once.
  - Group members must take on the identity of their group during the meeting.
  - One group cannot interrupt another.
  - Each speaker must take on the role of their assigned group.
  - To approve a measure, at least \_\_\_% of the groups must vote in favor.
3. Explain that you, the facilitator, will lead a vote on each of the six proposals. Each group will have a minute to confer and decide if they will or will not support the

proposal. If groups have not come to a consensus, they will have a few minutes to explain their position. Then a revote will take place.

4. Draw the following table on the board:

Measure	Yes Votes	No Votes
1. Water Quality Standards		
2. Hatchery Production		
3. Dam Removal		
4. Pinniped Removal		
5. Chinook Fishing Restrictions		
6. Vessel Restrictions		

5. Project the *Orca Task Force* slide deck.
6. Read through a slide.
7. Give students time to confer with their group to decide whether or not they would support the measure.
8. Give each group a minute to share the reasons why they support or oppose the measure.
9. Conduct a vote before moving to the next measure. Record each group's name in the corresponding column (i.e., yes votes or no votes) on the table.
10. After each of the six issues has been voted upon, give students a few minutes to reflect upon the end results.
11. Lead a class discussion, Think-Pair-Share, or free write using the following prompts:
  - What did this process feel like?
  - How might it have felt different to participate on the real Orca Task Force?



- What should happen if a small majority disagrees with a proposal supported by a majority of the Task Force?
- What should happen if a vote is split 50/50?
- What kind of testimony from other groups influenced your opinion?
- What kind of testimony from other groups did not influence your opinion?

12. Think about how well students collaborated throughout this exercise and share examples with the class. Let students know how you would like to see this type of collaboration in their future work.

### Activity - Part III

1. Share the following excerpt with the class:

In real life, many of our conservation goals and decisions are constrained by budgets. Even if all members of the Orca Task Force agreed to adopt a measure that does not guarantee there would be enough money to complete the project. In the upcoming activity, we will conduct a simulation to better understand real-world budget scenarios.

2. If students are not already sitting with their Orca Task Force group, instruct them to do so.
3. Give each group a copy of the [Priorities](#) handout and read through the instructions together.
4. Give the class about 5 minutes to complete the Priority column in Sections I.
5. Let the class know that the Task Force has been given a budget of \$1.1 billion to make investments that will build a thriving and resilient orca population.<sup>39</sup>
6. Tell the class that you are about to share the cost of each measure. As you share

this cost, someone from the group should write the number in the cost column.

- Measure 1: \$550 million (\$550,000,000)
- Measure 2: \$500 million (\$500,000,000)
- Measure 3: \$850 million (\$850,000,000)
- Measure 4: \$50 million (\$50,000,000)
- Measure 5: \$77 million (\$77,000,000)
- Measure 6: \$33 million (\$33,000,000)

**Note:** These are not real costs estimates and were created solely for the purpose of this classroom activity.

7. Give groups about 5 minutes to complete Part II of the handout.
8. While groups are working, add two additional columns to the table on the board: "Fund" and "Do Not Fund"

Measure	Yes Votes	No Votes	Fund	Do Not Fund
---------	-----------	----------	------	-------------

9. Give each group a minute to share the reasons why they would or would not fund the measure.
10. Conduct a vote before moving to the next measure. Record each group's name in the corresponding column (i.e., fund, do not fund) on the table. If time allows, this activity can be expanded into a debate or a consensus building activity.
11. After each of the six issues has been voted upon, give students a few minutes to share their observations of the end results.
12. If desired, lead a scenario in which the state has a major budget surplus or shortfall and adjust the budget accordingly. Have groups describe how their actions would change given the new budget.
13. In Think-Pair-Share, free write, or popcorn format, have students reflect upon the following questions:

- How did this process feel?
- How might this process have been similar or different to the real Orca Task Force?
- Were any voices missing from the Task Force? How could they have contributed to the conversation?
- What are the benefits and challenges of collaborating with many different groups?
- When someone's livelihood is at stake, how might this affect their ability to compromise?
- How can we find common ground, even with groups who have opposing views?

## Driving Question

Review the list of questions from Activity 1. Cross off any questions that were answered in today's activity. Add additional questions that may have arisen.

## Discussion Questions

1. As a society, how should we decide which conservation projects receive funding, especially when there are so many funding needs—like education, healthcare, and housing—and many species needing help?
2. It is human nature to want something now rather than in the future. For example, some fishers would rather have 100 fish in their nets now, than 200 next year. How does short-term thinking impact conservation efforts?
3. Conservation projects are sometimes scaled back, postponed, or cancelled due to budget constraints. Should economic issues drive the implementation of conservation projects? Why or why not?
4. How can decision makers ensure that all voices on an issue are heard?

5. How can we ensure that both Southern Residents and people are able to meet their basic needs?

## Public Product

Have groups create a video response to one or more of the following prompts. [Screencastify](#) and [Flipgrid](#) are two free tools that can help with this process. The videos can serve as an exhibit during the final public conference, should you choose to host one.

- What issues are most important to your group?
- How can your group balance its needs with the needs of the Southern Residents?
- What advice would you give to others who need to build consensus with other groups?

## Additional Resources



### Articles

[Inslee's budget takes big steps to save orcas and salmon](#)

[Orca task force adds 13 recommendations at final meeting as 'biological extinction' looms](#)  
Bellamy Pailthorp, KNKX

### Report

[Southern Resident Orca Task Force Report and Recommendations](#)

### Video

[Orca Task Force's final recommendations for saving Southern Resident Killer Whales](#) (49:48)

# Association of Washington Farmers

## What's Important to Me

- Ensuring family farms continue to feed the world.<sup>48</sup>
- Protecting farmers from burdensome taxes, fees, and regulations.<sup>49</sup>
- Ensuring access to water and protection of existing water rights.<sup>50</sup>
- Maintaining critical transportation infrastructure to improve farm-to-market access.<sup>51</sup>

## Stats

- Agriculture is Washington State's second largest industry.
- There are more than 39,000 farms operating on more than 15 million acres in Washington.<sup>52</sup>
- Washington farmers and ranchers produce \$7.9 billion of crops and livestock each year.<sup>53</sup>

## Summary<sup>40</sup>

Many of the farm and ranch families in our state are multi-generational. The actions they take on their farms today are done as wise stewards of their land that they intend their family to keep farming for many more generations. As long-time residents of Washington State, farmers and ranchers care about the plight of our resident orca population. We want to do all that is necessary to restore their numbers to a healthy, sustainable level. We are an organization that represents the social and economic interests of farm and ranch families.

*"We support orca recovery, and we will remain involved because it is a priority to us. When it comes to regulatory expansion, we just ask for caution moving forward."<sup>41</sup>*

## Water Quality<sup>42</sup>

Our state water quality regulations already exceed those of most other states. We are reluctant to support further water quality regulations. Additional regulations might cost us more money or force us to change our farming practices.

## Hatchery Fish

Since Southern Residents are starving, it makes sense to get them more food by increasing hatchery salmon. However, as most farmers know, when you interfere with nature, there can be unintended consequences. Hatchery fish can compete with wild fish for food and other resources. Hopefully, a short-term increase in hatchery production will not have long-term consequences for wild salmon. Once the Southern Residents are on better footing, we should scale back the hatchery production.

## Dam Removal<sup>43,44,45</sup>

We oppose breaching or removing the lower Snake River dams. The dams along that river are the lifeblood of those communities. Eliminating the dams would seriously hurt

the state's agricultural industry, which relies on irrigation water for farms in the Columbia Basin and beyond. The dams also allow barges to ship food around the world. Barges are more efficient and cheaper than rail or trucks. They also emit fewer greenhouse gases. If we remove the dams and have to ship by rail or truck, costs would increase for farmers and consumers.

## Pinniped Removal<sup>46</sup>

Harbor Seals have become so plentiful that they're essentially robbing the killer whales of their food. Harbor Seals eat the baby salmon, and that means that there are far fewer to grow into adult Chinook. The Southern Residents need the adult Chinook to eat. We would like the tribes to be given the responsibility to remove harbor seals and to be compensated for their work in restoring this balance. If we can't come together and address this predation issue then all the habitat restoration we are doing will count for nothing.

## Chinook Fishing Restrictions

As farmers, we depend on a harvest to make a living—like fishers do. Just like farming, fishing is often a multigenerational job—one that has been passed down for generations. We would hate for families and livelihoods to be impacted. If the Task Force restricts Chinook fishing, they should

figure out a way to compensate fishers for their losses.

## Vessel Restrictions<sup>47</sup>

Scientists have shown that the Southern Residents are affected by boat traffic and noise. It seems reasonable to ban boats from going near or harassing the whales.

## Questions

Through the perspective of the farm coalition above, answer the questions below.

1. How is your group connected to water, salmon, and/or Southern Residents?
2. How would you be affected if salmon and/or Southern Residents became extinct?
3. Which solutions would you support?
4. Which solutions would you oppose?
5. Which solutions would you be willing to compromise on for the greater good?





# Commercial Fishers

## What's Important to Me

- Providing for myself and my family
- Sustainable fish stocks
- Safe working conditions
- Practical vessel regulations

## Stats

- **200,000+** Jobs in CA, OR, and WA Supported by Commercial Fishing Industries in 2017.<sup>54</sup>
- **\$39.5 billion** Sales impacts from the U.S. commercial fisheries in CA, OR, and WA in 2017.<sup>55</sup>
- **734 million** Pounds of seafood caught commercially in CA, OR, and WA in 2017.<sup>56</sup>

## Summary

I grew up fishing for fun. Now I work as a commercial salmon fisher off the coast of Washington State. Fishing is my passion, but the work is not easy. I spend long days on rough waters and work hard to reel in fish for West Coast families. As a fisher, it is my duty to provide both myself and the West Coast with an adequate supply of fresh salmon.

*“We’re already operating on a shoestring of what we used to have.”<sup>57</sup>*

## Water Quality

Water quality can impact the amount of salmon available to fish. Too much sediment from erosion can suffocate salmon eggs. Too much runoff from farms and roads can kill adult salmon in just a few hours.<sup>58</sup> I worry that if stricter water quality regulations are not put in place and enforced, there might not be enough fish to catch.

## Hatchery Fish

Washington state has been using hatcheries to supplement salmon runs for more than 100 years. If we produce more hatchery fish, the Southern Residents can have more salmon to eat. When hatcheries produce more salmon, I also might have the opportunity to catch more fish and make more money.

## Dam Removal

My great grandfather used to tell stories about rivers overflowing with 70-pound salmon! After the dams were built, he began to notice a decrease in the number and size of salmon.<sup>59</sup> It also costs taxpayers a lot of money to repair aging and hazardous dams.<sup>60</sup> I would like to see dams without fish ladders removed and those rivers return to their former glory.

## Pinniped Removal<sup>61</sup>

As a fisher, I often encounter hungry harbor seals. In Puget Sound, these pests eat about 1.5 million juvenile Chinook each month!<sup>62</sup> They also try to steal the fish I have worked so hard to catch!<sup>63</sup> Last year, harbor seals damaged my fishing gear while looking to get a quick snack. I am in favor of killing problematic pinnipeds near commercial fishing areas. This will also help the Southern Residents get more food.

## Chinook Fishing Restrictions

I am a father of three children. Catching salmon allows me to provide for them. A ban on Chinook fishing would reduce the amount of money I can make and cause my family to suffer. Restrictions are already in place to limit the number of Chinook I can catch, and I don't want to see further limits. I don't want to see the Southern Residents go extinct, but we have to find other ways to protect these animals.

## Vessel Restrictions<sup>64</sup>

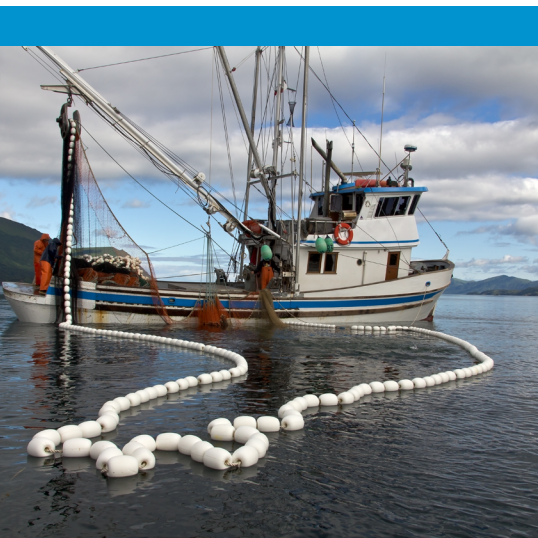
I have mixed feelings about telling boats where they can and cannot go. Not all boaters are responsible—I have seen some go too close and too fast around the Southern Residents. This probably causes the whales a lot of stress. Other boaters are just transiting an area or going fishing away from the whales. I'd support some

additional restrictions for boats following the whales. However, I do not want vessel restrictions to interfere with my ability to fish.

## Questions

Through the perspective of the commercial fisher above, answer the questions below.

1. How is your group connected to water, salmon, and/or Southern Residents?
2. How would you be affected if salmon and/or Southern Residents became extinct?
3. Which solutions would you support?
4. Which solutions would you oppose?
5. Which solutions would you be willing to compromise on for the greater good?



