NWAC RRT 10 Southern Resident Killer Whale Deterrence Task Force Final Report

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List of Acronyms

AHD – Acoustic Harassment Device

EPA – Environmental Protection Agency

ESA – Endangered Species Act

F/V – Fishing Vessel

IOSA – Islands Oil Spill Association

NCP –National Contingency Plan

NMFS – National Marine Fisheries Service

NOAA – National Oceanic and Atmospheric Association

NWAC – Northwest Area Committee

NWACP – Northwest Area Contingency Plan

NWFSC – Northwest Fisheries Science Center

OPA – Oil Pollution Act

OSLTF – Oil Spill Liability Trust Fund

PRC – Primary Response Contractor

PWWA – Pacific Whale Watch Association

SRKW – Southern Resident Killer Whale

USCG – US Coast Guard

VOO – Vessel Of Opportunity

WDFW – Washington Department of Fish and Wildlife

WRRL – Worldwide Response Resource List

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Executive Summary

Southern Resident killer whales (SRKW) and numerous other toothed and baleen whale species seasonally reside in the Salish Sea, an area transected with busy international shipping lanes, commercial fishing areas, and is popular with recreational boaters. Exposure to oil spills has been identified as a significant threat to killer whales. In light of the known impacts of an oil spill on killer whales an emergency response killer whale hazing implementation plan was developed by NOAA and incorporated into the Northwest Area Contingency Plan (NWACP). At present there are three pre-approved deterrence methods to minimize exposure to a spill for killer whales described in Section 9310 (Northwest Wildlife Response Plan) of the NWACP including use of oikomi pipes, underwater firecrackers, and low flying helicopters. The protocols established by NOAA and WDFW for killer whale deterrence operations were implemented for the first time in 2022 as part of the Fishing Vessel (F/V) Aleutian Isle response incident. This incident resulted in the creation of the Northwest Area Committee Regional Response Team 10 Whale Deterrence Task Force. The goals of the Task Force were to review current whale deterrence response planning and identify responders throughout the SRKW critical habitat in order to provide updates to the NWACP and to identify funding mechanisms to support whale deterrence activities. Most of the Task Force's work was focused on a two-day workshop at the University of Washington's Friday Harbor Laboratories in December 2023. This report provides a summary of the workshop discussions, recommendations, and updates to appropriate oil spill response plans in the NWACP for Sections 9310.

Workshop Summary

The whale deterrence workshop built upon the current state of knowledge in whale deterrence and identified continued gaps and challenges. Task Force members, experts in whale behavior, whale deterrence, oiled wildlife response, and oil spill response participated in the workshop and shared:

- A review of the Incident Command System structure, wildlife and whale deterrence response.
- A review of the current NOAA Southern Resident killer whale authorized hazing tools and implementation plans.
- A review of the whale deterrence activities during the F/V Aleutian Isle incident.
- A summary of the acoustic analysis of oikomi pipe use during the F/V Aleutian Isle response.
- A review of preparation requirements for deterrence training, drills, equipment staging and use
- An overview of the funding structure for response needs with a discussion around how to provide funding to ensure that responders are compensated during incidents where vessels or spill sources are unknown.

Workshop participants also identified potential primary response teams, locations of whale response assets (teams and equipment), and where there are geographical and temporal gaps in response assets. Additional challenges and gaps were also identified and where possible solutions were proposed to address current challenges and gaps.

Whale Deterrence Tools

The wildlife response plan (Section 9310) of the NWACP contains information related to whale monitoring and deterrence. This plan describes how killer whale deterrence may be implemented using the three pre-authorized tools - oikomi pipes, underwater firecrackers or seal bombs, or use of helicopters. These tools have been rated on efficacy, time to deploy, time to train, and availability of

equipment. There are also other hazing methods and tools that could be considered in the event of a spill, but these may only be used with approval from NOAA headquarters. Reconnaissance and monitoring are also a vital part of the whale deterrence operations. This report provides a summary of the advantages and limitations of the pre-approved authorized tools and alternate tools, including acoustic and non-acoustic tools. All deterrence tools, whether pre-authorized or alternate tools should:

- Not be harmful to whales, or other wildlife in the area deployed.
- Motivate whales to move away from the stimulus.
- Be capable of rapid deployment and be maintained on station between the whales and an oil-impacted area.
- Be deployable to form a barrier to whale movement, either physical or acoustic.
- Acoustic tools should transmit within the target species specific hearing range and have controllable intensity and monitoring to avoid hearing damage.
- Be unlikely to cause habituation.
- Be straightforward to train response teams with.
- Be readily available, either stored with other whale deterrence tool caches, or transported to a location quickly.

For all methods, workshop participants acknowledged that it is unknown how fast killer whales may habituate to the signal rendering it ineffective, numerous environmental and whale related variables were also noted to potentially impact the efficacy of deterrence methods. Whale and environmental variables that could impact deterrence efficacy are also summarized in this report.

Training, Drill, and Equipment Needs

The need for training and drills has been identified as a priority for whale deterrence operations by WDFW and other agencies, including the Whale Deterrence Task Force. WDFW has identified potential "choke points" where deployment of specific deterrence tools could occur at predetermined locations, similar to pre-authorized boom deployment as documented in Geographic Response Plans (GRPs). More work is required to determine how whale transit behavior and environmental factors such as current and tidal conditions, depth, and distance would influence deterrence attempts. But whale deterrence response preparedness will benefit from drills that allow the deployment of whale response assets/teams within the context of an incident.

Response

Whale deterrence response resources include personnel, vessels, deterrence equipment, acoustic monitoring stations, and sighting networks. The locations of response assets were identified during the workshop and through subsequent research. Primary organizations or individuals identified as potential responders capable of providing on-water whale deterrence activities include known research organizations, non-profits, and agencies with expertise in whale behavior. Thirty-nine potential response assets were identified to be distributed throughout the inland waters of WA State, though most are concentrated in the northern straits around the San Juan Islands. These included organizations that could provide potential on-water Tier 1 deterrence teams (21), caches of oikomi pipes (2), Tier 2 on-water reconnaissance organizations such as the Pacific Whale Watch Association (2), Tier 3 land based sighting networks (4) and hydrophone sites (11).

Spatial gaps for deterrence asset availability include the Olympic Peninsula west of Dungeness Spit with only the Makah Tribe identified out at Neah Bay and the USCG at Port Angeles, with localized gaps around Anacortes and Whidbey Island. Response equipment caches were identified as being needed in high-risk locations, and additional high-risk locations should be identified. Temporal gaps for deterrence resources are mostly related to weather conditions and the seasonal availability of many organizations to provide response assets. All information related to response assets requires regular updating, and tracking that can be achieved through the Worldwide Response Resource List (WRRL). Workshop participants identified additional gaps and challenges related to whale deterrence. These included gaps and challenges with communication systems, procedural challenges, weather and field conditions, and equipment distribution, use, and training challenges.

Funding Structure

One of the key goals of the Whale Deterrence Task Force was to identify funding mechanisms to ensure response teams are adequately trained, equipped, and compensated. At the federal level funding is available through the Oil Spill Liability Trust Fund (OSLTF) and the Comprehensive Environmental Response Compensation and Liability Account Fund (CERCLA). The OSLTF is not able to cover the costs of preparedness efforts, and while it is able to reimburse for the costs incurred by organizations that are involved with a response the reimbursement process is often lengthy placing additional burdens on small (especially non-profit) organizations. Workshop participants discussed what a sustainable funding model should look like to ensure that response teams are trained and ready to respond. This need for sustainable funding is pertinent to all wildlife response but concerns were raised regarding the shortcomings of the current funding structure that precludes support for preparedness and equipment.

Despite the diverse input from workshop participants no clear funding mechanism was identified to support whale deterrence operations, especially those that can't be funded through the federal or state spill response funds. The WDFW oil spill response program received a grant in 2024 to provide training and drill opportunities for a limited time. This grant also provides for conducting further acoustic studies on oikomi pipe use; however, this is not a long-term solution.

Recommendations

The workshop produced a list of 35 recommendations that related to response assets (teams and equipment), training and drills, response structure and communications, deterrence methods, research needs and funding. The top five recommendations were:

1 Create and train dedicated primary responders to be able to deploy during a spill response event.
2 Research efficacy and usability of alternative deterrence methods – e.g., Hukilau surface deterrence, Acoustic Harassment Devices, Genus-wave device, Lubell speakers and playbacks.
3 Identify potential primary responder teams in advance, including a list of whale experts in the region that can be approved by NOAA to lead deterrence operations.
4 Identify sustainable funding opportunities to ensure regular training and drills for primary response teams.
5 Identify opportunities to have USCG fill geographical gaps in the short-term during an incident response.

These recommendations were identified as either short- or long-term actions and fell into the broad categories of 1: Identifying and training primary response assets, 2: Research into the efficacy of deterrence tools, and 3: Securing funding to ensure response assets are trained and response ready and compensated for training and response activities. Whale deterrence response involves a combination of reconnaissance and monitoring, and deterrence activities. A diversity of organizations is needed to provide response due their varied type, capacity, and expertise, to capture this diversity and formalize whale deterrence operations an additional recommendation was the creation of a tiered system of responders similar to that used in whale disentanglement response.

Parallel to the SRKW Task Force's efforts a series of updates were made to the NWACP regarding Sections 9310 (Northwest Wildlife Response Plan), 9311 (Wildlife Deterrence (hazing) Resources), and 9312 (Oil Spill Marine Mammal Resources). Concurrent to the Task Force efforts the NWACP Section 9310 was updated and Sections 9311 and 9312 were incorporated into the appendices of 9310. The Task Force subsequently recommended that the content of these appendixes' sections be moved to the Ecology Oil Spills 101 website. The Task Force has provided updated lists of potential response assets to WDFW for confirmation and inclusion on spills101.org.

1.0 Introduction

The Salish Sea is one of the world's largest and most biologically rich inland seas supporting numerous species of mammals, birds, fish, and invertebrates (Gaydos and Pearson, 2011). This diverse fauna is in turn vital to the regional economy, culture, and quality of life (Khangaonkar et al., 2021). The region also includes busy international shipping lanes providing access to the Port of Vancouver and the Ports of Seattle and Tacoma as well as other ports, terminals, and refineries in Washington State. These ocean-going vessels include tanker, cargo, bulk carriers, and cruise ships. Ferries and government vessels including Coast Guard and Navy are also common in the region. In addition to shipping and commercial traffic there are oil spill risks associated with smaller vessels including commercial tugs, fishing vessels, wildlife viewing boats, and numerous recreational boats ranging in size from small skiffs to large sailing and motor cruising boats (summarized in Sobocinski, 2021). These busy waterways are also designated Southern Resident killer whale critical habitat (NOAA, 2008).

Southern Resident killer whales (SRKW) and numerous other toothed and baleen whale species seasonally reside in the Salish Sea. Exposure to oil spills has been identified as a significant threat to killer whales (NOAA, 2008, Matkin et al., 2008). Both SRKW and Bigg's killer whales regularly occupy the inland waters of the Salish Sea and are at heightened risk due to the overlap of shipping and boating activity with important foraging areas. The SRKW's small population size and social structure puts this endangered species at risk for a catastrophic event that could affect the whole population (NOAA, 2008). Following a spill the whales (and other marine mammals) may initially be exposed to hazardous substances through inhalation, contact, and ingestion as volatile components evaporate (Harris et al., 2011; Jarvela Rosenberger et al., 2017). After the Exxon Valdez ran aground in Alaska in 1989, two pods of killer whales were witnessed swimming through the spill in Prince William Sound. Matkin et al., (2008) found that the AB Pod of fish-eating killer whales declined by a third, with a yet more significant decline for the mammal-eating AT1 Group. According to NOAA[1] these killer whale populations have not yet recovered, although the AB pod is showing signs of a slow recovery[2].

In light of the known impacts of an oil spill on killer whales an emergency response killer whale hazing implementation plan was developed by NOAA (2014, Appendix 1) and incorporated into the Northwest Area Contingency Plan (NWACP). At present there are three pre-approved deterrence methods to minimize exposure to a spill for killer whales described in Section 9310 of the NWACP including use of oikomi pipes, underwater firecrackers, and low flying helicopters. The protocols established by NOAA and WDFW for killer whale deterrence operations were implemented in August and September 2022 as part of the Fishing Vessel (F/V) Aleutian Isle response incident. The F/V Aleutian Isle incident highlighted several challenges related to implementation of killer whale deterrence. As a result, a whale deterrence Task Force was created by the Northwest Area Committee Regional Response Team 10 to investigate improvements for response during incidents, and funding sources for training, and to provide updates to the NWACP.

The Task Force sought membership from organizations, agencies, and individuals engaged in or with an interest in oil spill response and wildlife and whale deterrence (Appendix 2). The specific goals for the Task Force are detailed in Section 1.1.

[1] https://blog.response.restoration.noaa.gov/more-two-decades-later-have-killer-whales-recovered-exxon-valdez-oil-spill

[2] https://evostc.state.ak.us/status-of-restoration/killer-whales/

This report represents a summary of the Task Force's efforts. This report provides:

- Summary of the whale deterrence workshop hosted at the University of Washington's Friday Harbor Laboratories in December 2023,
- Maps displaying locations of whale deterrence response assets throughout in the greater Puget Sound waters of Washington State,
- Recommendations that resulted from the two-day workshop and recommended updates to the NWACP.