# Environmentalists

## What's Important to Me

- Preserving the environment for future generations
- Creating regulations that are enforceable
- Ensuring equitable and sustainable use of resources
- Holding polluters accountable

## Stats

- **14 million pounds** Toxic pollution entering Puget Sound every year.<sup>65</sup>
- **2.5 Hours** Time it takes for toxic road runoff to kill adult salmon.<sup>66</sup>
- **90%** Amount of nutrients and chemicals that can be filtered by a rain garden.<sup>67</sup>

## Summary

My home is on San Juan Island and I enjoy watching whales from shore. I'm concerned about the number of boats I see around the Southern Residents I have worked at an environmental non-governmental organization (NGO) for the past 15 years. Our organization aims to reduce water pollution. We help homeowners install rain gardens and repair leaks in their vehicles. We also help people select safer fertilizers and household cleaners. By reducing water pollution, we protect people and the Southern Residents.

*“What affects the Southern Residents ultimately affects all of us.”*

## Water Quality

Improving water quality is my passion! When it rains, pollutants from yards, roadways, and farms runoff into rivers. These pollutants eventually make their way to the ocean. Some pollutants accumulate in the blubber and breast milk of Southern Residents. Young whales can receive lots of contaminants from their mothers.<sup>68</sup> I think our state should provide incentives for homeowners to install rain gardens and maintain their vehicles. I would also like the state to better regulate harmful chemicals.

## Hatchery Fish<sup>69</sup>

Even though our state has been producing hatchery fish for more than a century, I do not support the practice. Hatchery fish can compete with wild fish for resources and can get wild fish sick. While producing more hatchery fish might seem like a quick fix, I think we should focus on solutions that do not have so many unintended consequences.

## Dam Removal<sup>70,71</sup>

Now that solar energy, wind energy, and natural gas have become cheaper than hydroelectric power, I do not see a reason to keep the dams. Dams make it harder, and sometimes impossible, for salmon to migrate. Fish ladders have been installed at some dams, but they are expensive and



many salmon still cannot complete their migration. Dams are also expensive to maintain and repair, and I think the money would be better spent elsewhere.

## Pinniped Removal<sup>72</sup>

Over the years, I have read different debates about killing harbor seals and sea lions in order to help salmon. Removing an animal from its habitat or killing it seems inhumane and could cause unintended consequences.<sup>73</sup> Even if this does help salmon, I believe that we should focus on other solutions to recover salmon populations.

## Chinook Fishing Restrictions

Depending on the population size, the J, K, and L pods must catch approximately 300,000 Chinook salmon a year. Since people do not need Chinook to survive, I believe we should temporarily ban commercial and recreational Chinook fishing. People can rely on other sources of protein, such as oysters and Alaska pollock, and get omega-3 fatty acids from algae.<sup>74</sup> If a ban is enacted, maybe we can create a job retraining program or provide equipment for fishers to catch or raise other species?

## Vessel Restrictions<sup>75</sup>

As a child, my family and I would go whale watching every summer. We saw whales and other species too, like seals and sea

birds. Despite these fun experiences, I've read studies about how boat noise and traffic has a huge impact on the Southern Residents and can make it harder for them to find food. I would like the state to expand vessel restrictions, increase enforcement, and encourage people to watch the whales from the shore. While some people are concerned that whale watching regulations will impact the local economy, I've read reports and articles that show regulations haven't hurt whale watch companies since they can sustain their businesses by watching other wildlife.

## Questions

Through the perspective of the environmentalist above, answer the questions below.

1. How is your group connected to water, salmon, and/or Southern Residents?
2. How would you be affected if salmon and/or Southern Residents became extinct?
3. Which solutions would you support?
4. Which solutions would you oppose?
5. Which solutions would you be willing to compromise on for the greater good?





# Northwest Treaty Tribes

## What's Important to Me

- Exercising and protecting our treaty rights.<sup>93</sup>
- Responsibly co-managing our shared resources.
- Protecting resources on which the tribes rely for their economic, cultural, and spiritual survival.<sup>94</sup>

## Stats

- Fishing tribes in Western Washington eat more fish and shellfish than the average person.<sup>95</sup>
- Most tribal ceremonies, funerals, or important occasions focus around salmon and other marine food sources.<sup>96</sup>

## Summary<sup>76,77</sup>

The 20 treaty Indian tribes in western Washington are leaders in efforts to protect and restore cultural and natural resources in the region. In the mid-1850s, the United States government wanted to make Washington a state. The government negotiated a series of treaties with tribes in the region. Through the treaties, the tribes “ceded” or gave up most of their land and in exchange reserved certain rights to protect their way of life. Tribes reserved rights to harvest fish, shellfish, wildlife, and other natural resources in exchange for most of the land that we currently live on today. Because all cultural and natural resources are connected, and because of their role as co-managers with the state, treaty tribes are active in every aspect of cultural and natural resources management in Western Washington.

*“We need to move past this short-term thinking that destroys the environment and resources we depend upon. We must use our collective energy to innovate and build healthy economies that will feed and sustain us ... not kill us.”<sup>78</sup>*

## Water Quality<sup>79,80,81,82,83</sup>

Under the federal Clean Water Act, tribes and states are responsible for setting water quality standards. Better water quality standards protect everyone. We want a rule that ensures we have the cleanest water possible, not only for ourselves and our families, but for all citizens of Washington. Studies show that Puget Sound juvenile salmon acquire significantly more contaminants than salmon from other parts of the Pacific Northwest. Some of these contaminants become more concentrated as they move up the food chain. Since Southern Residents are eating contaminated salmon, they accumulate harmful chemicals in their blubber. This can lead to reproductive disorders, compromised immune systems, and cancer. It is morally and legally wrong for the state to allow large private companies to profit at the expense of the environment and the citizens of the state.

## Hatchery Fish<sup>84,85</sup>

Hatcheries can help support salmon populations but are no substitute for natural salmon. Hatcheries make sure we have fish to catch. Hatchery fish are part of the answer to salmon recovery, but they were never meant to replace wild fish. And we have to make sure that never happens. One of the main reasons hatcheries were built in the first place was to replace natural salmon production lost to dams, development, logging, and other factors. But hatcheries can't really make up for the habitat we've already lost—and the habitat we continue to lose every day. All hatcheries do is hide the problem for a while. Both hatchery and naturally spawning salmon depend on the same habitat for their survival. Putting more salmon into degraded habitat does not result in more fish.

## Dam Removal<sup>86,87</sup>

If we are serious about salmon recovery—and I can assure you that the tribes are dead serious—we have to get serious about protecting and restoring salmon habitat. It's the only way wild salmon recovery will happen. The construction of massive concrete dams has destroyed many critical fishing spots and made it nearly impossible for salmon to complete their migration. We have a choice and it's one or the other: dams or salmon.

## Pinniped Removal<sup>88,89</sup>

Harbor seals and California sea lions in Western Washington could be hurting salmon, orcas, and other marine species—as well as fishing communities and economies—far more than we think. Scientists estimate that seals and sea lions eat about 1.4 million pounds of threatened Puget Sound Chinook each year. That is six times more salmon than Indian and non-Indian fisheries combined! Historically, tribal fishers never used to see seals and sea lions traveling up Western Washington rivers. The overpopulation of seals and sea lions is slowing salmon recovery. Our region has spent billions of dollars and countless hours to recover salmon. Booming seal and sea lion predation puts those investments and salmon at risk, and denies Southern Residents the food they desperately need.

## Chinook Fishing Restrictions<sup>90,91</sup>

Tribal fisheries managers have steadily reduced tribal Chinook salmon harvests in response to declining wild salmon populations. Even the most severe fisheries management actions—such as allowing no fisheries—have failed to restore wild salmon runs. That's because habitat degradation and loss is occurring faster than we can reduce or eliminate fisheries. Even if we were to end all fishing everywhere today, some runs would still become extinct simply because their habitat has been destroyed or degraded to the point that it can no longer



# Northwest Treaty Tribes - Pg 3

## Questions

Through the perspective of the Northwest Treaty Tribes above, answer the questions below.

1. How is your group connected to water, salmon, and/or Southern Residents?
2. How would you be affected if salmon and/or Southern Residents became extinct?
3. Which solutions would you support?
4. Which solutions would you oppose?
5. Which solutions would you be willing to compromise on for the greater good?

sustain them. Fishing defines the tribes as a people. It was the one thing above all else that the tribes wished to retain during treaty negotiations with the federal government 150 years ago. Nothing was more vital to the tribal way of life then, and nothing is more important now. Tribal fishers are not responsible for the salmon's decline, yet are continually expected to bear a disproportionate share of the salmon conservation burden. The treaty Indian tribes are not interested in any goal other than rebuilding threatened wild salmon runs—and the ecosystems on which they depend—to historic levels that can again sustain harvest. Anything less should be unacceptable to everyone.

And don't stop eating or serving Chinook if you want to help Southern Residents. It might make you feel better for a while, but it accomplishes little. It makes recovering Chinook even harder, by devastating the livelihoods of fishers and their families who care most about salmon recovery. Indian and non-Indian fishers are the greatest advocates for salmon recovery and the most accountable for their conservation. Contributing to the economic extinction of fishing will only accelerate the salmon's decline.

## Vessel Restrictions<sup>92</sup>

To save the Southern Residents, we need to reduce the effects of vessel traffic. Vessel noise that interferes with the Southern Residents' ability to hunt and communicate. There is also the danger of ship strikes and stress caused by boater harassment. The whale watching industry is important for the local economy. It contributes \$60 million each year to the regional economy and supports hundreds of jobs. Unfortunately, the stress caused by being chased by whale watching boats can contribute directly to a Southern Residents' death over time. That's considered a "direct take" by ESA standards, and it's against federal law.





# Taxpayer

## What's Important to Me

- Affording my family's basic needs
- Good schools
- Safe parks and neighborhoods
- Reasonable taxes

## Stats

- **\$2.2 million**  
WA state and local tax revenue could be lost each year if the Southern Residents go extinct.<sup>100</sup>
- **\$1.1 billion**  
2-year budget proposed to support the recovery of Southern Residents.<sup>101</sup>

## Summary

I live in a city with a high cost of living. After taxes, nearly all of my paycheck goes to pay for my housing, food, and transportation. While I want a healthy environment for my children and future grandchildren, I do not want to pay more taxes to clean up other people's pollution. Our government needs to hold companies and individuals accountable for their actions. Taxpayers should not be stuck with unfair costs.

*"Polluters should be responsible for cleaning their own messes. I don't want my taxes to increase because of others' mistakes."*

## Water Quality

After very heavy rains, I have noticed floods or large pools of water in my neighborhood. These pools and puddles often have gasoline or other pollutants floating on the top. My city has proposed installing a new type of drainage to stop the flooding and filter the pollutants before they get swept into the ocean. I think they were called bioswales. While I would love to reduce flooding and pollutants, I'm concerned about increasing my taxes. I'm also wondering if this money would be better spent elsewhere. I'm really torn on whether or not to support this measure.

## Hatchery Fish

I love the idea of being able to give the Southern Residents more salmon relatively quickly and easily. However, I have concerns about the costs. Last year, I remember reading an article about how much it costs to produce just one hatchery salmon—nearly \$5,000!<sup>97</sup> I think we need to find a more cost effective way to increase salmon populations.

## Dam Removal

On the weekends, my friends and I take trips near the local dam to swim and kayak—it's my favorite way to unwind after a long week at work. It costs a lot of money, like millions of dollars, to remove a dam and restore a river.<sup>98</sup>

Since a lot of our local electricity is generated from hydropower, I'm worried my electricity bill would increase too. I would like to see the dams stay where they are.

## Pinniped Removal

I really love seals and sea lions, and always look forward to seeing them at the beach. However, I can understand why fishers might want to kill those that regularly steal fish and damage their fishing gear. I also understand why some people want to kill seals and sea lions to leave more salmon for the Southern Residents. I do not know if I can justify killing one species to save another.

## Chinook Fishing Restrictions

From what I've read in the news, it really seems like Southern Residents immediately need more Chinook salmon. However, I feel for the fishers who are just trying to make a living. For some fishers, this is the only job they know. Fishing might also be an important part of their family history. I'm not sure how to feel about this.

## Vessel Restrictions

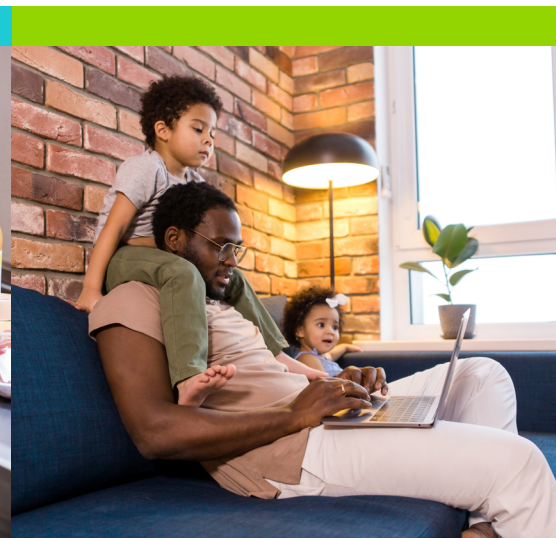
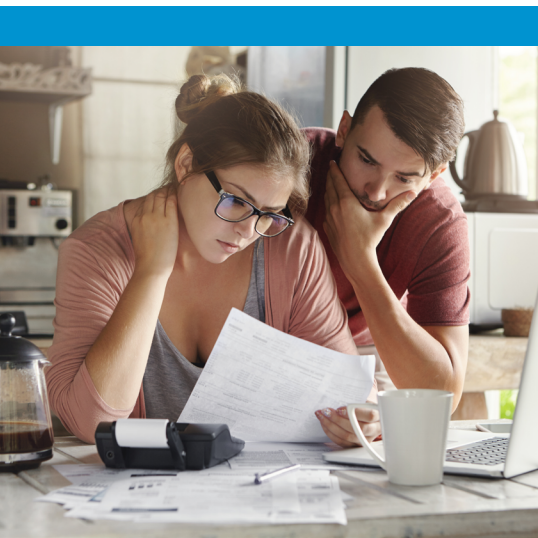
It makes me so angry when I see boats harassing whales! The last time I was at the beach, I saw dozens of boats and jet skis surrounding a pod of whales.<sup>99</sup> If I was

a whale, I certainly wouldn't want boats chasing me or my family. How are the whales supposed to eat and rest while they are constantly being disrupted by boaters? I would be in favor of stricter laws and big fines for those who break the law.

## Questions

Through the perspective of the taxpayer above, answer the questions below.

1. How is your group connected to water, salmon, and/or Southern Residents?
2. How would you be affected if salmon and/or Southern Residents became extinct?
3. Which solutions would you support?
4. Which solutions would you oppose?
5. Which solutions would you be willing to compromise on for the greater good?



# Whale Watching Industry

## What's Important to Me

- Making a living through whale watching
- Educating the public about the natural history and importance of marine mammals
- Ensuring healthy marine mammal populations so our whale watching business can thrive
- Common sense vessel regulations

## Stats

- **\$2.2 million**  
WA state and local tax revenue could be lost each year if the Southern Residents go extinct.<sup>110</sup>
- **\$1.1 billion**  
2-year budget proposed to support the recovery of Southern Residents.<sup>111</sup>

## Summary<sup>102</sup>

We are a group of responsible whale watching businesses. We promote responsible wildlife viewing and educate the public about issues affecting marine life. Each year, hundreds of thousands of visitors come to watch the Southern Residents and other marine mammals. Each business respects and admires our local watershed and wildlife. Many of the boat captains are naturalists, marine scientists, or educators. We are committed to conservation so that future generations can enjoy marine mammals as much as we do.

*“Our education efforts help inspire people to protect the Southern Residents. We also serve as a model for responsible boating around wildlife.”*

## Water Quality

Our state needs to invest more money in reducing water pollution. When we improve water quality, everyone benefits—people, salmon, marine mammals—the whole ecosystem. There are many ways we can work toward cleaner waterways, such as encouraging public

transportation, upgrading old combined sewer overflow systems, installing rain gardens, and promoting permeable pavement. These upgrades are not cheap, but they provide many benefits.

## Hatchery Fish

It is clear that the Southern Residents are starving. We understand that Southern Residents immediately need more Chinook to eat. However, we have also heard that hatchery salmon can outcompete wild salmon for food and habitat. Weighing the short-term benefits of hatchery salmon with the potentially long-term consequences to wild salmon is very difficult.

## Dam Removal<sup>103,104</sup>

We need to get more salmon in the mouths of the Southern Residents as soon as possible. Dams are not the only problem, but they are a big piece of it. Removing problematic and outdated dams would be a huge step in the right direction. A few years after the dams have been removed, the whales will have access to significantly more salmon.



## Pinniped Removal<sup>105</sup>

We all see the challenges which the Southern Residents are facing. One of the main issues they face is food scarcity. It's easy to understand why people blame seals and sea lions for gobbling up salmon at the mouths of some dams. People often want to blame what they can easily see. While some seals and sea lions might be eating a lot of salmon, we believe they have every right to the fish. As naturalists and whale watching operators, we cannot support the killing of any marine mammals.

## Chinook Fishing Restrictions<sup>106</sup>

We do not want to see anyone's livelihoods impacted to protect the Southern Residents. But since their favorite prey, Chinook salmon, are so scarce, we need to focus most of our efforts on salmon recovery. Until salmon runs are restored, we will continue to see the Southern Residents decline. Perhaps we can pay fishers to not fish Chinook for a few years? Or maybe we can give them the tools and training they need to fish other species? Or perhaps we can increase the number of hatchery fish? We don't have all the answers, but we do know we need to focus our efforts on recovering salmon.

## Vessel Restrictions<sup>107,108,109</sup>

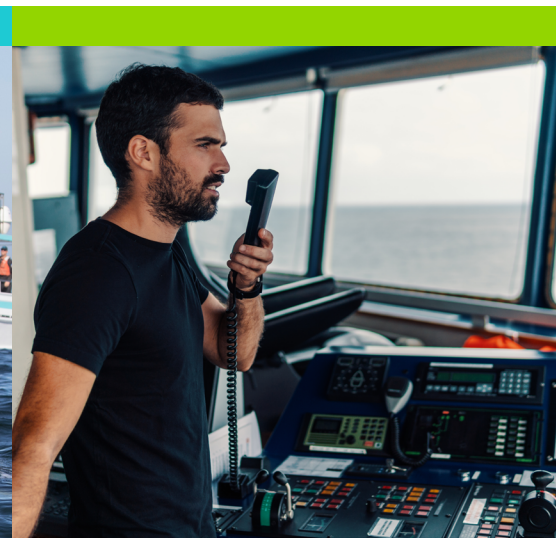
We fully support keeping recreational and shipping vehicles away from the Southern

Residents. But, we do not believe our whale watching boats are causing any harm. The speed of a boat is a big indicator of how much noise it will make. Our tour operators slow down when they are near the Southern Residents. We also shut off our engines as much as possible and limit our time watching the whales, especially when they are looking for food. We are always looking for new ways to minimize our impact on wildlife and to model responsible boating for others on the water. Additional boating restrictions could harm, or even shut down, some of our businesses. We are already doing everything we can to minimize our impact on the Southern Residents. We firmly believe that whale watching is not killing orcas—a lack of salmon is.

## Questions

Through the perspective of the whale watching coalition, answer the questions below.

1. How is your group connected to water, salmon, and/or Southern Residents?
2. How would you be affected if salmon and/or Southern Residents became extinct?
3. Which solutions would you support?
4. Which solutions would you oppose?
5. Which solutions would you be willing to compromise on for the greater good?





Group Members: \_\_\_\_\_

# Task Force Scenario

## Scenario

In 2018, Washington Governor Jay Inslee announced the creation of the Southern Resident Orca Task Force. This team of experts represents members of the Legislature, the Government of Canada, tribal, federal, local and other state governments, and the private and non-profit sectors. The Task Force has been charged with developing longer-term recommendations for Southern Resident recovery.

This team of 45 experts have widely diverging interests—ranging from tour boat operators to fishers and environmental organizations to hydropower operators. They will need to deliver actions that are politically feasible and create real change. The task force members will need to come to consensus on dozens of possible actions meant to target the three main problems whales face: limited prey, vessel traffic and noise, and contamination.

As a class, we will be participating in a mock Task Force to find solutions for the Southern Residents while balancing the cultural and economic needs of local communities.

## Part I: Group Summary

1. Describe the values and needs of your group.

---



---



---

2. How is your group connected to the Southern Residents?

---



---



---

3. What concerns does your group have?

---



---



---

4. What solutions would your group like to implement?

---



---



---

5. How could your group be affected by new policies or regulations designed to protect the Southern Residents?

---



---



---



---

## Part II: Task Force Members

**Directions:** While other groups are summarizing their values and needs, make notes below:

<p><b>Association of Farmers</b></p>	<p><b>Commercial Fishers</b></p>
<p><b>Environmentalists</b></p>	<p><b>Northwest Treaty Tribes</b></p>
<p><b>Taxpayers</b></p>	<p><b>Whale Watching Coalition</b></p>

Group Members: \_\_\_\_\_

# Priorities

## Part I

**Directions:** As a group, assign a priority to each of the measures. For example, Priority 1 would be the group's highest, or most important, priority. Priority 6 would be the group's lowest, or least important, priority. Keep your group's values and needs in mind as you are prioritizing these measures.

Measure	Priority	Cost
<p><b>Measure 1: Increase Water Quality Standards</b> Increasing water quality standards would create cleaner waterways. This proposal would also fund solutions, like bioswales and rain gardens, to clean up runoff. This can help more salmon survive. It can also reduce the amount of contaminants that accumulate in the Southern Residents.</p>		
<p><b>Measure 2: Increase Hatchery Production</b> Increase the amount of Chinook salmon being produced in hatcheries. This is the quickest way to get more salmon in the mouths of the Southern Residents.</p>		
<p><b>Measure 3: Remove Problematic Dams</b> Some dams pose a substantial obstacle to salmon recovery. Removal of problematic dams and barriers are important for recovering salmon.</p>		
<p><b>Measure 4: Remove Problematic Pinnipeds</b> Populations of some pinnipeds (e.g. seals and sea lions) have greatly increased over the last few decades. Some pinnipeds gather at the mouths of dams and eat lots of Chinook salmon. This proposal would make it easier for officials to kill problematic pinnipeds.</p>		
<p><b>Measure 5: Chinook Fishing Restrictions</b> Since the Southern Residents desperately need more Chinook, this proposal would seek a temporary ban on commercial and recreational Chinook fishing. This ban would not apply to subsistence fishing (catching fish to feed one's family or community).</p>		
<p><b>Measure 6: Vessel Restrictions</b> Boat traffic and noise interferes with the Southern Resident's ability to hunt for salmon and rest. This proposal would require boats to stay at least 400 yards away from the Southern Residents. It would also place a temporary ban on commercial whale watching tours.</p>		

## Part II

**Directions:** Keep your group's values and needs in mind as you answer the questions below.

1. The Task Force has been given a budget of \$1.1 billion (\$1,100,000,000). Does the budget seem low or high? Explain your reasoning.

---

---

---

---

2. If you think the budget is too low, where might additional funds come from? If you think the budget is too high, how should the excess funds be spent?

---

---

---

---

3. Given the budget of \$1.1 billion (\$1,100,000,000), which measures would your group prioritize? Explain your reasoning.

---

---

---

---

4. How do these measures benefit our:

**Society**

---

---

---

**Economy**

---

---

---

**Environment**

---

---

---





Credit: Allison Shelley for EDUimages

## Activity 8: Yes, We Can!

A series of short case studies highlight how human passion and ingenuity can overcome seemingly insurmountable problems. Students then complete a skills and interests assessment to determine how they can use their talents and interests to help the Southern Residents.

### Key Student Questions

- How can people work together to solve seemingly insurmountable problems?
- How can I best use my interests and talents to help the Southern Residents?

## Key National Standards

### CCSS

- [CCSS.ELA-LITERACY.W.6.2.B](#), [7.2B](#), [8.2B](#)

### C3

- [D2.Civ.10.6-8](#).
- [D4.7.6-8](#).

## Supporting Vocabulary

**Changemaker**—One who desires change in the world and, by gathering knowledge and resources, makes that change happen.

**Civics**—The study of the rights and duties of citizens and of how government works.

**Ingenuity**—Skill or cleverness that allows someone to solve problems, invent things, etc.

**Insurmountable**—Impossible to overcome.

## Preparation

Decide how you would like students to view the slide deck. This can be set up as a presentation or as a gallery walk. If you would like to set up a gallery walk, print the slides and speakers notes and arrange them around the room.

## Introduction

1. Ask students to recall or free write about a time when they overcame a very difficult problem.
  - a. What did they do to address the issue?
  - b. Who helped them?
  - c. How did they feel after the problem was resolved?
2. Have a few volunteers share their experiences.
3. In popcorn format, have students name societal issues that feel overwhelming or insurmountable. *Climate change, crime, homelessness, poverty, systemic racism, etc.*



## Required Materials

- **Slide deck:**  
Yes, We Can!
- **Assessment:**  
[Yes, I Can!](#)  
Pg 100-101  
1 per student
- **Signup Sheet:**  
[Taking Action](#)  
Pg 102  
1 copy
- **Driving Question Poster** from Activity 1



4. Share the following excerpt with the class:

In the news, we often hear a lot of negativity about people, our communities, our country, and our government. For every negative example we hear, there are many more positive examples that we do not hear. Every day, people come together to solve small and big challenges—from designing and building the International Space Station to decoding the human genome—people are capable of accomplishing seemingly impossible problems when we work together.

5. Have students draw the following table on a piece of paper:

Project	Challenge	Outcome
---------	-----------	---------

6. Project the *Yes, We Can!* Slide deck or point out the stations around the room.
7. Instruct the students to write notes for each project as they listen to the slide deck or visit each station.
8. After the slide deck or stations have been completed, ask students to summarize their thoughts in popcorn or Think-Pair-Share format:
- How did these examples make you feel?
  - Did you find anything to be surprising, daunting, or inspiring?
  - What skills, tools, or interests did these collaborators need to accomplish their goal?