Additionally, this report aims to begin discussion around the efficacy of current and alternative deterrence tools and approaches and identify areas for future research.

1.1 Task Force Goals

The Task Force was established with two core goals. First to review current whale deterrence response planning and identify responders throughout the Southern Resident killer whale's critical habitat in order to provide updates to the NWACP and second, to identify funding mechanisms to support whale deterrence activities.

Specifically, the goals of this Task Force were:

1) To review current authorized whale deterrence plans and identify what and where response assets are located in the inland waters of Washington State.
2) To explore the efficacy of current and alternative deterrence tools and actions.
3) Identify funding mechanisms to ensure response teams are adequately trained, equipped, and compensated.
4) Identify and provide updates for the NWACP and for section 9310 Wildlife Response Plan, and additional oil spill marine mammal resources.

2.0 Workshop summary

The Task Force hosted a two-day workshop at the University of Washington's Friday Harbor Laboratories in December 2023. In addition to Task Force members, experts in whale behavior, whale deterrence, oiled wildlife response, and oil spill response participated in the workshop. The goal of the workshop was to bring subject area experts together to build upon the current state of knowledge in whale deterrence. A full list of attendees is available in Appendix 2.

The first whale deterrence workshop was hosted by NOAA and the Sea Doc Society in 2007 (Gaydos, 2007). The 2007 workshop reviewed available deterrence tools and provided recommendations to enable the SRKW oil spill deterrence plan to be created. It also laid the groundwork for current efforts and provides a platform for the current Task Force to build off. The Task Force has been able to review whale deterrence plans within the context of the current best available science related to the whales. Whale-related, and environmental variables were also reviewed to understand how they may impact the efficacy of the established plans and available tools. The workshop was structured around a combination of formal presentations, facilitated discussions, and break-out sessions; a full agenda is available in Appendix 3. Presentations included:

- A review of the Incident Command System structure, wildlife and whale deterrence response by Don Noviello (*Oil Spill Team Section Lead, WDFW*).
- A review of the current NOAA Southern Resident killer whale authorized hazing tools and implementation plans by Hanna Miller (*Natural Resource Management Specialist, NOAA Fisheries*).
- A review of the whale deterrence activities during the F/V Aleutian Isle incident by Hanna Miller,
- A summary of the acoustic analysis of oikomi pipe use during the F/V Aleutian Isle response by Dr. Jason Wood (*Acoustician and Managing Director*, *SMRU Consulting*).
- A review of preparation requirements for deterrence training, drills, and equipment staging and use by Montana McLeod (*Oil Spill Planning and Response Specialist, WDFW*).
- An overview of the funding structure for response needs with a discussion around how to provide funding to ensure that responders are compensated during incidents where vessels or spill sources are unknown. This presentation and discussion was led by Matt Bissel (*Preparedness Section Manager in the Spill Prevention, Preparedness, and Response Program at Washington State Department of Ecology*) and LCDR Brian Dykens (*US Coast Guard*).

The first day also engaged workshop participants in a breakout session that asked groups to:

1. Review potential response teams and their locations with a goal to identify where response teams were located, where equipment is currently located and where there are gaps.
2. Identify challenges and gaps in response plans and suggest solutions.
3. Identifying the temporal and spatial gaps for deterrence deployment.

The second day of the workshop focused on discussions surrounding available deterrence tools and factors that may influence the efficacy of deterrence actions. Dr. David Bain (*Orca Conservancy*), Paul Cottrell (*Marine Mammal Response, Department of Fisheries and Oceans, Canada*), Jeff Foster (*Whale Sanctuary Project*), and Jared Towers (*Bay Cetology*) shared their experiences with deterrence tools and approaches setting the scene for broader discussions around how whale behavior and environmental variables may influence deterrence actions and the efficacy of different tools and approaches, including

alternative tools. Workshop participants produced a list of recommendations that focused on deterrence plans, authorized deterrence tools, and research needs related to understanding the effectiveness of current and alternative deterrence tools. The products of this workshop include this report with recommendations and findings and updates to appropriate oil spill response plans in the NWACP for Sections 9310, the Wildlife Response Plan.

2.1 Summary of Wildlife in Oil Spill Response Planning

The National Oil and Hazardous Substances Pollution Contingency Plan, also known as the National Contingency Plan (NCP), is the U.S. federal government's outline for responding to oil spills and hazardous substance releases[3]. Following the NCP, Area Committee's may create Area Contingency Plans, such as the NWACP, that outline localized response structures and specific plans. These plans involve multiple agencies with many priorities during an oil spill response, including the protection of wildlife. NWACP section 9310 specifically address wildlife and marine mammal response. This plan describes the framework through which actions to protect wildlife are implemented during an oil spill. Wildlife response is coordinated through the Wildlife Branch of the Operations Section in the formal Incident Command System (ICS). ICS is a standardized approach to incident management that enables a coordinated response among various jurisdictions and agencies and establishes common processes for incident-level planning and resource management. (ICS, NWACP Section 2000). The ICS Wildlife Branch is able to expand its scope depending on the incident to add leads to groups and create a new group dedicated to whale deterrence if needed (NWACP Section 9310, Appendix B). Don Noviello (*WDFW*) provided an overview of ICS and highlighted key tasks of the Wildlife Branch (WB) that include assessing the impact and ongoing risk to wildlife, coordinating teams for reconnaissance, search and capture (generally birds, pinnipeds, and small cetaceans in marine incidents), deterrence, field stabilization, and primary care rehabilitation of impacted wildlife. For whales, the WB's core tasks involve coordinating with NOAA to establish monitoring of whale species in or near the impacted area, tracking their movements, and coordinating reconnaissance with on-scene response teams to implement hazing operations if required. A review of the Wildlife Branch's role with regard to whales is also provided in Gaydos (2007).

The WB follows dedicated protocols that have been established to minimize impacts from a spill on killer whales. These dedicated response protocols have been established by NOAA and WDFW and incorporated into the NWACP, with the intent of preventing killer whales from entering or remaining in waters contaminated by an oil spill. These protocols were developed following a workshop hosted by the SeaDoc Society and NOAA in 2007 that sought to determine what tools would be most effective and available to deter killer whales (Gaydos, 2007). The protocols were further updated in 2014 (NOAA, 2014). The plans were put into action for the first time after the fishing vessel, F/V Aleutian Isle sank off the west side of San Juan Island, on August 13, 2022. Despite these plans there remain gaps in equipment availability as well as an understanding of the efficacy of whale deterrence methods, especially with regard to a highly at-risk species such as the SRKW. Factors that may impact the efficacy of deterrence tools and protocols are reviewed in Section 4.0.

[3] https://www.epa.gov/emergency-response/national-oil-and-hazardous-substances-pollution-contingency-plan-ncp-overview#:~:text=The%20National%20Oil%20and%20Hazardous,spills%20and%20hazardous%20substance%20releases.

2.2 Review of F/V Aleutian Isle Incident

Hanna Miller (*NOAA Fisheries*) provided an overview of the F/V Aleutian Isle Incident response with regard to the implementation of the killer whale hazing plan. The F/V Aleutian Isle, a 58 ft purse seine fishing vessel sank off the west side of San Juan Island around 2pm on August 13, 2022, with an estimated 2,500 gallons of diesel and 1,400 ft of seine netting on board. By 5pm the same day a 1.75-mile-long sheen was visible on the water's surface. Around this time the endangered Southern Resident killer whales (SRKW) were spotted off Victoria in the Strait of Juan de Fuca headed east towards San Juan Island. The whales arrived off the southwest end of San Juan Island that evening and eventually headed north towards the impacted area. However, the whales turned around and headed south again before reaching the spill area. The US Coast Guard activated a Unified Command on the morning of August 14th to lead the response; because of the proximity to the Canadian border, the response included Canadian agencies.

Due to their proximity and endangered status, the SRKW were a primary focus of the spill response from the start. Implementation of the killer whale hazing plan was discussed between NOAA and WDFW and local response teams were assembled. Teams included government employees, scientific researchers, and NGOs. The Wildlife Branch coordinated the distribution of oikomi pipes between the response teams and the USCG. They also mobilized the assistance of local sighting networks and researchers (including Orca Network, Pacific Whale Watch Association, SMRU Consulting, Orcasound and the Canadian Department of Fisheries and Oceans, DFO) to help monitor whale sightings and particularly the movements of SRKW. Over the course of the response two deterrence drills took place, the first on August 16 involved six vessels to practice deployment and use of the oikomi pipes and practice alignments, the second drill occurred on August 25 and was coordinated in an international effort with the Canadians. The later drill allowed teams to try different pipe striking patterns, attempt to respond to simulated whale movements, and importantly also allowed an opportunity for acoustic measurements to be taken (see section 2.2.1).

While there was ultimately no need to implement the hazing plan for SRKW during the Aleutian Isle response, the SRKW monitoring was critical. However, the Wildlife Branch did activate the deterrence response teams on three occasions, once for SRKW on August 28, but the whales turned around prior to reaching the deterrence location, and on two occasions when two Biggs killer whales were identified approaching the impacted area. On September 18, a day after the Aleutian Isle had been lifted to the surface and was secured alongside a barge, operations were underway to remove an oily mix of fuel and water from the recovered vessel. These operations resulted in sporadic sheening at the surface. Two males from the T60s were observed traveling towards the barge during these efforts. Three response boats deployed oikomi pipes. The same individual whales were observed swimming near the barge again on September 20, soliciting the Wildlife Branch to initiate another hazing effort with oikomi pipes. On both occasions the whales responded to the pipes with a deep dive, exhibiting vertical avoidance behavior and were not observed swimming through any pockets of sheen.

The Aleutian Isle was finally lifted from the water and onto the salvage barge on September 21 and with it the significant threat to the environment was also removed. This incident was the first Tier 2 incident (requiring regional and/or national resources) for the US Coast Guard Sector Puget Sound in 15 years. It was also the first incident in which the whale hazing plan was implemented since its creation in 2012. The incident resulted in a series of after action hotwashes to review the response, the creation of this

NWAC Task Force, presentations at regional conferences and oil spill related training events, including Transport Canada's Salish Sea Symposium and the 2023 Science of Oil Spills class, as well as sharing information with other regions and countries. There have been internal conversations with the NMFS Marine Mammal Health and Stranding Response Program regarding deterrence operations, how pre-approval should be implemented, and how a Co-investigator (CI) letter can be issued for individuals leading the on-water deterrence operations. ESA Section 7 Consultations have been updated, NOAA is updating their internal NMFS protocols, especially related to response preparedness and communications, including media releases. Conversations have also been initiated with welders about pipe variations and related costs, including what materials could be used and different pipe lengths. Another tool that has come online since the December workshop is the activation of a dedicated Cetacean Desk within USCG Sector Puget Sound[4]. Modeled on Canada's Marine Mammal Desk the USCG will help collect sightings from professional mariners through the Vessel Traffic Service (VTS) and input these into the Whale Report Alert System (WRAS).

2.2.1 Summary of the acoustic analysis of oikomi pipe use during the Aleutian Isle response.

SMRU Consulting presented their analysis of acoustic recordings collected during the August 25 deterrence drill. Six response vessels took part in the drill that involved the response vessels banging pipes in a line at the mouth of Open Bay off Henry Island. Recordings were taken with a hydrophone at 10 m and 30 m and analyzed in PAMGuard and Matlab. In total 443 strikes were analyzed. The analysis revealed that there is significant variability in the range of the sound created by the pipes. SMRU Consulting found a 10-20 dB variance in sound levels but noted that experiments with strike technique will be needed to understand what is driving this variance. The sound produced was well below any Level A acoustic thresholds, and the Level B acoustic threshold (160 dB rms) was typically met at around 10 m. More details on this analysis and the results are available in Tabbutt and Wood (2024).

There was some discussion around this presentation, Dr. Brad Hanson (*NWFSC, NMFS*) highlighted the human limitations related to position in the boat, and how quickly a person might tire from banging on a pipe. Hanson also noted that the same person doesn't consistently produce the same noise, begging the question '*is there an optimal banging duration?*'. This led to further discussion among participants regarding sources in sound variability and effect of distance, as well as the need to experiment with strike technique or position to improve guidance of how to most effectively use oikomi pipes. There was also discussion about the duration of banging and the possibility of reproducing a similar sound using underwater speakers. More on the use of underwater speakers as a deterrence tool is available in section 2.3.2.

2.3 Review of Deterrence Tools

The wildlife response plan (Section 9310) of the NWACP contains information related to whale monitoring and deterrence. This plan describes how killer whale deterrence may be implemented using the three pre-authorized tools - oikomi pipes, underwater firecrackers or seal bombs, or use of helicopters. These tools have been rated on efficacy, time to deploy, time to train, and availability of

[4] https://www.pacificarea.uscg.mil/Our-Organization/District-13/Units/Sector-Puget-Sound/VTS-Puget-Sound/USCG-Cetacean-Desk/

equipment (Gaydos, 2007). Hanna Miller (*NOAA Fisheries*) provided workshop participants with an overview of killer whale deterrence during oil spills and explained how the three pre-authorized tools were chosen during the 2007 workshop summarized in Gaydos (2007).