## Activity

- Assess how students are feeling about their ability to help the Southern Residents by conducting a Fist to Five poll with the following prompt: As a student, can you make a difference for the Southern Residents?
- Ask for a few students with different opinions to share their thinking.
- Explain that the class will now take some time to reflect upon how their own talents and interests can be used to help the Southern Residents.
- Give each student a copy of the [Yes, I Can!](#) handout and read through the instructions together.
- Give the class about 20 minutes to complete the handout.
- In pairs, small groups, or a gallery walk format, ask students to share their work.
- Ask students to list any additional issues they identified to help the Southern Residents and write these ideas on the *Taking Action* signup sheet. Pass the signup sheet around the class and save it for Activity 9.

## Driving Question

Review the list of questions from Activity 1. Cross off any questions that were answered in today's activity. Add additional questions that may have arisen.

## Discussion Questions

1. How much of a difference can young people make in addressing the problems facing our society? What makes their voices uniquely powerful? What examples from the past or present can you think of to support your opinion?
2. What qualities, skills, or perspectives are unique to young people and how might they help make their voices powerful?
3. Given that there are so many other people whose actions are affecting the Southern Residents, what difference do individual actions make?
4. What does the word changemaker mean to you?
5. What changes would you like to see happen in our school, community, state, country, or even the world to help the Southern Residents?

## Public Product Option

Students can turn their *Yes, I Can* handout into a vision board, collage, poster, or blog post that can be shared with the school, their family, or the larger community.

## Share Your Students' Work

Help inspire Southern Resident conservation around the globe by sharing your experience with this unit. Tag photos, student work, and student quotes.

- Facebook: [@NOAAFisheriesWestCoast](#)
- Twitter: [@NOAAFish\\_WCRO](#)
- Instagram: [@NOAAFisheries](#)



## Additional Resources



### Article

#### Irrational or Only Human?

This article explains how behavioral economics drives our environmental choices.

### Curriculum

#### The Power to Change the World

This unit from the *New York Times* helps young people understand how they can make a difference on social issues.

### Framework

#### Social Change Ecosystem Map

This framework helps individuals understand how their values and roles can advance social change.

### Video

#### Young People Are the Now (11:24)

Teacher Elizabeth Robbins describes how once young people have a framework for thinking of themselves as active players in their communities, their nation, or their world, they can achieve much more than we realize.



Name: \_\_\_\_\_ Date: \_\_\_\_\_ Class: \_\_\_\_\_

# Yes, I Can!

We each can make a difference in our local and global communities. When we understand the things that we do well, what we enjoy doing, and the issues we care most about, it is easier to create change. Your passion can be the spark that inspires others, starts a new movement, and creates lasting change. Let's take some time to reflect upon our own skills and interests and discover how they can be used to help the Southern Residents.

## Skills, Qualities and Characteristics

**Directions:** Circle your best skills, qualities, and characteristics. Add any that might be missing from the list.

Active	Clever	Eager	Imaginative	Persistent
Adventurous	Compassionate	Easy going	Introspective	Polite
Amusing	Confident	Enthusiastic	Introverted	Responsible
Articulate	Cooperative	Flexible	Kind	Self-reliant
Artistic	Coordinated	Focused	Loyal	Strong
Athletic	Courageous	Friendly	Open minded	Thoughtful
Aware	Courteous	Generous	Organized	Unique
Brave	Creative	Hard working	Original	
Calm	Dedicated	Helpful	Outgoing	
Capable	Dependable	Honest	Passionate	
Caring	Determined	Humorous	Patient	

## Interests

**Directions:** Circle your favorite interests. Add any that might be missing from the list.

Art	Debate	Leadership	Singing
Band	Dance/Movement	Math	Social studies
Business	Drama	Metal working	Sports
Choir	Engineering	Music	Technology
Civics	Foreign language	Poetry	Wood working
Communications	Gardening	Public speaking	Writing
Computer science	Geography	Reading	
Cooking	History	Robotics	
Crafting	Journalism	Science	

## Ways to Take Action

**Directions:** Circle the civic actions that most interest you. Add any that might be missing from the list.

- |                                |                             |                                 |
|--------------------------------|-----------------------------|---------------------------------|
| Create a petition              | Create a public performance | Plan acts of civil disobedience |
| Create a social media campaign | Design public art           | Raise money                     |
| Create an afterschool club     | Educate others              | Take legal action               |
| Contact businesses             | Engage the press            | Volunteer                       |
| Contact lawmakers              | Plan protests               | Write an editorial              |

## Issues Affecting Southern Residents, Salmon, and Watersheds

**Directions:** Circle the issues that most interest you. Add any that might be missing.

- |                                 |                               |                              |
|---------------------------------|-------------------------------|------------------------------|
| Boat traffic                    | Emissions from factories      | Pesticides                   |
| Boat noise                      | Habitat loss                  | Pollutants from farms        |
| Climate change                  | Hunger                        | Pollutants from factories    |
| Dams and other passage barriers | Impervious pavement           | Pollutants from urban runoff |
| Drought                         | Improper disposal of medicine |                              |
| Emissions from vehicles         | Leaks from vehicles           |                              |

## Reflect

1. Write at least two sentences to describe how your skills and interests can be used to help the Southern Residents. Be sure to cite specific examples from the lists above.

---



---



---



---

2. What skills or interests would you like to continue to develop? How might these skills and interests help you become a changemaker?

---



---



---



---

# Signup Sheet: Taking Action

**Directions:** Add your name below each of the topics that most interest you.

Boat Traffic	Emissions from Factories	Pesticides
Boat Noise	Habitat Loss	Pollutants from Farms
Climate Change	Hunger	Pollutants from Factories
Dams & Passage Barriers	Impervious Pavement	Pollutants from Urban Runoff
Drought	Improper Disposal of Medicine	
Emissions from Vehicles	Leaks from Vehicles	







Credit: Allison Shelley for EDUimages

## Activity 9: Taking Action

Students work in small groups to design an action project for the Southern Residents that demonstrates their learning and supports their personal interests and talents. Projects can be scaled to your timeline and students' interests.

### Key Student Questions

- What future do we envision for the Southern Residents?
- What solutions do we want to take action on?
- What steps do we need to take to complete our project?

## Key National Standards

### CCSS

- CCSS.ELA-LITERACY.CCRA.[SL.1](#); CCSS.ELA-LITERACY.SL.[6.1](#), [7.1](#), [8.1](#)
- CCSS.ELA-LITERACY.CCRA.[SL.4](#); CCSS.ELA-LITERACY.SL.[6.4](#), [7.4](#), [8.4](#)
- CCSS.ELA-LITERACY.CCRA.[SL.5](#); CCSS.ELA-LITERACY.SL.[6.5](#), [7.5](#), [8.5](#)
- CCSS.ELA-LITERACY.CCRA.[SL.6](#); CCSS.ELA-LITERACY.SL.[6.6](#), [7.6](#), [8.6](#)
- CCSS.ELA-LITERACY.WHST.[6-8.7](#)

### C3

- [D4.3.6-8.](#)
- [D4.7.6-8.](#)
- [D4.8.6-8.](#)

## Keyword

**Action plan**—A proposed strategy or course of action.

## Supporting Vocabulary

**Active citizen**—A person who actively takes responsibility and initiative in areas of public concern.

## Preparation

1. Review the *Taking Action* signup sheet from Activity 8 and assign each student to one group. Place 2-3 students in each group.
2. Decide the scope of the project. This activity can be scaled to your timeline and students' interests. Options might include:
  - a. Complete the Action Plan handout.
  - b. Raise some funds.
  - c. Develop campaign materials.
  - d. Create digital maps or models.
  - e. Partner with afterschool programs, scouts, and community organizations to implement the *Action Plan*.



## Required Materials

- **Signup Sheet:**  
[Taking Action](#), completed during Activity 8
- **Handout:**  
[Action Plan](#)  
Pg 108-113  
1 per group of 2-3
- **Driving Question**  
Poster from Activity 1

3. Decide how many class periods students will have to work on their project and identify key deadlines such as: project outline, project budget, project materials list, project partners, project completion, public presentation, etc.
4. Decide the budget for each group, if any.
5. Decide which materials and supplies will be available to students.
6. Reach out to [wcr.education@noaa.gov](mailto:wcr.education@noaa.gov) if you would like any additional support.

## Introduction

1. Direct students to review the board or paper with the Driving Question.
2. Give students a few minutes to reflect upon all of the questions they have answered throughout the unit.
3. Ask students if they feel prepared to make a meaningful difference for the critically-endangered Southern Resident killer whales.
4. In Think-Pair-Share, free write, or popcorn format, have students share their thoughts.

## Activity

1. Share the following excerpt with the class:

Today, we will begin channeling all of your newfound knowledge and passion for the Southern Residents into a campaign for meaningful change. You will work in small groups to tackle the issues that are most important to you. You will have the freedom and flexibility to use your own talents and interests to shape this project.

2. Share the group assignments with the class and ask students to sit with their team members.

3. Give each group a copy of the [Action Plan](#) handout.
4. As a class, complete Part I.
5. Give groups time to complete at least Parts II and III. Circulate around the room to answer questions. If the answers would be helpful for the rest of the class, share this information aloud.
6. Bring the class back together to discuss any potential issues or challenges.
7. Tell the class that groups will be meeting regularly to continue working on their projects.
8. See the suggested Group Meeting, Reflection, and Demonstration exercises below. Work with the class to create a group meeting schedule and to plan a day of reflection and a community demonstration.

## Group Meetings

At least once a week, host group meetings so students can continue planning and implementing their projects.

1. Ask students to get out their Action Plan.
2. Have students return to their groups.
3. Each group should review their Action Plan and work on the next steps.
4. Circulate around the room to answer any questions.
5. Have each group report back on their overall progress and any challenges they might be facing.

## Reflection

After the groups have completed their projects, lead a class discussion using one or more of the following prompts. Alternatively, students may respond to the prompts with an essay or free write.



1. What were the easiest and most challenging parts of this project?
2. What did you learn throughout this project?
3. What have you learned about yourself throughout this project?
4. How could you continue to be involved in Southern Resident conservation and recovery efforts after this project?

## Demonstration

After groups have completed their projects and reflections, a demonstration is a great way for them to celebrate their successes and share their experiences with others. Consider hosting one of the following demonstrations at your school or local community center.

- Create posters for school or the community library.
- Host a workshop to teach other kids how to get involved.
- Write an article in a local newspaper or blog.
- Share each of the projects at a school assembly.

## Share

Your students' projects can help inspire other classroom projects and others see their role in stewardship. Tag photos, student work, and student quotes using @[NOAAFisheriesWestCoast](#) (Facebook) or @[NOAAFish\\_WCRO](#) (Twitter). If you would like your class' story to be featured on our website, [please let us know](#).

## Discussion Questions

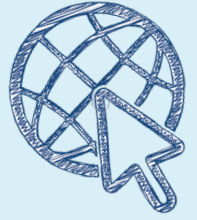
1. What motivates you to take action?
2. What steps can you take to start addressing an issue you care about?
3. Does everyone take action after learning about an important issue? Why or why not?
4. By working to protect Southern Residents, how do we also help people?
5. Has this process changed your views on learning or school? Why or why not?

## Additional Resources

### Curriculum

#### [Learning to Give](#)

Learning to Give provides lesson plans that help youth learn about their communities and how they can help others with their time and talent



### Toolkits

#### [Creating Systems Level Change in Cities](#)

This Toolkit helps cities provide all children with opportunities to play, learn, and grow with nature in their daily lives.

#### [Green Schoolyards for Healthy Communities](#)

Greening schoolyards can be a powerful strategy for making sure that all kids have access to the benefits of nature.

#### Sea Stewards Handbook ([English](#), [Spanish](#))

This handbook introduces students to the biggest issues facing our ocean and what individuals can do to make a difference.

#### [Tools of Change](#)

Find strategies and case studies that motivate your key audiences to take the action you wish them to take.

#### [Youth Changing the World](#)

Youth Service America provides youth with tools to improve their communities through service.



Group Members: \_\_\_\_\_

Topic: \_\_\_\_\_

# Action Plan

## Part I: Background

Project scope \_\_\_\_\_

Key deadlines

---



---



---

Budget \_\_\_\_\_

Materials and supplies

---



---



---

## Part II: Group Member Agreement

**Directions:** Before your group begins creating an action plan, it is important to create a Group Member Agreement. This agreement will help us identify expectations of one another. Work together to create a shared list of expectations for your group.

1. Each member of the group should try to:

---



---



---



---

2. Each member of the group should try not to:

---



---



---



---

3. If a group member is not following our Group Member Agreement:

---



---



---

### Part III. Define Roles

**Directions:** Teams are more likely to stay on task when each member has a role. Work together to assign each person in your group at least one role.

**Facilitator:** \_\_\_\_\_

The facilitator moderates discussions, keeps the group on task, and assigns work as needed. The facilitator might say things like, "Let's hear from someone else next." or "That's an interesting idea, but let's get back to the task at hand."

**Recorder:** \_\_\_\_\_

The recorder takes notes, summarizes team discussions, and keeps all necessary records. The recorder might say things like, "Did I summarize this correctly?" or "Could you please repeat what you just said?"

**Runner:** \_\_\_\_\_

The runner gets supplies or requests help from the teacher when the group needs support. The runner might say things like, "I will go get the markers. How many do we need?" or "It looks like we might be stuck. Should I go get the teacher for help?"

**Timekeeper:** \_\_\_\_\_

The timekeeper keeps the group on schedule and makes sure the group is aware of upcoming deadlines. The timekeeper might say things like, "We only have five minutes left, let's move on to the next topic." or "Remember, our final project is due in two weeks."

### Part IV. Brainstorm

**Directions:** Spend some time thinking and talking about the questions below. Then work with your group to come to a consensus.

1. What are the goals of this project?

---



---



---

2. What steps do we need to take to complete this project?

---



---



---

3. What information do we need to know before we begin?

---



---



---

4. What supplies will we need?

---



---



---

5. Will we need to do any advertising (e.g., posters, social media, flyers, etc.)?

---



---



---

6. How will we know if our project has been successful (e.g., number of people who attended an event, number of people who committed to biking to school, amount of money raised, etc.)?

---



---



---

**Part V. Plan**

**Directions:** Complete the following table with as much detail as possible. If necessary, use the internet for additional research.

<b>Action Steps</b> What will be done?	<b>Time Required</b> How long will it take to complete this step?	<b>Responsibilities</b> Who will do each part?	<b>Deadlines</b> When is each step due?	<b>Resources</b> What resources are needed?
1.				

<b>Action Steps</b> What will be done?	<b>Time Required</b> How long will it take to complete this step?	<b>Responsibilities</b> Who will do each part?	<b>Deadlines</b> When is each step due?	<b>Resources</b> What resources are needed?
2.				
3.				
4.				
5.				



<b>Action Steps</b> What will be done?	<b>Time Required</b> How long will it take to complete this step?	<b>Responsibilities</b> Who will do each part?	<b>Deadlines</b> When is each step due?	<b>Resources</b> What resources are needed?
6.				
7.				
8.				
9.				

<b>Action Steps</b> What will be done?	<b>Time Required</b> How long will it take to complete this step?	<b>Responsibilities</b> Who will do each part?	<b>Deadlines</b> When is each step due?	<b>Resources</b> What resources are needed?
10.				

**Part VI. Reflect**

**Directions:** Answer the questions below using complete sentences.

1. Did your group achieve its goals? Explain.

---

---

---

---

---

---

---

2. What went well?

---

---

---

---

---

---

---

3. What could have gone better?

---

---

---

---

---

Name: \_\_\_\_\_ Date: \_\_\_\_\_ Class: \_\_\_\_\_

## Pre/Post Assessment

### Part I: Recall and Reason

Directions: Circle the most correct answer.

1. Which pods are part of the Southern Resident clan?
  - a. A, G, R
  - b. G, H, I
  - c. J, K, L
  - d. K, M, Y
2. Southern Residents are:
  - a. Extinct
  - b. Endangered
  - c. Thriving
  - d. Threatened
3. Southern Residents prefer to eat:
  - a. Canary rockfish
  - b. Chinook salmon
  - c. Harbor seals
  - d. Market squid
4. Southern Residents are economically important because they:
  - a. Are at the top of the food chain
  - b. Are sold to zoos and aquariums
  - c. Attract whale-watching tourists
  - d. Help fishers locate fish
5. Southern Residents are culturally important because they are:
  - a. A cheap and nutrient-rich food source
  - b. The first whales to return to the Salish Sea each year
  - c. Featured in several popular movies, including Free Willy
  - d. Part of the Coast Salish peoples' traditions
6. Southern Residents greatly influence their ecosystem since they are:
  - a. Apex predators
  - b. Ecosystem engineers
  - c. Marine mammals
  - d. Native species

7. One major challenge facing the Southern Residents is:
  - a. Attacks from sixgill sharks
  - b. Boat traffic
  - c. Lack of habitat
  - d. Not enough rockfish to eat
  
8. Noise pollution makes it harder for Southern Residents to:
  - a. Breathe
  - b. Hunt
  - c. Reproduce
  - d. Swim
  
9. Individuals can reduce water pollution by:
  - a. Fixing leaky vehicles
  - b. Flushing old medicine down the toilet
  - c. Taking shorter showers
  - d. Using extra lawn fertilizer
  
10. One side benefit of protecting the Southern Residents is:
  - a. Cheaper salmon
  - b. Cleaner water
  - c. Fewer sea lions
  - d. More urban runoff

**Part II: Explain**

**Directions:** Answer the following questions using complete sentences.

1. If Southern Residents went extinct, how might ecosystems, economies, and/or cultures be affected? Describe at least two examples.

---



---



---



---

2. Many different groups of people can take action, including individuals, communities, industries, and governments.
  - a. Which action(s) are most effective? Explain your thinking.

---



---



---



b. If one type of action is more effective, should we stop doing the other types of actions? Explain your thinking.

---



---



---

3. There are many ways that people can get involved to help save Southern Residents.  
 a. Describe one specific action that individuals can take to save Southern Residents.

---

b. How does this action help Southern Residents?

---



---



---

c. How does this action also help people?

---



---



---

4. Collaboration is necessary to save the Southern Residents. Describe at least one benefit and at least one drawback to collaboration on Southern Resident conservation.

---



---



---

5. Sometimes protecting one species can come at a cost to other species or certain groups of people. This is called a tradeoff.

a. What is one potential tradeoff for protecting the Southern Residents?

---



---



---

b. Who or what will this tradeoff affect?

---



---



---

c. How could the effects be minimized?

---



---



---

**Part III: Reflect**

**Directions:** How much do you agree with each of the statements below? There are no right or wrong answers. Circle your response.

1. The Southern Residents are part of the economy of the Pacific Northwest.

Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree

2. My own actions can affect the Southern Residents.

Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree

3. Individual actions have the greatest effect on the environment.

Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree

4. We should try to reduce water pollution.

Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree

5. We should try to reduce marine noise pollution.

Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree

6. We should try to increase salmon populations.

Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree

7. I try to reduce my environmental footprint.

Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree

8. I encourage others to reduce their environmental footprint.

Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree

9. I believe that people benefit when we protect the Southern Residents.

Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree

10. I believe that people benefit when we protect the environment.

Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree

# Pre/Post Assessment: Answer Key

## Part I: Recall and Reason

1. C	3. B	5. D	7. B	9. A
2. B	4. C	6. A	8. B	10. B

## Part II: Explain

1. Answers will vary. Possible answers include:

- Ecosystem impacts: disruptions to the food web
- Economic impacts: fewer people whale watching; loss of whale watching revenue and jobs; fewer tourists in the Pacific Northwest
- Cultural impacts: loss of a culturally significant species; loss of traditions including songs, dances, and stories

2. Answers will vary. Possible answers include:

a. Governmental actions are typically most effective because they affect large-scale change and often come with penalties for those who do not comply. Industry actions are also effective because they create large-scale change and can encourage other companies to follow suit. Community actions can be effective in changing governmental policies and/or industrial practices.

b. We should continue taking individual actions, even though other types of actions can be more effective. Individual actions add up. Individual actions and values can also encourage companies to change their models and practices.

3. Answers will vary. Possible answers include:

a. Encouraging governments to make stronger regulations, encouraging companies to be more environmentally responsible, biking and walking whenever possible, using natural cleaning products, installing rain gardens, using less water, volunteering for salmon habitat restoration, using less water, using fewer herbicides and pesticides, etc.

b. Ensure students have drawn a logical conclusion between the action and the benefit to Southern Residents. For example, volunteering for salmon habitat restoration projects will increase healthy salmon habitat and increase salmon populations in the long run. This will increase the amount of prey available to the Southern Residents.

c. Ensure students have drawn a logical conclusion between the action and the benefit to people. For example, restoring salmon habitat will filter pollutants from point and nonpoint sources. This improves water quality, which benefits all people.

4. Answers will vary. Possible answers include:

a. Benefits: policies could get more buy in, projects could have more funding sources, more perspectives and voices are heard, more creative solutions are proposed, more groups have buy in and ownership, etc.

b. Drawbacks: processes take more time, groups might not come to a consensus, tension might build between different groups, power dynamics might come into play, every group does not have a seat at the table, etc.

5. Answers will vary. Possible answers include:

- a. The livelihoods of different groups could be affected (e.g., fishers, whale watching companies, farmers, etc.), seal and sea lions might be culled, dam removals could cost taxpayers a lot of money, etc.
- b. Insure students have drawn a logical conclusion between the tradeoff and those who might be affected. For example, additional whale watching restrictions would affect people working on whale watching boats and the communities that are dependent on income from whale watching tourists.
- c. Insure students have drawn a logical conclusion between the tradeoff and minimizing impacts. For example, if salmon fishing restrictions are enacted, fishers could be given equipment to catch a different species or retrained for different trades.

### Part III: Reflect

No correct answers. Use this section as a springboard for discussion and to assess students' attitudes and behaviors.



# Glossary

## A

**Action plan**—A proposed strategy or course of action.

**Active citizen**—A person who actively takes responsibility and initiative in areas of public concern.

**Apex predator**—A predator that, as an adult, has no natural predators in its ecosystem.

## B

**Bioaccumulation**—An increase in the concentration of a chemical in a biological organism over time, compared to the chemical's concentration in the environment. The source of the chemical can be from the water, soil, sediment, or air the organism interacts with or from the food it eats.

**Biomagnification**—A process that results in the accumulation of a chemical in an organism at higher levels than are found in its food. It occurs when a chemical becomes more and more concentrated as it moves up through a food chain.

## C

**Calls**—Pulsed signals which have discrete patterns that can be recognized by ear and by spectrogram. They are the main component of the orca communication repertoire.

**Changemaker**—One who desires change in the world and, by gathering knowledge and resources, makes that change happen.

**Civics**—The study of the rights and duties of citizens and of how government works.

**Clicks**—Part of the whale's sonar and are used for echolocation: for finding and locating food sources, for defining other objects in the ocean, and locating the whale in its environment.

**Collective action**—People working together to achieve a common objective.

**Co-manager**—A person who manages something jointly with one or more other people.

**Communication**—The act or process of using words, sounds, signs, or behaviors to express or exchange information or to express your ideas, thoughts, feelings, etc., to someone else.

**Community**—A group of people that share some commonality, often based on where they live, what they do, a shared social characteristic, or shared interests.

**Culture**—The behaviors, beliefs, arts, and products (things) of a community or group of people.

## E

**Echolocation**—The sonar-like system used by some animals to detect and locate objects by emitting usually high-pitched sounds that reflect off the object and return to the animal's ears or other sensory receptors.

**Economy**—The system of production, distribution, and consumption of goods and services.

**Ecosystem**—A community of organisms (plant, animal, and other living organisms) and the abiotic parts of their environment.

**Endangered species**—Animals or plants that are in danger of becoming extinct.

**Environment**—The physical surroundings in which we live, including living (biotic) and nonliving (abiotic) factors.

**Extinct**—Animals or plants that have died out completely.

## I

**Indicator species**—A species whose presence, absence, or relative well-being in a given environment is a sign of the overall health of its ecosystem.

**Individual action**—Actions taken by one individual person, acting based on their personal decisions.

**Inextricably**—Impossible to separate.

**Ingenuity**—Skill or cleverness that allows someone to solve problems, invent things, etc.

**Insurmountable**—Impossible to overcome.

## L

**Lifblood**—An important part.

## M

**Map**—A drawing of a particular area such as a city, a country, or a continent, showing its main features as they would appear if you looked at them from above.

**Marine mammals**—Warmblooded animals that live in marine waters and breathe air directly. These include porpoises, dolphins, whales, seals, and sea lions.

## N

**Natural resource manager**—Someone charged with protecting natural resources such as land, water, soil, plants and animals.

**Naturalist**—A person who studies plants and animals as they live in nature.

**Noise pollution**—Unwanted or excessive sound that can harm human health, wildlife, or environmental quality.

## P

**Policymaker**—A person responsible for making policy, especially in government.

**Political**—Relating to politics or government.

**Pollutant**—Any substance introduced to the environment that adversely affects the health of an organism, the health of an ecosystem, or the usefulness of a resource.

## R

**Responsibility**—Something that you should do because it is morally right, legally required, etc.

**Ripple effect**—A situation in which one event causes a series of other events to happen.

## S

**Schoolyard**—The area next to or surrounding a school where students typically play.

**Secondary extinction**—Once one species goes extinct it may cause other extinctions.

**Single-action bias**—Relying on only one action to reduce a threat.

**Social**—Relating to people or society in general.

**Sociopolitical**—Involving both social and political factors.

**Stakeholder**—A person with an interest or concern in something.

**Subsistence**—Harvesting food to feed one's family or community; not for profit.

**Survive**—To remain alive.

**Systemic change**—Change that leads to sustainable and large-scale impacts.

**Systems**—A collection of parts that have some influence on one another and the whole.

## T

**Task force**—A group of people who deal with a specific problem.

**Threat**—Something that could cause trouble or harm.

**Thrive**—To grow or develop successfully.

**Time immemorial**—Very old or ancient. From a time so long ago that it cannot be remembered.

## U

**Umbrella species**—Species that are selected for conservation-related decisions because the conservation and protection of these species indirectly affects the conservation and protection of other species within their ecosystem.