In addition to the pre-authorized tools, whale hazing implementation relies on monitoring to determine if whales are in the area and if so where they are, which species and individuals (particularly for the SRKW) they are and their direction of travel. The initiation of deterrence activity will be considered anytime whales are reported within 50 miles of the spill (NWACP Section 9310). The plan identifies Haro Strait and Strait of Georgia to the Canadian border off Point Roberts as an area likely to cause the greatest risk to Southern Resident killer whales May through September, and Admiralty Inlet and central Puget Sound during October through January. However, presence patterns of whales have changed significantly in recent years and the presence of the SRKW in inland waters is less predictable than in the past (Ettinger et al., 2022), suggesting that updates to the Wildlife Response Plan may need to address the deterrence gaps in areas of the SRKW critical habitat that extends beyond the Salish Sea.

Whale deterrence activities are determined by a "Decision Tree" that starts with communications about resources, e.g., what is available and where (Figure 1), this predetermined decision tree allows for a scaled response. The scale of a response should be appropriate to the location of the whales relative to the spill location. As risk from the spill increases (i.e., the whales get closer to the spill location or the type/amount of oil spilled increases) the intensity of deterrence measures activated will increase. Pre-approved deterrents should be considered if the risk of entering oil exceeds the risk of disturbing the whales through hazing operations (NWACP Section 9310), NOAA will make the decision regarding the initiation of whale deterrence actions. The pre-approved hazing methods are covered under a NMFS Marine Mammal Health and Stranding Response Program permit. This permit authorizes 'take' under the ESA and MMPA for specific hazing methods, where a "take" is an action that may cause harm or harassment to a whale. NMFS Headquarters holds this permit, but Co-investigator (CI) letters have been written to Dr. Brad Hanson and the USCG. Additional CI letters may be written for the Killer Whale deterrence lead either before or during a response to facilitate deterrence operations (e.g., this was done for Jeff Foster and Paul Cottrell for the F/V Aleutian Isle response effort in 2022).

Under the NMFS Marine Mammal Health and Stranding Response Program permit the USCG may implement pre-approved hazing methods if there is a high risk of exposure to a spill. There are also other hazing methods and tools that could be considered in the event of a spill, but these may only be used with approval from NOAA headquarters. To help streamline communications during any future spills, NMFS has developed an internal initial actions protocol to help connect the appropriate NMFS staff with oil spill responders and to ensure coverage of activities under the ESA.

The presentation allowed workshop participants to discuss current whale deterrence plans and the importance of working within the ICS structure and with the Wildlife Branch. The value of experienced observers assisting with monitoring and reconnaissance, especially as an immediate action was also highlighted by workshop participants. Another area highlighted as a critical need was for contact lists that are reviewed regularly and updated. Suggestions for improving these resources are covered in section 6.2 of this report. While these are all actions that can improve current deterrence methods there was also recognition of the need to further assess whale hazing methods. WDFW provided a summary of current whale hazing methods but stressed the desire for improvements in current systems that

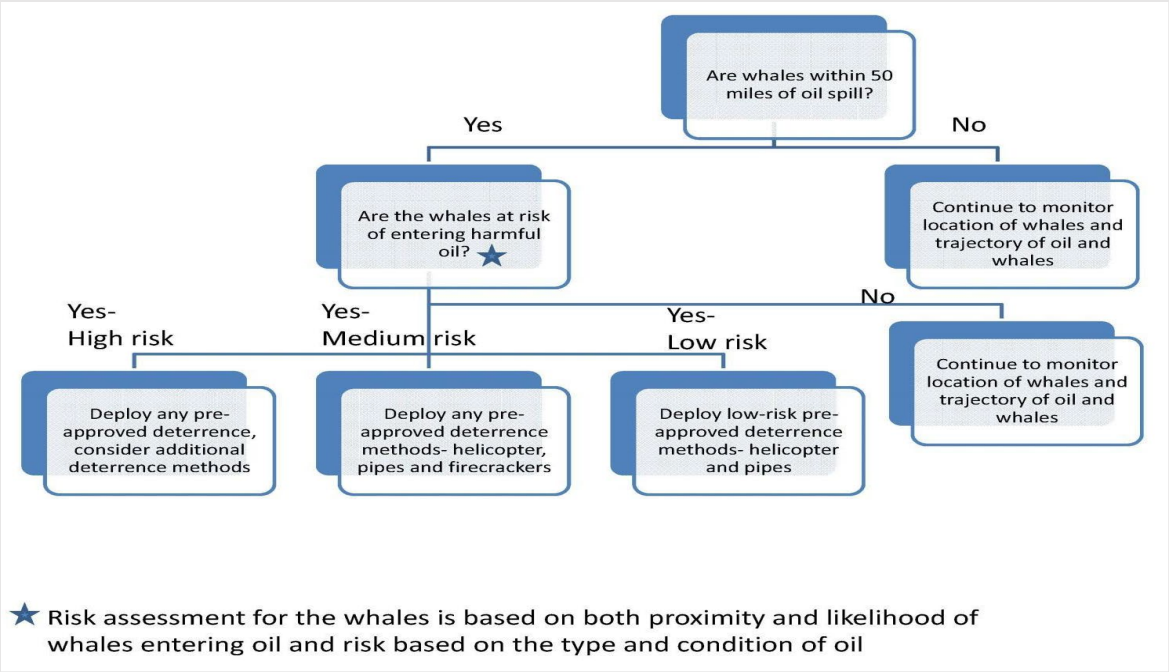

Figure 1. The decision tree for immediate deployment of pre-approved hazing techniques. It is used to assess risk of oil spill to whales and the scale of whale deterrence response, from the NWACP 9310, Appendix C2.

included faster deterrence deployment, improved efficacy of deterrence, e.g., are there new methods, and what can be done to make deterrence more effective in deep water or fast currents. Along with additional research into deterrence systems and associated deployment of systems being identified. Additionally, the need to better understand whale movement patterns and how these patterns may impact deterrence efforts was also expressed. Section 4.0 provides further background on how whale related, and other environmental variables may influence the efficacy of whale deterrence operations.

The following sub-sections provide summaries of the pre-approved deterrence methods and a selection of alternate deterrence methods discussed during the workshop. A summary of the advantages and disadvantages of each method has been provided.

2.3.1 Pre-authorized tools

Whale deterrence operations described in Section 9310 of the Northwest Area Contingency Plan describes three methods that have been pre-approved for use and can be authorized by the Federal-On-Scene-Coordinator (NOAA, 2014) without further consultation with NMFS. These authorized deterrence methods include the use of oikomi pipes, underwater firecrackers (also referred to as seal bombs), and low flying helicopters. Of the three methods pre-approved for use on killer whales in the Northwest, oikomi pipes have the best evidence for efficacy, though this remains limited. This was demonstrated in shallow water in Barnes Lake Alaska in the mid-1990s (Bain, 1995) when a group of stranded killer whales was herded out of a narrow inlet to open water. Oikomi pipes have long been used to herd other small cetaceans during targeted fisheries for food and the capture industry (Brownell et al., 2008). The use of firecrackers is largely untested on killer whales for deterrence purposes, though seal bombs were

used during the aquarium collection captures of the 1970s[5] and are currently being used by sailors in Spain in attempts to scare a select few individual whales away from damaging their boats[6]. have been used to deter pinnipeds at the Hiram M Chittenden Locks in Seattle (NOAA, 1987), and at the Bonneville Dam on the Columbia River (Brown et al., 2009). Likewise, evidence for the efficacy of low-flying (50-100 ft) helicopters is scarce and anecdotal and as such whale experts should be onboard to monitor whale behavior before and during hazing attempts by helicopters (NOAA, 2014). A MH-60S Knighthawk helicopter was observed hovering for 20-30 seconds over a group of killer whales in September 2006 on the west side of San Juan Island. Orca Network reported that the whales appeared to attempt to avoid the helicopter (Helm, 2006). The low altitude component seems to be essential as Fearnbach et. al., (2011) reported using a smaller R44 Clipper Helicopter operating at 750 to 1000 ft to photograph killer whales without causing a change in behavior of the whales. This is consistent with underwater measurement of a Coast Guard HH-65 helicopter taken in November 2015 using a hydrophone at Lime Kiln Lighthouse that indicated received sound pressure attenuated rapidly with helicopter altitude (Veirs and Veirs unpublished report).

There have been several drills testing the use of oikomi pipes and aircraft since the whale deterrence plans were established. In 2013 a joint drill between NOAA, WDFW, and the San Juan Island based Islands Oil Spill Association (IOSA) enabled teams to practice oikomi pipe use; this drill also involved a fixed-wing aircraft (WDFW unpublished Report). The lessons learned from this first drill led to updates to the implementation plan (NOAA, 2014). In 2018 another drill using oikomi pipes occurred near Roche Harbor that allowed vessels to practice different position configurations as well as test pipe rigging on boats (Orcasound, unpublished report). The most recent oikomi pipe drills occurred during the F/V Aleutian Isle response in August 2022.

The ability to conduct drills with the pre-approved tools provides opportunities to improve implementation in the field and the rapidity with which a deterrence response can be implemented. However, it is important to understand the advantages and disadvantages (or limitations) of each method. These are described in Table 1. For all methods, it is unknown how fast killer whales may habituate to the signal rendering it ineffective. Dr. David Bain suspects that killer whales are unlikely to habituate to oikomi pipes. There are also numerous environmental and whale related variables that may impact the efficacy of these hazing methods. These are summarized in Section 4.0.

[5] https://www.seattletimes.com/seattle-news/environment/the-orca-and-the-orca-catcher-how-a-generation-of-killer-whales-was-taken-from-puget-sound/

[6] https://www.theca.org.uk/orcas/interaction-deterrent-library

Table 1. Summary of advantages and disadvantages of the pre-approved whale hazing tools.

Hazing Method	Advantages	Disadvantages
Oikomi Pipes	▪ Known effectiveness on many delphinid species. ▪ Low risk to animals. ▪ Equipment relatively cheap and easy to store for long periods of time. ▪ Little maintenance required. ▪ If response teams available and trained can be deployed quickly in some areas. ▪ Lower safety risk to response teams. ▪ Short training period.	▪ Requires trained and available response teams (minimum of 3 teams; 10 vessels/mile). ▪ Communication requirements between boats, land-based observers, and Wildlife Branch. ▪ Dependent on good sea conditions (<3kts). ▪ May not be effective in all situations and locations. ▪ Most effective for herding killer whales, not keeping them out of a very large area. ▪ Crew fatigue. ▪ Storage and availability of required crew PPE equipment. ▪ Logistical challenges related to needing multiple boats and crews. ⌑ Vessels must be <200 yds apart ⌑ Vessels should be coordinated and moving in a unified fashion ⌑ Two lines of vessels more effective than one.
Helicopters	▪ Could be deployed quickly if USCG aircraft available. ▪ Aircraft available through private vendors. ▪ Potential for whale injury is low – sound levels transmitted into the water are not sufficient to cause hearing injury and no physical contact could occur. ▪ Provide real-time tracking data. ▪ May be used in combination with firecrackers	▪ Requires skilled pilots and crew with experience of conducting low level fly passes over whales (50 ft). ▪ Requires additional trained observers. ▪ High risk for pilots and crew. ▪ Expensive. ▪ Limited by fuel availability and flying conditions. ▪ May increase the risk of a group of whales scattering increasing monitoring and deterrence challenges. ▪ Habituation likely.
Firecrackers (seal bombs)	▪ Known effectiveness during killer whale captures. ▪ Inexpensive. ▪ Quick to deploy. ▪ Small number of personnel required.	▪ Ignition potential; should not be used in areas with highly volatile oil or unknown oil type. ▪ Limited availability of firecrackers. ▪ Challenges with safely storing and handling small explosives on small vessels. ▪ Requires a permit for responders. ▪ USCG and other trustee agencies do not have seal bombs readily available to them. ▪ Logistics of accessing and distributing to USCG crews. ▪ Mixed efficacy, e.g., herding during captures verses preventing depredation. ▪ Risk of bodily or acoustic harm to animals. ▪ Higher risk to responders. ▪ Requires personnel familiar with killer whale behaviors.

2.3.2 Alternative tools

The current whale deterrence plans revolve around the use of three pre-authorized tools. However, additional tools can be considered and used in a deterrence event, if approved through NOAA headquarters. Requests to use non-approved tools must detail why they would be more effective than approved tools along with an assessment of their risk and why their use is warranted. Moreover, these alternative tools may not be readily available to responders adding additional logistical barriers to their use during an emergency event. However, alternative deterrence options that increase the suite of tools available to deter whales from interacting with oil spills should be considered. All deterrence tools, whether pre-authorized or alternate tools should:

- Not be harmful to whales, or other wildlife in the area deployed.
- Motivate whales to move away from the stimulus.
- Be believed to elicit a reliable reaction in the target animal(s).
- Be capable of rapid deployment and be maintained on station between the whales and an oil-impacted area.
- Be deployable to form a barrier to whale movement, either physical or acoustic.
- Acoustic tools should transmit within the target species specific hearing range and have controllable intensity and monitoring to avoid hearing damage.
- Be unlikely to cause habituation.
- Be unlikely to harm other wildlife in the impacted area.
- Be straightforward to train response teams with.
- Be readily available, either stored with other whale deterrence tool caches, or transported to a location quickly.