## W

**Whistles**—Continuous tone emissions that may last for many seconds.

# Endnotes

- 1 Cauvel, Kimberly. "Despite Attention, Orca Population Continues to Shrink." AP NEWS, 1 Oct. 2018, [apnews.com/article/cdef416fd3f14aceb4725753f2afb11b](https://apnews.com/article/cdef416fd3f14aceb4725753f2afb11b).
- 2 Owen, Brenna, and Alastair Spriggs. "For Coast Salish Communities, the Race to Save Southern Resident Orcas Is Personal." Canada's National Observer, 17 Sept. 2019, <https://www.nationalobserver.com/2019/09/17/news/coast-salish-communities-race-save-southern-resident-orcas-personal>.
- 3 Hooper, Frank. "'Our Relatives Are Calling for Help' – Northwest Tribes Stand up for Dying Orcas." Buffalo's Fire, Indian Country Today, 14 Oct. 2018, [www.buffalofire.com/our-relatives-are-calling-for-help-northwest-tribes-stand-up-for-dying-orcas](http://www.buffalofire.com/our-relatives-are-calling-for-help-northwest-tribes-stand-up-for-dying-orcas).
- 4 Dunagan, Christopher. "Samish Tribe Names the Newest Member of J Pod." Kitsap Sun, 22 Oct. 2009, [pugetsoundblogs.com/waterways/2009/10/22/samish-tribe-names-the-newest-member-of-j-pod](http://pugetsoundblogs.com/waterways/2009/10/22/samish-tribe-names-the-newest-member-of-j-pod).
- 5 Northwest Treaty Tribes Magazine, Fall 2018 issue, <https://nwtreatytribes.org/publications/magazine>.
- 6 Noren, Dawn P. "Estimated Field Metabolic Rates and Prey Requirements of Resident Killer Whales." Marine Mammal Science, vol. 27, no. 1, 2010, pp. 60–77. Digital Commons, [doi:10.1111/j.1748-7692.2010.00386.x](https://doi.org/10.1111/j.1748-7692.2010.00386.x).
- 7 Ma, Michelle. "Resident Orcas' Appetite Likely Reason for Decline of Big Chinook Salmon." UW News, University of Washington, 16 Dec. 2019, [www.washington.edu/news/2019/12/16/resident-orcas-chinook-salmon](http://www.washington.edu/news/2019/12/16/resident-orcas-chinook-salmon).
- 8 Ma, Michelle. "Largest Chinook Salmon Disappearing from West Coast." UW News, University of Washington, 27 Feb. 2018, [www.washington.edu/news/2018/02/27/largest-chinook-salmon-disappearing-from-west-coast](http://www.washington.edu/news/2018/02/27/largest-chinook-salmon-disappearing-from-west-coast).
- 9 Harrison, John. "Washington's Orca Task Force Recommends Protections For A Declining Species." Northwest Power and Conservation Council, 23 Oct. 2019, [www.nwcouncil.org/news/washingtons-orca-task-force-recommends-protections-declining-species](http://www.nwcouncil.org/news/washingtons-orca-task-force-recommends-protections-declining-species).
- 10 Van Deren, Matt, et al. "The Whales in Our Waters: The Economic Benefits of Whale Watching in San Juan County." Earth Economics, 2019, [static1.squarespace.com/static/561dc6e4b039470e9afc00/t/5c48a1e442bfc14525263268/1548264128844/SRKW\\_EarthEconomics\\_Jan2019-Digital.pdf](https://static1.squarespace.com/static/561dc6e4b039470e9afc00/t/5c48a1e442bfc14525263268/1548264128844/SRKW_EarthEconomics_Jan2019-Digital.pdf).
- 11 Van Deren, Matt, et al. "The Whales in Our Waters: The Economic Benefits of Whale Watching in San Juan County." Earth Economics, 2019, [static1.squarespace.com/static/561dc6e4b039470e9afc00/t/5c48a1e442bfc14525263268/1548264128844/SRKW\\_EarthEconomics\\_Jan2019-Digital.pdf](https://static1.squarespace.com/static/561dc6e4b039470e9afc00/t/5c48a1e442bfc14525263268/1548264128844/SRKW_EarthEconomics_Jan2019-Digital.pdf).
- 12 Grace, Sharon. "Endangered Southern Resident Killer Whales Add Minimum of \$65-\$70 Million to Washington State's Economy." DamTRUTH, 2015, [www.srkwcsi.org/economic-value](http://www.srkwcsi.org/economic-value).
- 13 Van Deren, Matt, et al. "The Whales in Our Waters: The Economic Benefits of Whale Watching in San Juan County." Earth Economics, 2019, [static1.squarespace.com/static/561dc6e4b039470e9afc00/t/5c48a1e442bfc14525263268/1548264128844/SRKW\\_EarthEconomics\\_Jan2019-Digital.pdf](https://static1.squarespace.com/static/561dc6e4b039470e9afc00/t/5c48a1e442bfc14525263268/1548264128844/SRKW_EarthEconomics_Jan2019-Digital.pdf).
- 14 Kassakian, Jen and Flight, Maura. "Final Analysis of the Economic Viability of Commercial Whale Watching License Holders." Industrial Economics, Inc., 2020, <https://wdfw.wa.gov/sites/default/files/2020-09/finalviabilityanalysis082020.pdf>.
- 15 "West Coast Region Science in the Studio Award." NOAA Fisheries, 8 Apr. 2021, [www.fisheries.noaa.gov/west-coast/outreach-and-education/west-coast-region-science-studio-award](http://www.fisheries.noaa.gov/west-coast/outreach-and-education/west-coast-region-science-studio-award).
- 16 Birgit Kriete. "Orcas in Puget Sound." Puget Sound Nearshore Partnership Report No. 2007-01. Seattle District, U.S. Army Corps of Engineers (Seattle, Washington). <https://wdfw.wa.gov/sites/default/files/publications/02191/wdfw02191.pdf>.
- 17 Thompson, Evan. "From Pest to Pet to Icon: Our Evolving Relationship With Orcas." HeraldNet [Everett, WA], 4 Nov. 2018, [www.heraldnet.com/life/from-pest-to-pet-to-icon-our-evolving-relationship-with-orcas](http://www.heraldnet.com/life/from-pest-to-pet-to-icon-our-evolving-relationship-with-orcas).
- 18 Shedd, Taylor, et al. "Epimeletic Behaviour in a Southern Resident Killer Whale (Orcinus Orca)." *The Canadian Field-Naturalist*, vol. 134, no. 4, 2021, pp. 316–20. Crossref, [doi.org/10.22621/cfn.v134i4.2555](https://doi.org/10.22621/cfn.v134i4.2555).
- 19 Northwest Fisheries Science Center. "Southern Resident Killer Whale Research in the Pacific Northwest." NOAA Fisheries, 31 July 2020, [www.fisheries.noaa.gov/west-coast/science-data/southern-resident-killer-whale-research-pacific-northwest](http://www.fisheries.noaa.gov/west-coast/science-data/southern-resident-killer-whale-research-pacific-northwest).
- 20 Northwest Fisheries Science Center. "Diversity of Fish Species Support Killer Whale Diet Throughout the Year." NOAA Fisheries, 5 Mar. 2021, [www.fisheries.noaa.gov/feature-story/diversity-fish-species-support-killer-whale-diet-throughout-year](http://www.fisheries.noaa.gov/feature-story/diversity-fish-species-support-killer-whale-diet-throughout-year).
- 21 "Chinook Salmon." NOAA Fisheries, 2020, [www.fisheries.noaa.gov/species/chinook-salmon](http://www.fisheries.noaa.gov/species/chinook-salmon).

- 22 Cauvel, Kimberly. "Despite Attention, Orca Population Continues to Shrink." AP NEWS, 1 Oct. 2018, [apnews.com/article/cdef416fd3f14aceb4725753f2afb11b](https://www.apnews.com/article/cdef416fd3f14aceb4725753f2afb11b).
- 23 Northwest Fisheries Science Center. "Nearby Vessels Interrupt Feeding of Southern Resident Killer Whales, Especially Females." NOAA Fisheries, 12 Jan. 2021, [www.fisheries.noaa.gov/feature-story/nearby-vessels-interrupt-feeding-southern-resident-killer-whales-especially-females](https://www.fisheries.noaa.gov/feature-story/nearby-vessels-interrupt-feeding-southern-resident-killer-whales-especially-females).
- 24 National Geographic Society. "Noise Pollution." National Geographic, 15 July 2019, [www.nationalgeographic.org/encyclopedia/noise-pollution](https://www.nationalgeographic.org/encyclopedia/noise-pollution).
- 25 Clear Seas Centre for Responsible Marine Shipping. "Underwater Noise & Marine Mammals." Clear Seas, 6 Nov. 2020, [clearseas.org/en/underwater-noise](https://clearseas.org/en/underwater-noise).
- 26 Clear Seas Centre for Responsible Marine Shipping. "Underwater Noise & Marine Mammals." Clear Seas, 6 Nov. 2020, [clearseas.org/en/underwater-noise](https://clearseas.org/en/underwater-noise).
- 27 Kaplan, Maxwell B., and Susan Solomon. "A Coming Boom in Commercial Shipping? The Potential for Rapid Growth of Noise from Commercial Ships by 2030." *Marine Policy*, vol. 73, 2016, pp. 119–21. Crossref, doi:10.1016/j.marpol.2016.07.024.
- 28 Pailthorp, Bellamy. "Lummi Nation Mourns Lost Southern Resident Orcas, Renames Those Remaining." KNKX, 27 Aug. 2019, [www.knkx.org/post/lummi-nation-mourns-lost-southern-resident-orcas-renames-those-remaining](https://www.knkx.org/post/lummi-nation-mourns-lost-southern-resident-orcas-renames-those-remaining).
- 29 Friends of the San Juans. "Southern Resident Killer Whales given Lummi Name in a Traditional Ceremony." *The Journal of the San Juan Islands* [San Juan Island, WA], 12 Sept. 2019, [www.sanjuanjournal.com/life/southern-resident-killer-whales-given-lummi-name-in-a-traditional-ceremony](https://www.sanjuanjournal.com/life/southern-resident-killer-whales-given-lummi-name-in-a-traditional-ceremony).
- 30 Kassakian, Jen and Flight, Maura. "Final Analysis of the Economic Viability of Commercial Whale Watching License Holders." Industrial Economics, Inc., 2020, <https://wdfw.wa.gov/sites/default/files/2020-09/finalviabilityanalysis082020.pdf>.
- 31 Grace, Sharon. "Endangered Southern Resident Killer Whales Add Minimum of \$65-\$70 Million to Washington State's Economy." *DamTRUTH*, 2015, [www.srkwcsi.org/economic-value](https://www.srkwcsi.org/economic-value).
- 32 Van Deren, Matt, et al. "The Whales in Our Waters: The Economic Benefits of Whale Watching in San Juan County." *Earth Economics*, 2019, [static1.squarespace.com/static/561dc6e4b039470e9afc00/t/5c48a1e442bfc14525263268/1548264128844/SRKW\\_EarthEconomics\\_Jan2019-Digital.pdf](https://static1.squarespace.com/static/561dc6e4b039470e9afc00/t/5c48a1e442bfc14525263268/1548264128844/SRKW_EarthEconomics_Jan2019-Digital.pdf).
- 33 Noren, Dawn P. "Estimated Field Metabolic Rates and Prey Requirements of Resident Killer Whales." *Marine Mammal Science*, vol. 27, no. 1, 2010, pp. 60–77. Digital Commons, doi:10.1111/j.1748-7692.2010.00386.x.
- 34 Ma, Michelle. "Resident Orcas' Appetite Likely Reason for Decline of Big Chinook Salmon." *UW News*, University of Washington, 16 Dec. 2019, [www.washington.edu/news/2019/12/16/resident-orcas-chinook-salmon](https://www.washington.edu/news/2019/12/16/resident-orcas-chinook-salmon).
- 35 Ma, Michelle. "Largest Chinook Salmon Disappearing from West Coast." *UW News*, University of Washington, 27 Feb. 2018, [www.washington.edu/news/2018/02/27/largest-chinook-salmon-disappearing-from-west-coast](https://www.washington.edu/news/2018/02/27/largest-chinook-salmon-disappearing-from-west-coast).
- 36 Harrison, John. "Washington's Orca Task Force Recommends Protections For A Declining Species." *Northwest Power and Conservation Council*, 23 Oct. 2019, [www.nwcouncil.org/news/washingtons-orca-task-force-recommends-protections-declining-species](https://www.nwcouncil.org/news/washingtons-orca-task-force-recommends-protections-declining-species).
- 37 Van Deren, Matt, et al. "The Whales in Our Waters: The Economic Benefits of Whale Watching in San Juan County." *Earth Economics*, 2019, [static1.squarespace.com/static/561dc6e4b039470e9afc00/t/5c48a1e442bfc14525263268/1548264128844/SRKW\\_EarthEconomics\\_Jan2019-Digital.pdf](https://static1.squarespace.com/static/561dc6e4b039470e9afc00/t/5c48a1e442bfc14525263268/1548264128844/SRKW_EarthEconomics_Jan2019-Digital.pdf).
- 38 Brown, Karina. "Impossible Choices: The Complicated Task of Saving Both Orca and Salmon." *Courthouse News Service* [Pasadena, CA], 7 Sept. 2018, [www.courthousenews.com/impossible-choices-the-complicated-task-of-saving-both-orca-and-salmon](https://www.courthousenews.com/impossible-choices-the-complicated-task-of-saving-both-orca-and-salmon).
- 39 The Office of the Governor, Jay Inslee. "Saving the Southern Resident Orca." *Access Washington*, Jan. 2019, [www.governor.wa.gov/sites/default/files/documents/SRKW-policy-brief\\_Jan2019.pdf](https://www.governor.wa.gov/sites/default/files/documents/SRKW-policy-brief_Jan2019.pdf).
- 40 Washington Farm Bureau. "The October 24 Orca Task Force Recommendations." *Southern Resident Orca Task Force*, 29 Oct. 2018, [pspwa.app.box.com/s/wlam0up9a81d200lii7t5mlaigmg3poo](https://pspwa.app.box.com/s/wlam0up9a81d200lii7t5mlaigmg3poo).
- 41 Sowersby, Shauna. "Fish and Wildlife Could See Expanded Powers under One Proposal to Help Save Orcas." *The News Tribune* [Tacoma, WA], 30 Jan. 2019, [www.thenewstribune.com/news/politics-government/article225263855.html](https://www.thenewstribune.com/news/politics-government/article225263855.html).
- 42 Washington Farm Bureau. "The October 24 Orca Task Force Recommendations." *Southern Resident Orca Task Force*, 29 Oct. 2018, [pspwa.app.box.com/s/wlam0up9a81d200lii7t5mlaigmg3poo](https://pspwa.app.box.com/s/wlam0up9a81d200lii7t5mlaigmg3poo).
- 43 Leslie, Jacques. "On the Northwest's Snake River, the Case for Dam Removal Grows." *Yale E360*, Yale School of the Environment, 10 Oct. 2019, [e360.yale.edu/features/on-the-northwests-snake-river-the-case-for-dam-removal-grows](https://e360.yale.edu/features/on-the-northwests-snake-river-the-case-for-dam-removal-grows).



- 44 Washington Farm Bureau. "The October 24 Orca Task Force Recommendations." *Southern Resident Orca Task Force*, 29 Oct. 2018, [pspwa.app.box.com/s/wlam0up9a81d200lii7t5mlaimg3poo](https://pspwa.app.box.com/s/wlam0up9a81d200lii7t5mlaimg3poo).
- 45 Le, Phuong. "Task Force Considers Breaching Dams to Save Endangered Orcas." *Kitsap Sun*, Associated Press, 18 Oct. 2018, [eu.kitsapsun.com/story/news/local/2018/10/18/task-force-considers-breaching-dams-save-endangered-orcas/1689096002](https://eu.kitsapsun.com/story/news/local/2018/10/18/task-force-considers-breaching-dams-save-endangered-orcas/1689096002).
- 46 Larson, Bob, and Gerald Baron. "Chinook to Orcas Pt 3." *Ag Information Network of the West*, 9 July 2018, [www.aginfo.net/report/40364/Washington-State-Farm-Bureau-Report-Chinook-to-Orcas-Pt-3](https://www.aginfo.net/report/40364/Washington-State-Farm-Bureau-Report-Chinook-to-Orcas-Pt-3).
- 47 Washington Farm Bureau. "The October 24 Orca Task Force Recommendations." *Southern Resident Orca Task Force*, 29 Oct. 2018, [pspwa.app.box.com/s/wlam0up9a81d200lii7t5mlaimg3poo](https://pspwa.app.box.com/s/wlam0up9a81d200lii7t5mlaimg3poo).
- 48 Washington Farm Bureau. "The Voice of WA Agriculture." *Washington Farm Bureau*, 2021, [wsfb.com](https://wsfb.com).
- 49 Washington Farm Bureau. "Legislative Priorities." *Washington Farm Bureau*, 2021, [wsfb.com/legislative-priorities](https://wsfb.com/legislative-priorities).
- 50 Washington Farm Bureau. "Legislative Priorities." *Washington Farm Bureau*, 2021, [wsfb.com/legislative-priorities](https://wsfb.com/legislative-priorities).
- 51 Washington Farm Bureau. "Legislative Priorities." *Washington Farm Bureau*, 2021, [wsfb.com/legislative-priorities](https://wsfb.com/legislative-priorities).
- 52 Sandison, Derek. "Washington State Department of Agriculture." *National Association of State Departments of Agriculture*, 2021, [www.nasda.org/organizations/washington-state-department-of-agriculture](https://www.nasda.org/organizations/washington-state-department-of-agriculture).
- 53 Sandison, Derek. "Washington State Department of Agriculture." *National Association of State Departments of Agriculture*, 2021, [www.nasda.org/organizations/washington-state-department-of-agriculture](https://www.nasda.org/organizations/washington-state-department-of-agriculture).
- 54 "U.S. Commercial and Recreational Fisheries, Job Impacts, 2017." *NOAA Fisheries*, 2018, [media.fisheries.noaa.gov/dam-migration/feus2017-info-graphic-jobs2.jpg](https://media.fisheries.noaa.gov/dam-migration/feus2017-info-graphic-jobs2.jpg).
- 55 "U.S. Commercial and Recreational Fisheries, Sales Impacts, 2017." *NOAA Fisheries*, 2018, [media.fisheries.noaa.gov/dam-migration/feus2017-info-graphic-sales.jpg](https://media.fisheries.noaa.gov/dam-migration/feus2017-info-graphic-sales.jpg).
- 56 Fisheries of the United States, 2017. U.S. Department of Commerce, NOAA Current Fishery Statistics No. 2017. [www.fisheries.noaa.gov/national/fisheries-united-states-2017](https://www.fisheries.noaa.gov/national/fisheries-united-states-2017).
- 57 Lacitis, Erik. "Lean Year for Coho Means Big Worries for Westport Salmon Charters." *Seattle Times* [Seattle, WA], 11 Apr. 2016, [www.wildsalmon.org/projects/restoring-the-lower-snake-river/seattle-times-lean-year-for-coho-means-big-worries-for-westport-salmon-charters.html](https://www.wildsalmon.org/projects/restoring-the-lower-snake-river/seattle-times-lean-year-for-coho-means-big-worries-for-westport-salmon-charters.html).
- 58 WSG News Blog. "Urban Runoff Killing Coho Salmon, but Simple Solution Within Reach." *Washington Sea Grant*, 20 Oct. 2021, [wsg.washington.edu/urban-runoff-killing-coho-salmon-but-simple-solution-within-reach-2](https://wsg.washington.edu/urban-runoff-killing-coho-salmon-but-simple-solution-within-reach-2).
- 59 Reimann, Matt. "There Used to Be Salmon as Big as Golden Retrievers in the Columbia River, but Dams Killed Them Off." *Medium*, *Timeline*, 26 Apr. 2017, [timeline.com/there-used-to-be-salmon-as-big-as-golden-retrievers-in-the-columbia-river-but-dams-killed-them-off-20854d1f971e](https://timeline.com/there-used-to-be-salmon-as-big-as-golden-retrievers-in-the-columbia-river-but-dams-killed-them-off-20854d1f971e).
- 60 American Society of Civil Engineers. "2017 Infrastructure Report Card, Dams." *Report Card for America's Infrastructure*, 2017, [www.infrastructurereportcard.org/wp-content/uploads/2017/01/Dams-Final.pdf](https://www.infrastructurereportcard.org/wp-content/uploads/2017/01/Dams-Final.pdf).
- 61 West Coast Regional Office. "Deterring 'Nuisance' Pinnipeds." *NOAA Fisheries*, 11 Mar. 2021, [www.fisheries.noaa.gov/west-coast/marine-mammal-protection/deterring-nuisance-pinnipeds](https://www.fisheries.noaa.gov/west-coast/marine-mammal-protection/deterring-nuisance-pinnipeds).
- 62 Pamplin, Nate, et al. "Impact of Pinnipeds on Chinook Salmon." *Washington Department of Fish and Wildlife*, 14 Feb. 2018, [wdfw.wa.gov/sites/default/files/about/commission/meetings/2018/12/dec1418\\_06\\_presentation.pdf](https://wdfw.wa.gov/sites/default/files/about/commission/meetings/2018/12/dec1418_06_presentation.pdf).
- 63 Gorman, Brian. "NOAA Says Three States Can Remove Certain Sea Lions That Threaten Protected Salmon." *NOAA Fisheries*, West Coast Regional Office, 1 Oct. 2019, [www.fisheries.noaa.gov/west-coast/marine-mammal-protection/noaa-says-three-states-can-remove-certain-sea-lions-threaten-protected-salmon](https://www.fisheries.noaa.gov/west-coast/marine-mammal-protection/noaa-says-three-states-can-remove-certain-sea-lions-threaten-protected-salmon).
- 64
- 65 Place, Eric. "How Much Petroleum Enters Puget Sound In Stormwater?" *Sightline Institute*, 13 Jan. 2010, [www.sightline.org/2010/01/13/how-much-petroleum-enters-puget-sound](https://www.sightline.org/2010/01/13/how-much-petroleum-enters-puget-sound).
- 66 Doughton, Sandi. "Toxic Road Runoff Kills Adult Coho Salmon in Hours, Study Finds." *The Seattle Times* [Seattle, WA], 12 Feb. 2016, [www.seattletimes.com/seattle-news/environment/whats-killing-coho-study-points-to-urban-road-runoff](https://www.seattletimes.com/seattle-news/environment/whats-killing-coho-study-points-to-urban-road-runoff).
- 67 Groundwater Foundation. "All About Rain Gardens." *Groundwater Foundation*, [www.groundwater.org/action/home/raingardens.html](https://www.groundwater.org/action/home/raingardens.html).
- 68 Mongillo, Teresa, et al. "Exposure to a mixture of toxic chemicals: Implications for the health of endangered Southern Resident killer whales." *NOAA Fisheries*, NOAA Technical Memorandum NMFS-NWFSC-135, 2016, [doi:10.7289/V5/TM-NWFSC-135](https://doi.org/10.7289/V5/TM-NWFSC-135).