Potential Acoustic Deterrence Tools

Most alternative tools are acoustic and include acoustic pingers, underwater playbacks, and sonar. Seal-scarers and cracker shells were also discussed by workshop participants as other potential acoustic tools. Seal scarers are similar to oikomi pipes, while cracker shells have been used successfully to deter harbor porpoise and Dall's porpoise in Hubbard Glacier, Yakutat, Alaska. Cracker shells are fired up into the air towards the animals and are considered lower risk to the cetaceans than seal bombs, are lower risk to deterrence responders, don't require responders to be as close to whales as seal bombs do, and they are also relatively easy to deploy (J. Foster, *Pers. Comm.)*, however Gaydos (2007) reported that they have limited success and should not be used when they could be fired into an area with seabirds, which may complicate the ability to get the cracker to explode close enough to the whales.

Acoustic pingers, sonar and underwater playbacks are known to have some success in deterring marine mammals, though their effectiveness for killer whale deterrence during a spill incident is unknown. Acoustic pingers have been developed mostly for the purpose of reducing marine mammal bycatch in drift net fisheries or reducing fishery loss to depredation by marine mammals. Manufactures such as FishTek Marine (anti-depredation pinger) and Future Ocean (Netshield Anti-Depredation Pinger) produce multiple versions of these pingers tailored to the hearing spectrum of different groups of marine mammals. An array of towed acoustic pingers may be practical and easier to deploy than the oikomi pipes. Unfortunately, there is little evidence regarding their efficacy with killer whales. The more intense acoustic harassment devices (AHD) commonly used by fish farms to deter pinniped depredation may be more effective. Morton and Symonds (2002) reported that AHDs used by fish farms in the

Broughton Archipelago, British Columbia caused the displacement of both Northern Resident and Biggs killer whales. However, there are no studies available to indicate whether the direction of the displacement can be controlled with AHDs, which may be important in more open water areas.

Underwater sonar may be a more effective tool for open water areas, especially since the intense signals emitted from Navy mid-range sonar is known to have a disruptive effect on killer whales and other cetacean behavior. However, these systems are very expensive, require specialized personnel to operate and their use could prove more harmful to animals, both the targeted killer whales and other marine mammals that may be in the area. Active sonar signals have been implicated as contributing to cetacean injury, stranding, and even death (Parsons, 2017).

A more promising acoustic deterrence tool is using an underwater playback system. Electronic playback systems, if small and rugged enough, have the potential to be deployed from high-speed capable boats, such as those used by potential whale deterrence response teams, enabling the type of rapid response that may be required to keep whales from an area impacted by oil. Lubell underwater speakers[7] are a good example of such a system and have been successfully deployed in Canada (P. Cottrell *pers comm.*). The Lubell system is commercially available and can be deployed from small vessels for a rapid hazing response. The Lubell 3400 or the Lubell LL9161 are reported to work in the 200 Hz to 20 KHz range with amplitude up to 180 dbm at 1 micro-Pascal @ 1 meter. This volume is comparable to the intensity of oikomi pipes. With the use of recorded stimuli, it is conceivable that an array of underwater speakers could be positioned by one or two vessels and centrally controlled. This would enhance coordination and vastly reduce the number of vessels and people needed to conduct deterrence operations, though this has yet to be tested as a stand-alone deterrence approach. They also offer the potential to play a wide variety of stimuli, e.g., the underwater sounds of oikomi pipes, seal bombs, seal scarers, or even other killer whale calls could be recorded and used for deterrence stimuli. Killer whale calls were successfully used as a part of the September 2023 efforts to free Biggs killer whales from Barnes Lake. In this case play-back of killer whales known to the stranded whales was used as an attractive signal. A system of this type with access to a library of sound signals could also prove more effective with the ability to playback different sound stimuli and reduce concerns surrounding habituation. For the successful implementation of an underwater speaker system a review of existing market available underwater speakers to play signals such as oikomi pipes with enough fidelity to recreate the part of the signal that killer whales react to is needed. Similarly, there have been recent advances in identifying the startle reflex in echolocating odontocetes (Gotz et al. 2020), suggesting that rapid onset of sounds can initiate a startle reflex that may have practical applications in deterrence efforts. A scientific review of the stimuli that measure the characteristics of the stimuli over the entire range of killer whale hearing would be required. Since the exact component of the signal that killer whales find objectionable is unknown, it is important that any system for playback can reproduce the signal over the range of killer whale hearing.

Potential Non-Acoustic Deterrence Tools

Acoustic tools continue to be the most favorable for killer whale deterrence activities. However, there are also non-acoustic deterrence tools available. Workshop participants discussed the use of water cannons, and hukilau. The USCG boats are equipped with water cannons that can be deployed to spray

[7] https://www.lubell.com/

water at the surface towards whales to keep them away from an area. The efficacy of this tool for deterring cetaceans is unknown and is thought to be poor for killer whales but it is a low-risk tool for both the whales and responders, however it should not be used if there is a risk or dispersing seabirds towards or into an oil impacted area. Hukilaus consist of a long surface line interspersed at intervals with weighted, vertical lines (Jourdain et al., 2021, Norris and Dohl, 1980), and have been successfully used to corral spinner dolphins (Norris and Dohl, 1980) and help guide killer whales away from, or to a desired area in three different instances. Figure 2, taken from Jourdain et. al., (2021), shows a hukilau set-up. Hukilaus have been used alone, or in combination with other tools for entrapped killer whales (Jourdain et al., 2021); the most recent use of hukilau was for the two Transient killer whales in Barnes Lake, Alaska in September 2023. The other instances occurred in Bent Harbor, Aristazabal Island, Canada in July 2013, and Lille Skorøya, Karlsøy, Norway in November 2019.

While the alternative deterrence tools discussed in this section could provide additional response capacity, they have their own set of advantages and disadvantages. We have provided a high-level summary of the advantages and disadvantages of the tools discussed in this section in Table 2. Gaydos (2007) also provided an overview of potential deterrence tools, (including the currently authorized and alternate tools considered here). Other tools that the 2007 workshop participants discussed included bubble curtains, vessel traffic, air guns, industrial construction noise, taste and scent deterrents, and fishing nets. Several of these were noted as to not have worked (e.g., pingers, vessel traffic, fishing nets, and cracker shells) or thought to be unlikely to work (e.g., taste and scent deterrents). Participants at the 2007 workshop undertook a voting exercise to determine what tools they felt would be most practical, while still being acceptable. Oikomi pipes scored highest followed by acoustic harassment devices (AHDs) and killer whale calls (Gaydos, 2007). As with the pre-approved hazing methods there are numerous environmental and whale related variables that may impact the efficacy of alternate hazing methods.

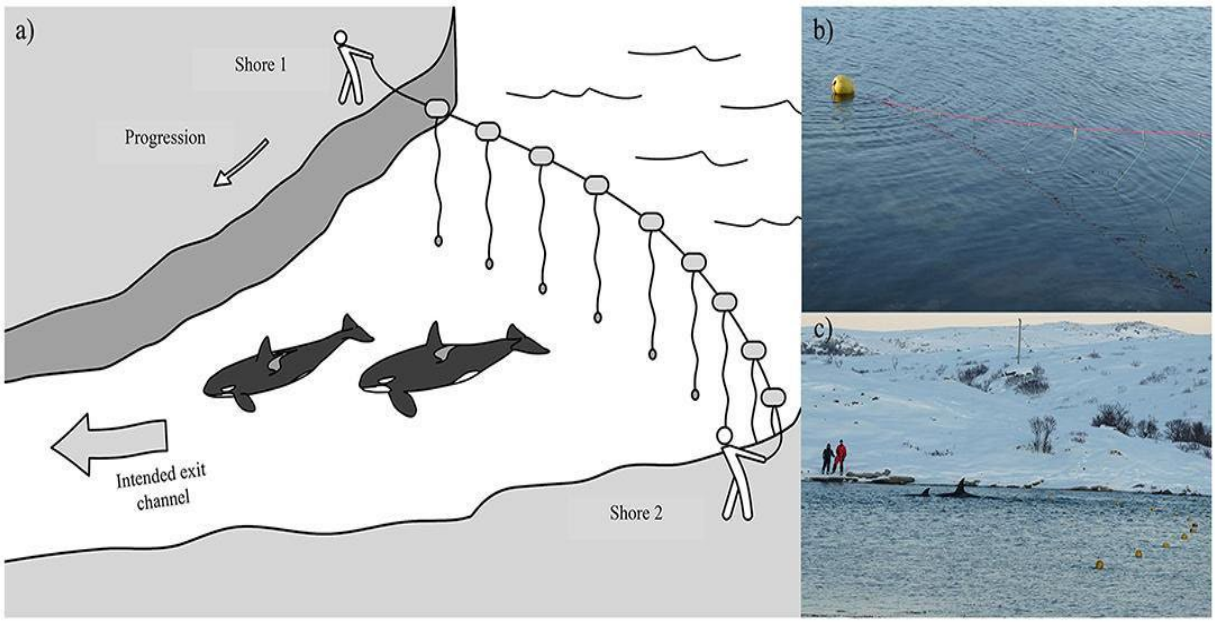

Figure 2. Illustration from Jourdain et al., (2021) that shows how a hukilau can be used to guide whales away from one area to another. The examples shown here and described in Jourdain et al., (2021) involved entrapped animals where the hukilau was used to guide the animals towards an exit channel that led to open water.

Table 2. Summary of advantages and disadvantages of alternative whale hazing tools.

Hazing Method	Advantages	Disadvantages
Water Cannon	▪ Immediately available for use on any USCG vessel. ▪ Low risk to whales. ▪ Low risk to responders. ▪ Non-acoustic.	▪ Efficacy thought to be poor. ▪ Only available on USCG boats, training required. ▪ Only surface. ▪ Some known attraction by killer whales to strong water pressure. ▪ Possible quick habituation. ▪ Potential for unintended dispersal of other wildlife (birds) into oiled area.
Pingers	▪ Potential for whale injury is low – sound levels transmitted into the water are not sufficient to cause hearing injury and no physical contact could occur. ▪ Low risk to responders. ▪ May require fewer response teams.	▪ Not readily available to responders ▪ May require additional training for effective use. ▪ Efficacy as a deterrent unknown but may be poor. ▪ Maintenance needs unknown.
Under Water Playback ***Killer whale calls***	▪ Low risk to whales. ▪ Low risk to responders. ▪ Adaptable if sound library available. ▪ Repertoire of potential stimuli for sound library. ▪ Less crew to operate. ▪ Avoid Habituation. ▪ Volume control and depth control ▪ Low risk to whales. ▪ Low risk to responders. ▪ Has been effectively used. ▪ Low cost if playback equipment available.	▪ Not readily available to responders. ▪ Development costs. ▪ Purchase and maintenance costs. ▪ Maintenance needs unknown. ▪ Training required for use and deployment. ▪ Potential complications in playback received compared to physical banging of oikomi pipes. ▪ Unlikely to be effective when trying to prevent whales from traveling through an open body of water. ▪ Requires knowledge of the whales being targeted and what call types they would most likely respond to & how they would respond. ▪ Requires good recordings of killer whale call types. ▪ Requires availability of a playback system. ▪ Habituation rate could be high limiting effectiveness.
Targeted Acoustic Startle Technology	▪ Species specific. ▪ Lack of habituation. ▪ Play back at depth.	▪ Still being developed. ▪ Sound signal needed to elicit a startle response in killer whales is unknown. ▪ The startle response and magnitude is unknown for killer whales. ▪ Cost unknown.

Hazing Method	Advantages	Disadvantages
		▪ Maintenance needs unknown.
Sonar	▪ Low risk to responders. ▪ May require fewer response teams. ▪ High intensity signals known to have a disruptive effect on killer whale behavior. ▪ Could cover larger area than is currently possible with other tools. ▪ Once acquired, could be readily available for use.	▪ Potential for whale injury is high – sonar is known to cause hearing damage, injury and even death for cetaceans. ▪ Very expensive. ▪ Require specialized skills to operate. ▪ Hard to access and may be classified. ▪ Potential impacts on other species.
Seal Scarers	▪ Similar to oikomi pipes. ▪ Low risk to responders. ▪ Low risk to whales.	▪ Not readily available. ▪ Unknown efficacy for whales.
Cracker Shells	▪ Low risk to whales. ▪ Low risk to responders. ▪ Safer than seal bombs.	▪ Poor public perception. ▪ Requires use of specialized firearm. ▪ Effectiveness may be poor for killer whales.
Hukilau	▪ Low risk to killer whales. ▪ Low risk to responders. ▪ Cost effective. ▪ Easy to store. ▪ Has been used successfully to herd or corral killer whales and other delphinid species.	▪ Entanglement risk for baleen whales. ▪ Limited areas for effective use. ▪ May require being used in combination with other tools, e.g., acoustic deterrents.

Figure 3. Canadian Fisheries and Oceans personnel using oikomi pipes during the Aleutian Isle incident in 2022. Photo: NOAA

2.4 Identified Training, Drill and Equipment Needs

The need for training and drills has been identified as a priority for whale deterrence operations by WDFW and other agencies. Montana McLeod, (*Oil Spill Planning and Response Specialist, WDFW*) provided the workshop with a presentation on the training, drill, and equipment needs identified by WDFW. While limited, past drill exercises, and the more recent F/V Aleutian Isle incident have provided several lessons learned; Montana identified these to include:

● Equipment constraints	● Deterrence tools have limitations (summarized in Section 2.3), however it is also important to understand the impact of environmental conditions on how easily a tool can be deployed, where it can be deployed, and how effective that tool is. Oftentimes a combination of methods may be required to implement a successful deterrence operation. Additionally, the impacts of deterrence tools on other species should be weighed in the decision process.
● A need for pre-planned primary responders	● A list of pre-identified primary responders that are willing and available to assist in the event of a spill is crucial.
● A need for trained and experienced primary responders	● Primary responders should be trained and have experience with use of oikomi pipes (the only tool that responders would currently be able to use). This would allow for quicker deployment of teams and a more reliable and resilient whale deterrence team.
● Better documentation of deterrence efforts when implemented.	● Documenting deterrence efforts provides a means of recording effectiveness of the effort, it also provides the ability to learn from each drill or event and build on those lessons learned to further improve deterrence efforts for the future.
● Equipment staging and tracking needs	● Equipment needs to be staged and available for primary response teams at key locations. There are limitations to the efficient transportation of oikomi pipes due to their size, but the F/V Aleutian Isle incident resulted in little tracking of who had what equipment and where that equipment ultimately ended up. This highlighted the need for including whale deterrence response equipment on the Worldwide Response Resource List (https://www.wrrl.us/) to allow broad tracking of available equipment by responders. In addition to the oikomi pipes responder go-bags should also be available to observers that include the required PPE and communication devices for teams.

WDFW highlighted the need to combine training with research in order to test both currently authorized and alternative deterrence methods. This would allow for a better understanding of the ease of deployment, the efficacy of tools, and identify best practices of different deterrence tools to ensure they are as effective as possible. Research into different pipe configurations (e.g., length, and material), and type (e.g., trumpet oikomi pipes or underwater playback) is needed. Other aspects of training identified as needed by WDFW include standardized use directions related to each deterrence tool type.

Deterrence tool choice may be influenced by location. WDFW have begun to identify potential “choke points” (Figure 3) where deployment of specific deterrence tools could occur at predetermined locations, similar to pre-authorized boom deployment as documented in Geographic Response Plans (GRPs). More work is required to determine how whale transit behavior and environmental factors such

as current and tidal conditions, depth, and distance would influence deterrence attempts at the identified choke points.

Equipment Needs

Oil spill response equipment is distributed throughout the inland waters of Washington State, and it is carefully documented and staged in areas to allow for swift and coordinated deployment when it is needed. Mobilizing and distributing equipment is also a pivotal part of whale deterrence operations, however, there were challenges with the coordination of both mobilization and demobilization of whale deterrence assets during the F/V Aleutian Isle response. This incident highlighted the need to coordinate whale deterrence equipment through the Worldwide Response Resource List (WRRL), a free database that contains information and specifications of thousands of oil spill response equipment throughout the US and Canada[8]. This would allow whale deterrence equipment to be tracked and availability status kept up to date. Other equipment needs identified by those who participated in the F/V Aleutian Isle response include personal protective equipment (PPE), including hearing and eye protection for pipe use, and VHF radios.

In addition to equipment related gaps WDFW and workshop participants highlighted the need to properly document deterrence activities, use standardized language and identify individual roles in an event, and better understand how tools can be combined to increase the likelihood of a successful whale deterrence operation. The need for a deterrence tool inventory was noted along with improving our understanding of the limitations associated with each tool type to enable planning that takes into account the circumstances of each unique spill event. There is also a critical need to resolve liability insurance issues for volunteer crews, though some of this could be resolved by identifying appropriate means to provide compensation to those teams that are trained as primary responders for whale deterrence. Organizations providing primary whale deterrence response may wish to acquire Primary Response Contractor (PRC) status for whale deterrence activities. This is part of a larger issue for incorporating responders in an official manner into an oil spill response that requires coordination with many agencies and partners. Additionally, there is a need for coordinated transboundary training and drill opportunities with US and Canadian whale deterrence teams and the expansion and implementation of cross-border agreements to include wildlife deterrence, for example through the Canadian Coast Guard-United States Coast Guard Joint Marine Pollution Contingency Plan (CANUSPAC). Participants in the F/V Aleutian Isle deterrence operations expressed confusion about their ability to implement deterrence or monitoring operations as part of the incident response if the whales were sighted in Canadian waters.

Drill Exercise Needs

Whale deterrence response preparedness would benefit from drills that allow the deployment of whale response assets/teams within the context of an incident. Such drills would ensure that communication between field teams (other deterrent teams as well as wildlife capture teams, cleanup crews, etc) is functional and that responders have appropriate support and oversight to ensure actions are authorized before deployment. Additionally, drills are needed that occur in the transboundary waters and allow agencies to coordinate responses over the two jurisdictions of Canada and the US.

[8] Worldwide Response Resource List (WRRL) https://www.wrrl.us/

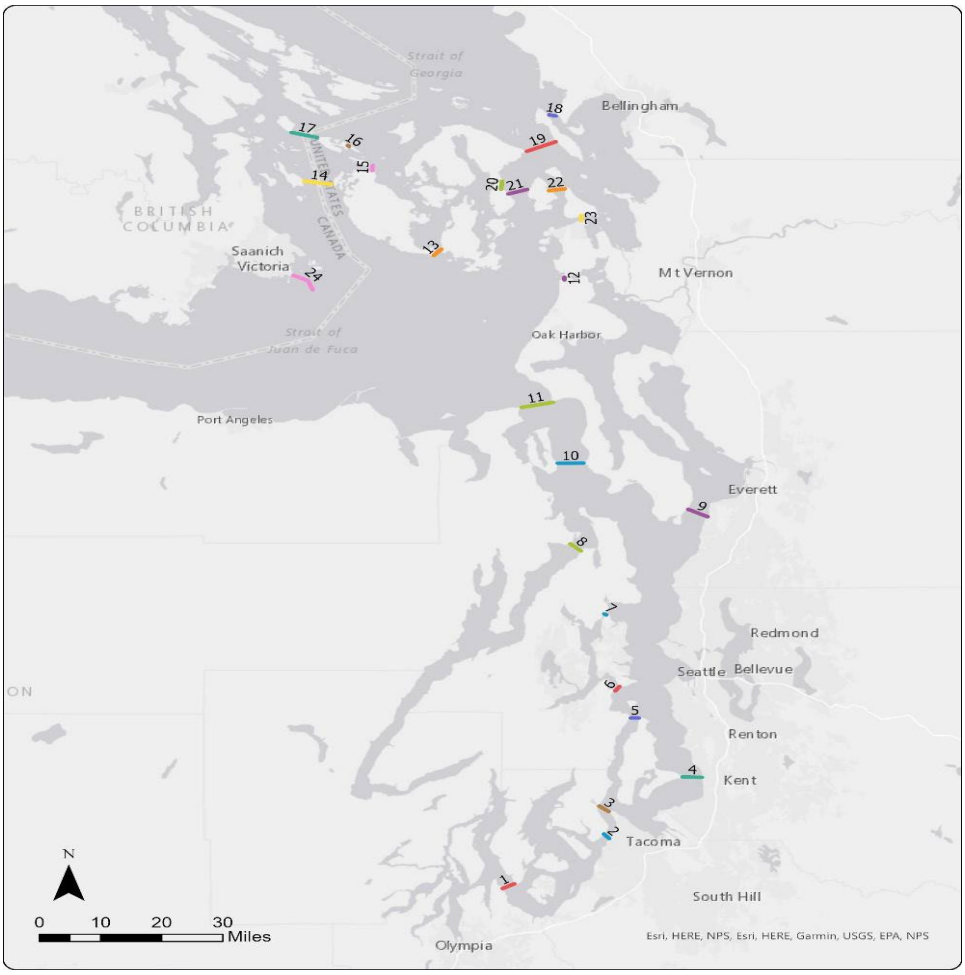

Figure 4.Potential choke points identified by WDFW as potential pre-determined deployment locations for whale deterrence operations.

3.0 Response Resources

Whale deterrence response resources include personnel, vessels, deterrence equipment, acoustic monitoring stations, and sighting networks. Workshop participants reviewed response resources to determine the following:

- Identify what resources are available and where they are located in the inland waters of Washington State.
- Identify the temporal and spatial gaps for resources and deployment opportunities.
- Identify any challenges and gaps in current response plans and suggest potential solutions.

Identifying response resources on the outer coast, including the coastal waters of Grays Harbor and the Columbia River, areas that are also part of the whales' critical habitat, were beyond the scope of the workshop and are not addressed in this section.

3.1 Deterrence resource types and locations

The locations of response assets were identified during the workshop and through subsequent research. The primary organizations or individuals identified as potential responders capable of providing on-water whale deterrence activities include known research organizations, non-profits, and agencies with expertise in whale behavior. There are 22 potential primary response-assets distributed throughout the inland waters of WA State, including USCG, NOAA, and WDFW teams. Ten potential teams could be available through research organizations, most of which are non-profits, and most are concentrated in the northern straits around the San Juan Islands. These are summarized in Table 3, and a more detailed list or agencies and organizations is provided in Appendix 4.

At present there are 2 caches of oikomi pipes located at the UW Friday Harbor Labs (10) and in Olympia with WDFW oil spill team (12). There are 11 hydrophone sites throughout the region that provide 24-hour acoustic monitoring (though not all nodes are always operational), and 4 larger sighting networks plus numerous regional Facebook sighting groups. In addition to land-based sighting networks the Pacific Whale Watch Association is also well placed to be able to provide on water real time reconnaissance and was able to provide this service during the F/V Aleutian Island response in 2022. The locations of response resource assets are summarized in Figure 4.

Table 3. Summary of primary response assets in the inland waters of Washington State.

Type	Number	Monitoring/Deterrence
Response Team	22	Deterrence
Shore based reconnaissance	5*	Monitoring
On water reconnaissance	11 (includes some response teams)	Monitoring
Oikomi Pipes	22	Deterrence
Hydrophones	11	Monitoring

**there are numerous regional active sighting groups on social media platforms that could provide assistance with shore-based monitoring.*

3.2 Temporal and spatial gaps in resource availability

Spatial gaps for deterrence asset availability include the Olympic Peninsula west of Dungeness Spit with the Makah Tribe and USCG identified out at Neah Bay and the USCG at Port Angeles (Figure 4). Localized gaps around Anacortes and Whidbey Island were also identified. Response equipment caches were identified as being needed in high-risk locations including, but not limited to Bellingham, Anacortes, Neah Bay, and Port Angeles. Additional high-risk locations should be identified, and responders will need to know where deterrence equipment is stored and how to access it. This information requires regular updating and can be achieved through the WRRL. But above all, limitations remain regarding the ability to implement a deterrence response on a large spatial scale so that whales can be deterred from coming close to an impacted area.

Temporal gaps for deterrence resources are mostly related to weather conditions and the seasonal availability of many organizations to provide response assets. There are also seasonal limitations to monitoring efforts due to both prevailing weather conditions and seasonality of organizations and businesses vessel operations. Weather can interfere with response efforts at any time of year however, while there is an increased chance of inclement weather in winter months, changes in climate patterns

and increased prevalence of wildfires during the spring and summer will pose challenges for deterrence operations. These climate related challenges will also add to health and safety challenges for response teams due to inclement weather, poor air quality and reduced visibility. The availability of response assets also varies seasonally, many organizations' small vessels are unavailable during winter months due to vessels being out of the water for the season, and/or crews are only seasonal (e.g., Soundwatch). The shorter day lengths and periods of poor visibility (e.g., fog, or due to wildfire smoke) reduce visibility and limit deterrence operation success, while fewer reconnaissance resources may be available either early in the morning or around dusk.