- 69 Vanden Brulle, Ramon, and Nick Gayeski. "An Overwhelming Body of Evidence: How Hatcheries Are Jeopardizing Salmon Recovery." *Wild Fish Conservancy Northwest*, [wildfishconservancy.org/resources/library/advocacy/wild-salmon-recovery-initiative/An%20Overwhelming%20Body%20-9C929.pdf/at\\_download/file](https://wildfishconservancy.org/resources/library/advocacy/wild-salmon-recovery-initiative/An%20Overwhelming%20Body%20-9C929.pdf/at_download/file).
- 70 Williams, Kale. "Proponents of Snake River Dam Removal Condemn Environmental Assessment." *The Oregonian* [Portland, OR], 28 Feb. 2020, [www.oregonlive.com/environment/2020/02/proponents-of-snake-river-dam-removal-condemn-environmental-assessment.html](http://www.oregonlive.com/environment/2020/02/proponents-of-snake-river-dam-removal-condemn-environmental-assessment.html).
- 71 Leslie, Jacques. "On the Northwest's Snake River, the Case for Dam Removal Grows." *Yale E360*, Yale School of the Environment, 10 Oct. 2019, [e360.yale.edu/features/on-the-northwests-snake-river-the-case-for-dam-removal-grows](https://e360.yale.edu/features/on-the-northwests-snake-river-the-case-for-dam-removal-grows).
- 72 West Coast Regional Office. "Deterring 'Nuisance' Pinnipeds." *NOAA Fisheries*, 11 Mar. 2021, [www.fisheries.noaa.gov/west-coast/marine-mammal-protection/deterring-nuisance-pinnipeds](https://www.fisheries.noaa.gov/west-coast/marine-mammal-protection/deterring-nuisance-pinnipeds).
- 73 Zhang, Sarah. "The Feeding Frenzy That Got Sea Lions Into Deep Trouble." *The Atlantic*, 31 Jan. 2019, [www.theatlantic.com/science/archive/2019/01/killing-sea-lions-save-salmon/581740/](http://www.theatlantic.com/science/archive/2019/01/killing-sea-lions-save-salmon/581740/).
- 74 Office of Communications. "Enjoy Sustainable Seafood at Home." *NOAA Fisheries*, 6 Apr. 2021, [www.fisheries.noaa.gov/feature-story/enjoy-sustainable-seafood-home](https://www.fisheries.noaa.gov/feature-story/enjoy-sustainable-seafood-home).
- 75 Tollit, Dominic, et al. "A Study to Estimate the Effect of Noise from Whale Watch Boats and Commercial Vessels and on Killer Whales." *Port of Vancouver, SMRU Consulting NA*, 11 July 2017, [www.portvancouver.com/wp-content/uploads/2017/01/2017-07-ECHO-Program-Estimating-the-effects-of-noise-from-commercial-vessels-and-whale-watch-boats-on-SRKW.pdf](http://www.portvancouver.com/wp-content/uploads/2017/01/2017-07-ECHO-Program-Estimating-the-effects-of-noise-from-commercial-vessels-and-whale-watch-boats-on-SRKW.pdf).
- 76 Northwest Treaty Tribes. "About Us." *Northwest Treaty Tribes, Northwest Indian Fisheries Commission*, 12 Aug. 2020, [nwtreatytribes.org/about-us](https://nwtreatytribes.org/about-us).
- 77 Northwest Indian Fisheries Commission and Salmon and Steelhead Habitat Inventory and Assessment Program. "2020 State of Our Watersheds State of Our Watersheds A Report by the Treaty Tribes in Western Washington A Report by the Treaty Tribes in Western Washington." *Northwest Indian Fisheries Commission, 2020*, [geo.nwifc.org/SOW/SOW2020\\_Report/SOW2020.pdf](https://geo.nwifc.org/SOW/SOW2020_Report/SOW2020.pdf).
- 78 Loomis, Lorraine. "Pollution-Based Economy Cannot Be Sustained." *Northwest Treaty Tribes, Northwest Indian Fisheries Commission*, 7 May 2020, [nwtreatytribes.org/pollution-based-economy-cannot-be-sustained](https://nwtreatytribes.org/pollution-based-economy-cannot-be-sustained).
- 79 Loomis, Lorraine. "A Bold Move for Salmon Habitat." *Northwest Treaty Tribes, Northwest Indian Fisheries Commission*, 4 June 2020, [nwtreatytribes.org/a-bold-move-for-salmon-habitat](https://nwtreatytribes.org/a-bold-move-for-salmon-habitat).
- 80 Loomis, Lorraine. "Politics, Not Science Behind Water Quality Rollback." *Northwest Treaty Tribes, Northwest Indian Fisheries Commission*, 3 June 2019, [nwtreatytribes.org/politics-not-science-behind-water-quality-rollback](https://nwtreatytribes.org/politics-not-science-behind-water-quality-rollback).
- 81 Loomis, Lorraine. "Better Water Quality Standards Protect Everyone." *Northwest Treaty Tribes, Northwest Indian Fisheries Commission*, 25 Feb. 2016, [nwtreatytribes.org/better-water-quality-standards-protect-everyone](https://nwtreatytribes.org/better-water-quality-standards-protect-everyone).
- 82 Loomis, Lorraine. "Pollution-Based Economy Cannot Be Sustained." *Northwest Treaty Tribes, Northwest Indian Fisheries Commission*, 7 May 2020, [nwtreatytribes.org/pollution-based-economy-cannot-be-sustained](https://nwtreatytribes.org/pollution-based-economy-cannot-be-sustained).
- 83 Northwest Treaty Tribes "What Treaty Tribes Are Saying about the State's Proposed Water Quality Standards." *Northwest Treaty Tribes, Northwest Indian Fisheries Commission*, 9 May 2016, [nwtreatytribes.org/treaty-tribes-saying-states-proposed-water-quality-standards](https://nwtreatytribes.org/treaty-tribes-saying-states-proposed-water-quality-standards).
- 84 Frank Jr., Billy. "Hatcheries Aren't Habitat." *Northwest Treaty Tribes, Northwest Indian Fisheries Commission*, 8 June 2004, [nwtreatytribes.org/hatcheries-arent-habitat](https://nwtreatytribes.org/hatcheries-arent-habitat).
- 85 Loomis, Lorraine. "Holding Habitat Impacts Accountable for Salmon Decline." *Northwest Treaty Tribes, Northwest Indian Fisheries Commission*, 5 Jan. 2021, [nwtreatytribes.org/holding-habitat-impacts-accountable-for-salmon-decline](https://nwtreatytribes.org/holding-habitat-impacts-accountable-for-salmon-decline).
- 86 Frank Jr., Billy. "Hatcheries Aren't Habitat." *Northwest Treaty Tribes, Northwest Indian Fisheries Commission*, 8 June 2004, [nwtreatytribes.org/hatcheries-arent-habitat](https://nwtreatytribes.org/hatcheries-arent-habitat).
- 87 Flaccus, Gillian and Associated Press. "Pacific Northwest Tribes: Remove Columbia River Dams." *The Spokesman-Review* [Spokane, WA], 14 Oct. 2019, [www.spokesman.com/stories/2019/oct/14/pacific-northwest-tribes-remove-columbia-river-dam](http://www.spokesman.com/stories/2019/oct/14/pacific-northwest-tribes-remove-columbia-river-dam).
- 88 Loomis, Lorraine. "Tribes Team Up with State on Harbor Seal Survey." *Northwest Treaty Tribes, Northwest Indian Fisheries Commission*, 2 Sept. 2020, [nwtreatytribes.org/tribes-team-up-with-state-on-harbor-seal-survey](https://nwtreatytribes.org/tribes-team-up-with-state-on-harbor-seal-survey).
- 89 Loomis, Lorraine. "Habitat Key for Salmon and Orcas." *Northwest Treaty Tribes, Northwest Indian Fisheries Commission*, 5 Apr. 2018, [nwtreatytribes.org/being-frank-habitat-key-for-salmon-and-orcas](https://nwtreatytribes.org/being-frank-habitat-key-for-salmon-and-orcas).
- 90 Frank Jr., Billy. "Tribal Fisheries Respond To Endangered Species Act." *Northwest Treaty Tribes, Northwest Indian Fisheries*

Commission, 15 July 1998, [nwtreatytribes.org/tribal-fisheries-respond-to-endangered-species-act](http://nwtreatytribes.org/tribal-fisheries-respond-to-endangered-species-act).

91 Loomis, Lorraine. "To Help Orcas, Eat Chinook." *Northwest Treaty Tribes*, Northwest Indian Fisheries Commission, 2 Oct. 2018, [nwtreatytribes.org/being-frank-to-help-orcas-eat-chinook](http://nwtreatytribes.org/being-frank-to-help-orcas-eat-chinook).

92 Loomis, Lorraine. "Habitat Key for Salmon and Orcas." *Northwest Treaty Tribes*, Northwest Indian Fisheries Commission, 5 Apr. 2018, [nwtreatytribes.org/being-frank-habitat-key-for-salmon-and-orcas](http://nwtreatytribes.org/being-frank-habitat-key-for-salmon-and-orcas).

93 Northwest Treaty Tribes. "About Us." Northwest Treaty Tribes, Northwest Indian Fisheries Commission, 12 Aug. 2020, [nwtreatytribes.org/about-us](http://nwtreatytribes.org/about-us).

94 Loomis, Lorraine. "Message from Chairman." *Northwest Indian Fisheries Commission*, 17 Sept. 2014, [nwifc.org/about-us/message-from-chairman](http://nwifc.org/about-us/message-from-chairman).

95 Northwest Treaty Tribes. "State to Adjust Fish Consumption Standards." *Northwest Treaty Tribes*, Northwest Indian Fisheries Commission, 7 Nov. 2011, [nwtreatytribes.org/state-to-adjust-fish-consumption-standards](http://nwtreatytribes.org/state-to-adjust-fish-consumption-standards).

96 Northwest Treaty Tribes. "State to Adjust Fish Consumption Standards." *Northwest Treaty Tribes*, Northwest Indian Fisheries Commission, 7 Nov. 2011, [nwtreatytribes.org/state-to-adjust-fish-consumption-standards](http://nwtreatytribes.org/state-to-adjust-fish-consumption-standards).

97 Minke-Martin, Vanessa, et al. "For Taxpayers, Hatcheries Are a Poor Investment." *Vancouver Island Free Daily*, Vancouver Island Free Daily and Black Press Group Ltd., 20 June 2020, [www.vancouverislandfreedaily.com/opinion/opinion-for-taxpayers-hatcheries-are-a-poor-investment](http://www.vancouverislandfreedaily.com/opinion/opinion-for-taxpayers-hatcheries-are-a-poor-investment).

98 Speir, Cameron, et al. "Uncertainty, Irreversibility and the Optimal Timing of Large-Scale Investments in Protected Species Habitat Restoration." *Frontiers in Marine Science*, vol. 2, 2015. Crossref, [doi:10.3389/fmars.2015.00101](https://doi.org/10.3389/fmars.2015.00101).

99 KING 5 Staff. "Swift Online Backlash after Boaters Spotted Harassing Orcas in Tacoma Narrows." KING 5, 20 July 2020, [www.king5.com/article/tech/science/environment/orcas-boaters-spotted-harassing-orcas-in-tacoma-narrows](http://www.king5.com/article/tech/science/environment/orcas-boaters-spotted-harassing-orcas-in-tacoma-narrows).

100 Earth Economics. "The Economic Impact of Killer Whales in the Salish Sea." *SeaDoc Society*, 4 Feb. 2019, [www.seadocsociety.org/blog/the-economic-impact-of-killer-whales-in-the-salish-sea](http://www.seadocsociety.org/blog/the-economic-impact-of-killer-whales-in-the-salish-sea).

101 Mapes, Lynda. "Gov. Jay Inslee Wants \$1.1B to Help Save Puget Sound's Critically Endangered Orcas." *The Seattle Times* [Seattle, WA], 13 Dec. 2019, [www.seattletimes.com/seattle-news/environment/gov-jay-inslee-wants-1-1-billion-to-help-save-puget-sounds-critically-endangered-orcas](http://www.seattletimes.com/seattle-news/environment/gov-jay-inslee-wants-1-1-billion-to-help-save-puget-sounds-critically-endangered-orcas).

102 Pacific Whale Watch Association. "Education and Conservation." *The Pacific Whale Watch*

Association, 2021, [www.pacificwhalewatchassociation.com](http://www.pacificwhalewatchassociation.com).

103 Soberg, Brett. "A Dam Good Idea." Eagle Wing Tours, 7 Apr. 2016, [www.eaglewingtours.com/articles/a-dam-good-idea](http://www.eaglewingtours.com/articles/a-dam-good-idea).

104 Kershaw, Francine, and Giulia Good Stefani. "Protecting Orca by Restoring Salmon." *Save Our Wild Salmon*, 22 Sept. 2017, [www.wildsalmon.org/tag/protecting-orca.html](http://www.wildsalmon.org/tag/protecting-orca.html).

105 Watson, Julie. "Commercial Whale Watching-Briefing." *Washington Department of Fish and Wildlife*, 15 Dec. 2020, [wdfw.wa.gov/sites/default/files/2020-12/december\\_15\\_packet.pdf](http://wdfw.wa.gov/sites/default/files/2020-12/december_15_packet.pdf).

106 Wieland Shields, Monika, and Cindy Hansen. "Whale Watching Isn't Killing Orcas — a Lack of Salmon Is." *Crosscut*, Cascade Public Media, 4 Dec. 2020, [crosscut.com/opinion/2020/12/whale-watching-isnt-killing-orcas-lack-salmon](http://crosscut.com/opinion/2020/12/whale-watching-isnt-killing-orcas-lack-salmon).

107 "Frequently Asked Questions." *Pacific Whale Watch Association*, 2021, [www.pacificwhalewatchassociation.com/faq](http://www.pacificwhalewatchassociation.com/faq).

108 "Media." *Pacific Whale Watch Association*, 2021, [www.pacificwhalewatchassociation.com/media](http://www.pacificwhalewatchassociation.com/media).

109 Wieland Shields, Monika, and Cindy Hansen. "Whale Watching Isn't Killing Orcas — a Lack of Salmon Is." *Crosscut*, Cascade Public Media, 4 Dec. 2020, [crosscut.com/opinion/2020/12/whale-watching-isnt-killing-orcas-lack-salmon](http://crosscut.com/opinion/2020/12/whale-watching-isnt-killing-orcas-lack-salmon).

110 Van Deren, Matt, et al. "The Whales in Our Waters: The Economic Benefits of Whale Watching in San Juan County." *Earth Economics*, 2019, [static1.squarespace.com/static/561dc6e4b039470e9afc00/t/5c48a1e442bfc14525263268/1548264128844/SRKW\\_EarthEconomics\\_Jan2019-Digital.pdf](http://static1.squarespace.com/static/561dc6e4b039470e9afc00/t/5c48a1e442bfc14525263268/1548264128844/SRKW_EarthEconomics_Jan2019-Digital.pdf).

111 Van Deren, Matt, et al. "The Whales in Our Waters: The Economic Benefits of Whale Watching in San Juan County." *Earth Economics*, 2019, [static1.squarespace.com/static/561dc6e4b039470e9afc00/t/5c48a1e442bfc14525263268/1548264128844/SRKW\\_EarthEconomics\\_Jan2019-Digital.pdf](http://static1.squarespace.com/static/561dc6e4b039470e9afc00/t/5c48a1e442bfc14525263268/1548264128844/SRKW_EarthEconomics_Jan2019-Digital.pdf).