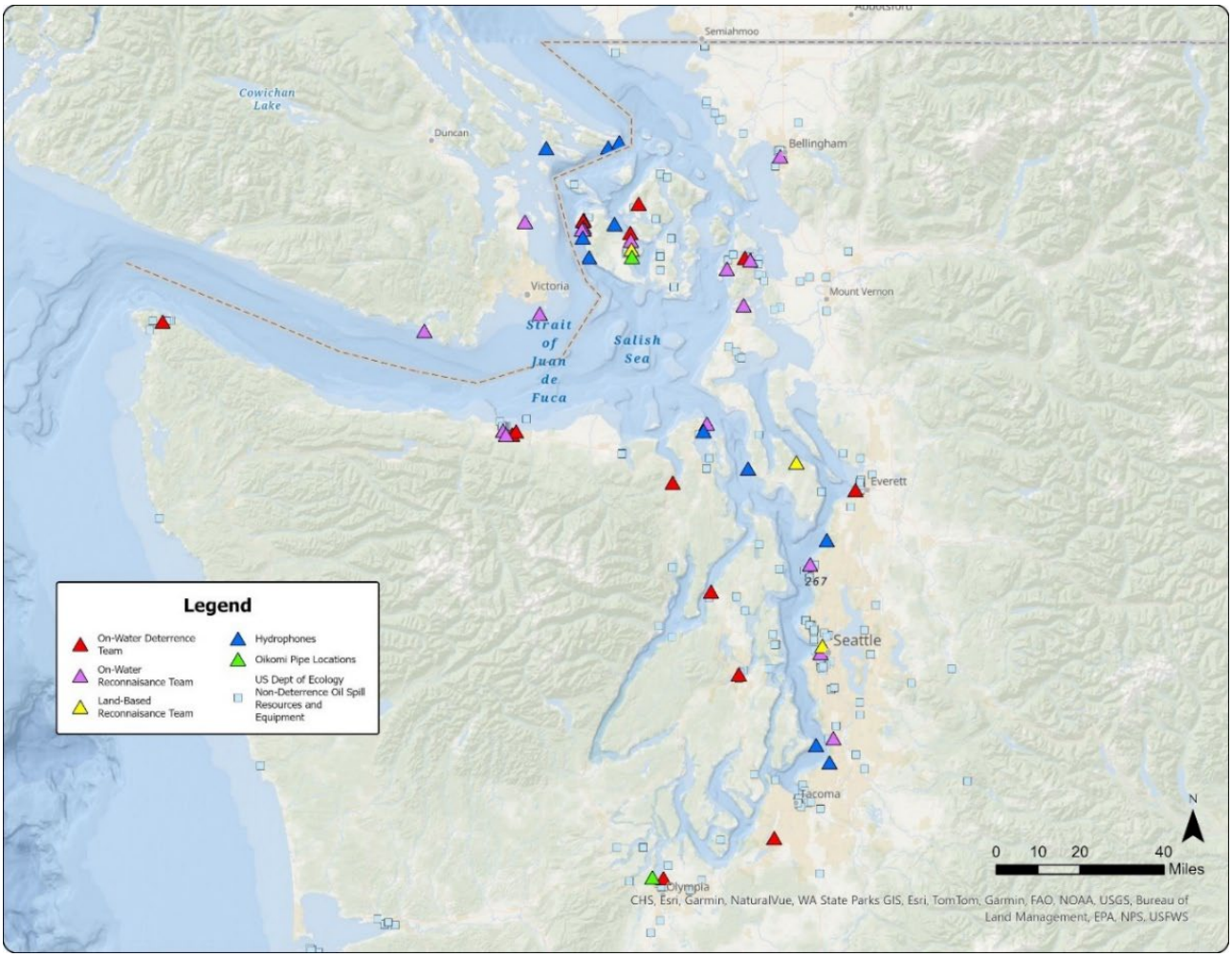

Figure 5.Locations of all potential response resource assets including on water primary responders (red triangle), on water reconnaissance teams (e.g., PWWA vessel ports, shown in purple triangle), land-based reconnaissance organizations (e.g., Orca Network, Orca Behavior Institute, and The Whale Museum shown by the yellow triangles), hydrophone nodes (shown by the blue triangles, and current locations of oikomi pipes (green triangles). This map also highlights the locations of Dept. of Ecology oil spill resources and equipment (light blue squares).

3.3 Other Gaps and Challenges Identified

Workshop participants identified additional gaps and challenges related to whale deterrence. These included gaps and challenges with communication systems, procedural challenges, weather and field conditions, and equipment distribution, use, and training challenges, these are listed below:

- Current whale deterrence plans rely on mostly small community non-profit organizations that may be brought on as subcontractors in the event of a response event, while other areas of oil spill response involve paid professionals. Gaps and challenges related to building well trained whale deterrence response teams include:
    - Challenges around liability insurance for volunteers from small non-profit organizations participating in response activities.
    - Funding challenges to ensure organizations/individuals participating in whale deterrence operations are compensated for training and deterrence activities.
    - Need to identify organizations and/individuals with expertise, equipped and trained to provide response activities, and available to participate in training.
    - Gaps related to management of whale deterrence response resource databases.
- Need to determine training requirements (including what and how often), and who should provide training to whale deterrence personnel.
- Equipment challenges include gaps in equipment, transportation ease, and a need to determine if equipment should be standardized. Currently no safety gear is provided to response personnel in advance of a response.
- Challenges with communications in the field due to poor cell phone service and busy VHF channels.
- Relying on hydrophones for monitoring presence of whales, especially during inclement weather or periods of poor visibility and at night is challenging as whales do not always vocalize or may not be close enough to fixed hydrophones to be detected. And while there is a growing community listening network there are still limitations to relying on community members to monitor hydrophones.
- There are significant gaps in understanding the efficacy of pre-approved (and alternative) deterrence methods with respect to both killer whales, and different populations and species, and the contexts within which they can be deployed.
- Gaps identified in transboundary interagency coordination of best management practice between the US and Canada. Including coordination of training and joint drill opportunities to ensure best possible response in transboundary waters.
- Significant gap in tribal involvement in, and coordination with tribes for the implementation of whale deterrence operations.

Suggested Solutions

Workshop participants identified a number of potential solutions that could help to improve whale deterrence readiness and implementation. These included:

- Improving communications on the water during a response and within the response command framework.

- Increasing training and drill opportunities, especially in the transboundary region to allow for international participation, coordination between agencies and, consider establishing regulatory agreements between agencies, e.g., through improving the CANUSWESTPAC oil spill plan to provide guidance to agencies to ensure that transboundary coordination on training and response can occur.
- Identifying organizations that can provide on-water response assets (personnel and boats) who could be trained to be primary responders.
- Preapprove response organizations, equip organizations and require training. Bring these community resources into the established spill response system.
- Identifying the resources available to support the primary responder organizations in their response roles, both to prepare for deterrence response operations and to participate in deterrence response operations during a spill event.
- Stand up a dedicated program for response training needs that includes a series of different required competencies that can be acquired and documented, as well as maintaining a list of assets by organization.
- Improving access to, and availability of equipment, as well as identifying areas where equipment can be stored and increasing equipment supplies to enable broader distribution, especially where gaps have been identified. Some workshop participants suggested that whale deterrence equipment be stored with Ecology's oil spill response equipment caches (Figure 4).
- Include satellite phones, and/or designated VHF radios with response equipment that can be used by both response boats and land-based teams.
- Include USCG, NOAA, and WDFW enforcement in deterrence training so that they can provide those response teams from organizations with whale expertise additional support during a spill event, and/or respond to incidents in areas were there are currently resource gaps, e.g., the Strait of Juan de Fuca and on the outer coast.
- Review and update the marine mammal response plan regularly.
- Explore how Tribal Coastal Guardian programs could be included in wildlife response, including whale deterrence efforts. In Canada there is a growing network of First Nation Guardian Programs such as the Coastal Guardian Watchmen of the Coastal First Nations Great Bear Initiative[9] that are being trained in environmental monitoring, including whale monitoring, and emergency response. Should similar programs be adopted by tribes in Washington State they could potentially help to fill some of the spatial gaps identified for response teams.

4.0 Factors Influencing the Efficacy of Deterrence Tools and Operations

Understanding the efficacy of deterrence operations continues to be one of the largest gaps in efforts to keep whales away from areas impacted by spills. There are numerous factors that may affect the efficacy of deterrence operations. Workshop participants discussed how whale and environment related factors may influence the effectiveness of deterrence tools. Additionally, there needs to be further research to identify what deterrence methods are most appropriate depending on location, and how

[9] Coastal Guardian Watchmen of the Coastal First Nations Great Bear Initiative https://coastalfirstnations.ca/

deterrence methods may impact other species presence, i.e., identifying and assessing the areas of risk associated with deterrence methods. These are summarized in the following sub-sections.

4.1 Whale related factors

Southern Resident killer whales (SRKW) co-evolved with Chinook salmon. Historically, the SRKW would hunt together in large social groups, with the entire pod (J, K, or L) or even multiple pods present. Reduced prey availability has radically altered the frequency and length of stay of the SRKW in the Salish Sea and they are no longer present in inland waters during times of year when they were traditionally commonly encountered, e.g., during the spring (Ettinger, et al., 2022; Stewart et al., 2021; Shields, 2018). Thus, introducing challenges in predicting either when SRKW may be in inland waters, or how long they may stay (Ettinger, et al., 2022). In addition to altered residency times, changes in group dynamics have also been recorded. Not only are the Southern Residents appearing in smaller group sizes, but the groups are also more spread out. Researchers have termed this "max spread". For example, when whales are foraging in Haro Strait they may be spread from the west side of San Juan Island at Limekiln Point State Park to the shore of Vancouver Island at Oak Bay. This presents challenges for whale deterrence teams related to how to prioritize the limited deterrence response assets that are available.

In addition to the challenges posed by the changes in group size dynamics and phenology of SRKW there are also challenges around predicting the whales' routes during a spill event. Once predictable travel routes through the Salish Sea are no longer reliable. At such times, it might be difficult to assess who is present, how far they are spread, and their directions of travel, consequently introducing additional difficulty in determining the best place to deploy assets for an effective deterrence operation.

Understanding where the whales are and where they may be going is a significant part of being able to implement a successful deterrence operation. However, it is also important to understand what they are doing. How whales may react to different stimuli is known to vary depending on their behavior at the time of exposure (e.g., Robertson et al., 2016, Christiansen et al., 2013). Southern Resident killer whales are known to switch from foraging to travel in the presence of boats (Lusseau et al., 2009, Holt et al., 2021). These factors may affect the efficacy of deterrence methods, however, further research is needed to better understand how whales may react to different stimuli. There was some discussion from workshop participants about whether it would be possible to co-opt natural behavior, such as prioritizing the safety of specific individuals over others and/or influencing leaders, so that the animals themselves become participants in the effort to protect them – e.g., can a deterrence effort turn a leader around so that this ultimately turns the rest of the pod away from an impacted area?

4.2 Multiple populations or species scenarios

The Salish Sea is a rich feeding ground for several cetacean species including odontocete and mysticete species (Gaydos and Pearson, 2011). In the event of a spill, it is possible that multiple killer whale populations and/or other species may be using the same areas at the same time, and this could change planned deterrence activities or challenge their effectiveness. Resident and Bigg's killer whale populations appear to have avoidance strategies and rarely overlap in time or space. When initiating a

deterrence procedure, it may be necessary to consider where different populations are geographically to avoid re-routing them into the path of another ecotype.
Similar to temporal and spatial presences contrasts, different feeding ecologies and habitat use between ecotypes may lead to alternate responses. Additionally, Residents, and increasingly many Bigg's killer whales spend more time in areas with higher concentrations of vessels and noise and as a result may not exhibit the same behavioral responses as those whales in less urban environments might. In some locations vessel noise may outcompete deterrence actions limiting their effectiveness, though this could be managed by implementing no-boat zones similar to the one implemented for the F/V Aleutian Isle response on the west side of San Juan Island. Awareness of location and direction of travel for all whale species in an area impacted by a spill event will likely result in the Wildlife Branch having to prioritize limited response assets in favor of listed species. Depending on the number of on-water responders available, there may also be opportunity to deploy multiple response teams or the opportunity to implement effective deterrence actions on different groups of whales. Additionally, potential adverse effects from deterrence operations on non-target species, such as baleen whales, pinnipeds, or marine birds, that may be in the same area need to be considered and weighed against the importance of preventing the killer whales from swimming through an impacted area. The complexity of the Salish Sea in terms of wildlife diversity also highlights the importance of robust monitoring and reconnaissance activities in a spill response.

4.3 Environmental factors

Whale deterrence operations will be influenced by the spill type and location. It will be important to understand how the spill interacts with the marine environment, particularly with regard to the ocean and weather conditions at the time of the spill. Key environmental factors that are likely to influence a whale deterrence operation include tides, currents, depth, sea state, and wind direction and speed. Factors that influence visibility, e.g., glare, fog, and wildfire smoke, and the spatial location of the spill and/or where a deterrence operation might be implemented also need to be considered and monitored. In some instances, the location and/or habitat sensitivity will influence response and deterrence options e.g., how acoustic shadows can occur around islands, understanding choke points (e.g., Figure 3), and recognizing the locations of other sensitive species and habitats.

Understanding the spill's spread, trajectory, and/or changes to other environmental and spatial factors is needed to communicate information to the deterrence teams in the field, as well as the rest of the Incident Command. If field conditions impact the use of deterrence tools, it will be necessary to communicate this to the Wildlife Branch so that they can determine alternative deterrence tools or offer more appropriate response actions. Changes in environmental conditions of the locations of deterrence operations may limit the effectiveness of, or determine tool choices.

5.0 Funding structure for response needs

One of the key goals of the Southern Resident Killer Whale Deterrence Task Force was to identify funding mechanisms to ensure response teams are adequately trained, equipped, and compensated. Matt Bissel, (*Preparedness Section Manager in the Spill Prevention, Preparedness, and Response Program at Washington State Department of Ecology)* and LCDR Brian Dykens (*USCG Puget Sound Sector*) provided an overview of funding structures for response needs and facilitated a discussion around how to fund responders in incidents where vessels or spill sources were unknown. Dykens described the funding structure for oil spill response operations. The main sources of funding include:

1) Oil Spill Liability Trust Fund (OSLTF): The OSLTF was authorized in 1990 after the Exxon Valdez grounding and the passage of the Oil Pollution Act (OPA). The fund can provide up to $1 billion for any one oil pollution incident. Its uses are delineated by the OPA and include federal removal costs incurred by the Coast Guard and EPA, State access for removal activities, payments to federal, state, and Tribes to conduct natural resources damage assessments and restorations, payment of claims for uncompensated removal costs and damages, research and development, and other specific appropriations[10]. The OSLTF consists of the Emergency Fund and the remaining Principal Fund. The Emergency Fund is available for Federal On-Scene Coordinators to ensure rapid, effective response to oil spills and for federal trustees to initiate natural resource damage assessments. The Emergency Fund is a recurring $50 million available to the President annually. The Principal Fund is the remaining balance of the OSLTF and is used to pay claims and fund appropriations by Congress to Federal agencies to administer the provisions of OPA and support research and development.
2) Comprehensive Environmental Response Compensation and Liability Act Fund (CERCLA): The CERCLA provides a Federal "superfund" to response costs, uncontrolled or abandoned hazardous-waste sites as well as accidents, spills and other emergency releases of pollutants and contaminants into the environment[11]. The CERCLA gives the EPA the power to recover costs from financially viable individuals and companies for clean-up.

Some of the funding challenges highlighted during the workshop included the fact that the OSLTF is not able to cover the costs of training or prevention efforts, and while it is able to reimburse for the costs incurred by organizations that are involved with a response the reimbursement process is often lengthy placing additional burdens on small (especially non-profit) organizations.

At the State level Matt Bissel summarized the State response account that has a maximum fund availability of $9 million. This fund is only able to cover response activities, and unlike the federal OSLTF is not able to cover any claims associated with impacts from a spill event. The State has identified Primary Response Contractors (PRCs) and these contractors are able to pay response crews and Vessels of Opportunity (VOOs). For the F/V Aleutian Isle response there was an attempt to ensure that those teams and vessels that participated in the whale deterrence activities received compensation through one of the PRCs participating in the response. While some did receive compensation not all parties may have completed the process.

[10] https://www.uscg.mil/Mariners/National-Pollution-Funds-Center/about_npfc/osltf/

[11] https://www.epa.gov/laws-regulations/summary-comprehensive-environmental-response-compensation-and-liability-act#

One of the fundamental questions posed was what does a sustainable funding model look like to ensure that response teams are trained and ready to respond? This question is pertinent to all wildlife response[12]. Workshop participants shared concerns around some of the shortcomings of the current funding structure that currently precludes this, these included:

- Funding is only available for active deterrence time, funding to support monitoring during an event is only available if it is adequately brought into the wildlife plan.
- Standby time is ineligible for reimbursement.
- Invoicing can be onerous for small research non-profits that are not set up to do this.
- Liability issues related to personnel and vessels and access,
- If there is an expectation to have dedicated response teams with equipment those teams will have to know how to use it thus there are training requirements.

Training needs and expectations were also discussed within the context of what should be expected of response teams, particularly around whether there should be an expectation that response teams should have the same minimum training requirements as other wildlife responders, e.g., basic ICS training and HAZWOPER training. This discussion also touched on who should provide training, what they should include, and noted that whale deterrence is quite different to other types of wildlife response. Discussion points around this issue included:

- Provide response teams with opportunities to take ICS training using the free online courses through FEMA.
- Provide response teams with annual opportunities to receive HAZWOPER training, organizations that provide this training include:
    - US Coast Guard, WA Ecology, Focus Wildlife, and WDFW – provide joint annual training for the 24-hour HAZWOPER and a free 8 hour HAZWOPER training (to maintain one's 24hr HAZWOPER certificate the 8 hour training is required each year as a refresher). Their annual training is specific to wildlife response.
    - Islands Oil Spill Association (IOSA) - provides HAZWOPER training 1-2 times per year in San Juan County. Training is prioritized for IOSAs Tier 1 responders but there are opportunities to extend this to other individuals and organizations involved in oil spill response.
- Provide response teams with training specific to whale deterrence including equipment set up, deployment and use.
- The locations and timings of currently available training can be a barrier to participation, especially if they are being held at a distance from the responder's location.
- Despite interest and willingness to undertake training it can be challenging to get volunteers to commit to extensive and regular training.

[12] Regarding wildlife response there is currently no requirement for funding and wildlife response. In 2021, a new regulation was passed requiring the use of wildlife response service providers (WRSPs) for spills involving wildlife. WRSPs are required to document training and permits, as well as meet regulated facility standards for oiled wildlife rehabilitation. Industry had to have an agreement (but no requirement that it be a paid agreement) with WRSPs for response. Oil Spill Response Organizations (OSROs) signed retainer contracts with WRSPs on behalf of their industry members. WRSPs are required to mobilize within 2 hours of activation with a specific set of resources. While there is a retainer, it is not enough to adequately support training and equipment provision. Wildlife Response continues to require a sustainable funding structure.

Despite the diverse input from workshop participants no clear funding mechanism was identified to support whale deterrence operations, especially those that can't be funded through the federal or state spill response funds. The WDFW oil spill response program received a grant in 2024 to provide training and drill opportunities for a limited time. This grant also provides for conducting further acoustic studies on oikomi pipe use; however this is not a long-term solution.

6.0 Recommendations

6.1 Workshop Recommendations

The workshop produced a list of 35 recommendations that related to response assets (teams and equipment), training and drills, response structure and communications, deterrence methods, and others (Appendix 5). The recommendations included a broad list of actions that are achievable in the short-term and those that will be longer-term efforts. Task Force members and workshop participants were asked to identify which recommendations their agency or organization could take the lead on, which agency or organization would be able to provide a supporting role, and then to identify their top three recommendations.

Seventeen agencies and organizations reviewed the recommendations and participated in the prioritization exercise. The prioritization exercise resulted in 19 of the 35 recommendations receiving at least one vote. The top five recommendations are listed below (Table 4), each is identified as either a short-term action or a long-term action. These top recommendations fall into the broad categories of 1: Identifying and training primary response assets, 2: Research into the efficacy of deterrence tools, and 3: Securing funding to ensure response assets are trained and response ready and compensated for training and response activities.

Table 4. Top five workshop recommendations.

Priority	Recommendation	Action Type
1	Create and train dedicated primary responders to be able to deploy during a spill response event.	Short Term
2	Research efficacy and usability of alternative deterrence methods – e.g., Hukilau surface deterrence, Acoustic Harassment Devices, Genus-wave device, Lubell speakers and playbacks.	Long Term
3	Identify potential primary responder teams in advance, including a list of whale experts in the region that can be approved by NOAA to lead deterrence operations.	Short Term
4	Identify sustainable funding opportunities to ensure regular training and drills for primary response teams.	Long Term
5	Identify opportunities to have USCG fill geographical gaps in the short-term during an incident response – e.g., the Olympic Peninsula has been identified as a gap for responder location.	Short Term

Whale deterrence response involves a combination of reconnaissance and monitoring, and deterrence activities. Different organizations are able to provide different levels of response depending on their type, capacity, and expertise. Creation of a tiered system of responders, modeled off the Islands Oil Spill Association's newly developed Tier One Response Teams for local IOSA volunteers in the San Juan Islands[13] was suggested at the workshop. IOSA's Tier One volunteers commit to getting their 24 HR HAWOPER and ICS training and attending quarterly training and drills. They are IOSA's "first responders" for on-scene site assessments when a spill occurs. This model is a similar model to that used for whale disentanglement response and could also work well as a means of formalizing whale deterrence response. Primary (or Tier one) Responders could be considered those that have whale expertise, are committed to getting and maintaining their 24HR HAZWOPER and ICS training and participating in regular training/drills and being equipped with deterrence equipment and safety gear. These Tier 1 or Primary Responders would be the first to be deployed if whale deterrence is required in the event of a spill. Task Force Members familiar with wildlife response also recommended that these organizations become Primary Response Contractors (PRCs) for the narrow scope of whale deterrence. Additional tiers might include organizations only able to provide on-water reconnaissance assistance (e.g., Tier 2), and organizations only able to provide shore-based reconnaissance assistance (e.g., Tier 3).

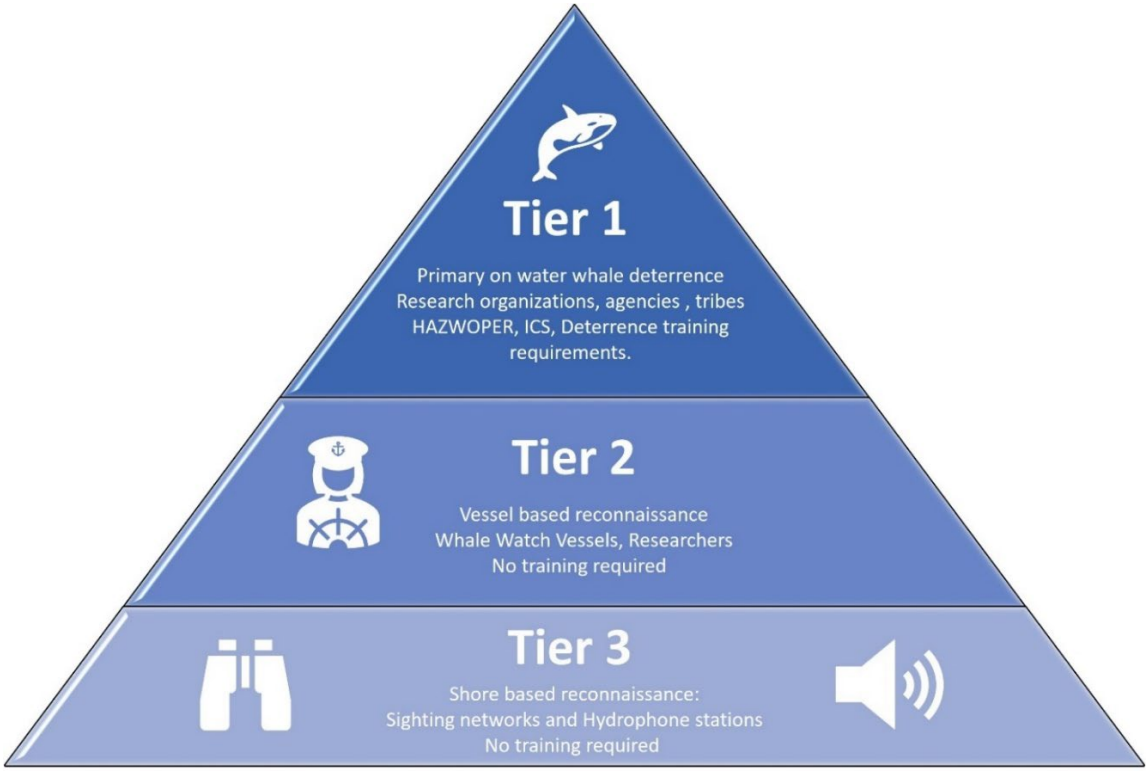

Figure 6. Outline of how whale deterrence response resources might be designated.

[13] https://www.iosaonline.org/training

6.2 Recommended Updates to the NWACP

Parallel to the SRKW Task Force's efforts a series of updates were made to the NWACP regarding Sections 9310 (Northwest Wildlife Response Plan), 9311 (Wildlife Deterrence (hazing) Resources), and 9312 (Oil Spill Marine Mammal Resources). Briefly, Section 9310 was updated and Sections 9311 and 9312 were incorporated into the appendices of 9310. The Task Force subsequently recommended that the content of these sections be moved to the Ecology Oil Spills 101 website. The requests made by the Task Force included:

1 Remove the material that had been transferred from Sections 9311 and 9312 into Appendices A.4 and A.5 of the draft 9310 document before its final publication. The headers for these appendices should remain in the current draft.
2 Under the respective headers, the following text should be inserted.

> "*Appendix A.4: "NOTE: The content previously contained within this appendix was taken from the now repealed Section 9312 of the Northwest Area Contingency plan (v21, 2020); The content addressing Marine Mammal Oil Spill resources has been moved and is now located on the Ecology Oil Spills 101 website at Oil Spills 101 Wildlife Resources"*
>
> *Appendix A.5: "NOTE: The content previously contained within this appendix was taken from the now repealed Section 9311 of the Northwest Area Contingency plan (v21, 2020); The content addressing Northwest Area Wildlife Deterrence Resources has been moved and is now located on the Ecology* ***Oil Spills 101 website at Oil Spills 101 Wildlife Resources"***

7.0 Conclusions

This report has provided a comprehensive summary of the NWAC RRT 10 Whale Deterrence Task Force efforts in 2023 and 2024. The Task Force and other experts that attended the whale deterrence workshop in December 2023 discussed the pros and cons of both pre-authorized and alternate deterrence tools and highlighted a series of gaps and challenges that currently impact whale deterrence efforts in the case of a spill event. Several reoccurring themes arose throughout the workshop and subsequent discussions between Task Force members. One was the need for a more formalized and prepared approach to whale deterrence operations that had a focus on response preparedness. This included the identification of primary on-water response teams that are trained and participate in regular drills similar to other oil spill response organizations, as well as more international coordination around whale deterrence preparation and operations. Another area included the need for a better understanding of the efficacy of deterrence tools and how their effectiveness may be affected by whale related and environmental factors. The need for more research into deterrence tool choice and efficacy was identified as a significant gap.

Funding mechanisms for preparedness and response efforts continues to be elusive, despite the diverse input from workshop participants, especially in those situations that can't be funded through the federal or state spill response funds. While grant funding is available for short term efforts to support training and some equipment procurement this is not a long-term solution. This challenge is not unique to whale deterrence; all oiled wildlife response and whale disentanglement efforts also face similar challenges in

ensuring funding for preparedness. The issue of funding was reiterated through several of the 35 recommendations that arose from the two-day workshop.

The workshop produced a broad list of 35 recommendations that resulted from the presentations, discussions, and exchange of information over the two days. This list included both short-term and longer-term actions. The top 5 recommendations fell into the broad categories of 1: Identifying and training primary response assets, 2: Research into the efficacy of deterrence tools, and 3: Securing funding to ensure response assets are trained and response ready and compensated for training and response activities. Workshop participants identified the need to create a standing whale deterrence subgroup once this Task Force sunsets. This will provide an avenue to track progress on a number of the recommendations provided in this report. Such a subgroup would also allow the exploration and identification of whale deterrence assets outside the Salish Sea in other areas of the Southern Resident killer whale's critical habitat as this was outside the scope of the workshop and this report.

A well prepared and organized whale deterrence operation is needed more than ever in the Salish Sea as Canada's expansion of the transmountain pipeline is now online adding an additional 696 tanker transits per year through the Southern Resident killer whale's critical habitat in the Salish Sea. In addition to increased shipping and tanker traffic the risks of accidents and oil spills involving smaller vessels also persists.

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Appendices

Appendix 1: Oil Spill Emergency Response Killer Whale – Hazing Implementation Plan

Oil Spill Emergency Response
Killer Whale – Hazing Implementation Plan

I. Introduction and Background

This implementation plan provides guidance for killer whale monitoring and hazing activities as part of the Northwest Area Contingency Plan. Hazing activities during emergency oil spill response is authorized under MMPA/ESA Research and Enhancement Permit 932-1905 issued to the NOAA Fisheries Marine Mammal Health and Stranding Response Program (MMHSRP), Dr. Teri Rowles. The Federal On- Scene Coordinator in the Unified Command has been delegated authority as a Co-investigator under Permit 932-1905 and may initiate certain pre-approved hazing activities to minimize killer whale exposure to oil or other emergency spill response activities.

The Southern Resident killer whale population is listed as endangered under the U.S. Endangered Species Act (ESA) and is also protected under the Marine Mammal Protection Act (MMPA). Oil spills have been identified as a primary threat to this population and the *Recovery Plan for Southern Resident Killer Whales* calls for developing strategies to deter killer whales from entering spilled oil (NMFS 2008). Evidence suggests that killer whales are unlikely to detect and avoid spilled oil, and exposure can result in population-level impacts (Matkin et al. 2008). During the initial phases of a spill response the Unified Command will take appropriate action to monitor and/or haze killer whales to minimize their exposure to spilled oil. Prior to full mobilization of the Unified Command and the field response effort under its direction, NOAA Fisheries has pre-approved monitoring activities and three hazing actions for consideration and emergency implementation by the Command. Hazing activities that have not been pre-approved must be coordinated with and authorized by NOAA Fisheries (see section V. below).

II. Monitoring

Beginning with notification of a spill, the Wildlife Branch Director will ascertain whether killer whales have been observed or are likely to be within 50 miles (8-10 hours) of the spill event. If killer whales have been observed or are likely to be within 50 miles, the Branch Director will designate a killer whale liaison to initiate communications with killer whale experts, researchers, sighting networks and advocacy groups to monitor/track the whale's movements relative to clean-up activities and the spill trajectory. Once whales have been located, the Branch Director (or designee) will determine whether it is safe to dispatch a trained whale observer to the scene to identify the type of killer whales (residents or transients) and, if residents, which members of the Southern Resident killer whale population are present. If dispatch of a trained observer to the scene is not safe or feasible, the Branch Director (or designee) should order appropriate resources to collect high definition digital photographs of individual whales at the surface for use by identification experts off scene to identify which whales are present (see photo instructions below). The Branch Director (or designee) will order real-time reconnaissance (vessels or aircraft) for continuous monitoring if killer whales appear to be moving toward the spill, the spill trajectory, or clean-up activities and/or are found within 20 to 30 miles (6 hours) of oil or trajectory. Once monitoring begins, the Branch Director (or designee) will consider hazing to deter the whale's progress toward the spill and will identify available assets to conduct hazing. Monitors that are tracking whales in the field must provide periodic location updates for comparison with spill

location and trajectory forecast information to ascertain if the whale's path may intercept the spill trajectory. If hazing assets have been identified they should be readied for deployment and staged to be on scene if whales are expected to approach within 10 miles (2 hours) of oil or spill trajectory. The following hazing techniques have been pre-approved for consideration and emergency use without prior consultation, if NOAA Fisheries staff are unavailable (see section III below). The Branch Director may choose to consult with NOAA Fisheries marine mammal resource specialists, if they are assigned to the spill, prior to hazing implementation but such consultation is not required for pre-approved techniques. Regardless of whether hazing is implemented, real time monitoring of whale movements within 20 to 30 miles (6 hour reconnaissance buffer) relative to the spill or spill trajectory should be conducted to a) determine if whales have been or are likely to be exposed to oil; and b) to remain prepared for the potential of killer whales encountering oil or spill response activities.

III. Pre-approved Methods

In situations where immediate action is necessary to prevent killer whales from entering oil NOAA Fisheries has pre-approved; *helicopters, Oikami pipes, and underwater firecrackers* (*seal bombs) deployed from vessels;* for use by response personnel under the direction of the Branch Director and Unified Command to attempt to herd/move whales. Pre-approved deterrents should be deployed if the risk of entering oil exceeds the risk of disturbing the whales through hazing techniques. Risk to the whales should be assessed based on the proximity of the whales to the oil and their likelihood of entering the oil as well as the type and condition of the oil. The Branch Director will determine whether to activate the Marine Mammal Hazing Unit to implement hazing activities or, if exposure is imminent, to order "on-scene" personnel to attempt hazing. Selection of the most appropriate hazing technique will depend on the particular spill conditions, location of whales, level of risk to the whales, and available assets. Helicopter hazing may be the most immediately available technique, particularly if there are aircraft available and in use for Reconnaissance. Multiple pre-approved techniques may be implemented in combination (i.e., oikami pipes and firecrackers deployed from the same vessels) or in sequence based on observations of the whales and time needed to mobilize hazing teams. Deployment of pre-approved hazing methods will be directed by the following decision tree (Figure 1).

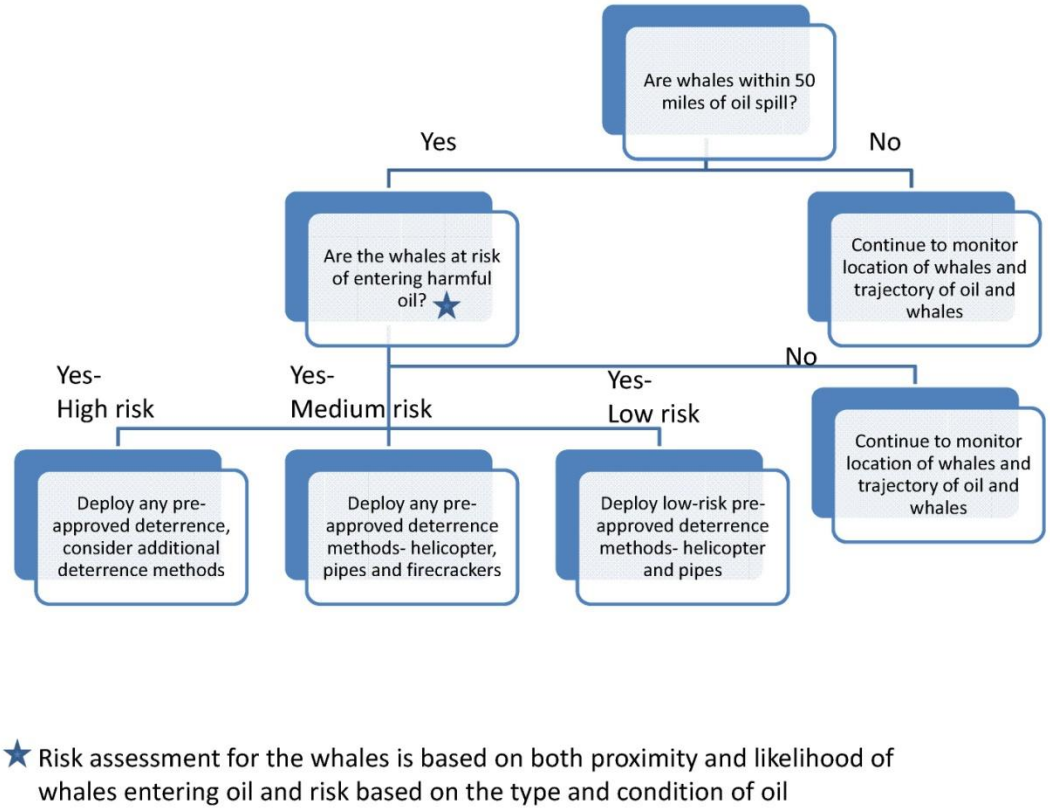

Figure 1. Decision Tree for immediate deployment of pre-approved hazing techniques

Helicopter

Background - Helicopters are effective tools for herding livestock in open terrain. There have been observations and reports of killer whales diving and changing direction when confronted by a helicopter hovering in their path. This technique is considered experimental and should be accompanied by detailed monitoring and observations of whale behavior (direction of travel, rate of speed, pod cohesion etc.) before close approach and during hazing by the helicopter. The expected response is aversion or avoidance of the helicopter. The stimulus that triggers the response is unknown but may be visual (approach from overhead), surface disturbance from prop wash (whales detect approaching change in surface condition (turbulence)), or acoustic engine or propeller noise transmitted to the water below the helicopter. Noise transmission into the water is most efficient in a circle below the helicopter roughly ½ the diameter of the flight altitude (for altitudes below 1000 feet).

Safety First – For personnel - Hazing whales with a helicopter requires low altitude maneuvering and hovering low over the water. Pilots should assess environmental conditions (visibility, turbulence etc.), surrounding air traffic (search and rescue, media), and surface vessel proximity to determine if it is safe to proceed with this technique. *For the whales* – The potential for whale

injury using this technique is low. Helicopter sound levels transmitted into the water are not sufficient to injure whale hearing even in the most intense area directly below the aircraft. No physical contact with whales is anticipated. There is some potential that aerial hazing could affect pod cohesion if different whales in the group respond differently to the helicopter. If the helicopter gets too close to the whales the potential for pod scattering may increase so cautious approach to the whale's position while monitoring for behavioral response is advised. If the pod breaks apart monitoring may become more difficult and require additional resources.

Operational Instructions – The optimal personnel complement aboard the aircraft during hazing is three: 1) the pilot, 2) a lead observer to continuously monitor the animals, provide whale information to the pilot and direct maneuvering, and 3) a data recorder/photographer to record notes of the encounter including pre- and post-hazing observations and take identification photographs. If fewer personnel are used, the observer can assume data collection and photography duties. To attempt a herding maneuver to divert the whale's path, the pilot should position the helicopter so that it will approach the whales from the direction of the spill. If safe to do so the helicopter should begin maneuvering at an altitude of 300 to 500 feet approximately ¼ to ½ mile from the whales maintaining its position between the whales and the direction of the oil, gradually reducing the distance to the whales and altitude. Observers should monitor closely for a response from the whales and pilots should continue to maneuver as necessary to obstruct paths to the oil. Pursuing the whales and closing the distance to the whales is permissible to maintain their retreat with aircraft maneuvering (hovering, zigzagging, and adjusting altitude) to reinforce the direction of travel away from the oil. Once whales have established, and are maintaining, a path away from the spill hazard, gradually increase distance from the whales (retreating toward the spill), increase altitude and continue monitoring effort. If the whales do not respond to the helicopter and continue travel along their original path unimpeded, notify the WBD of the whales' last position, direction and proximity to spill before leaving the whales to arrange for continued monitoring as whales approach the oil and/or deployment of alternate hazing resources. If the pod fragments when the helicopter approaches, notify the WBD and pass along the available information to inform subsequent hazing activities. If whales do not respond to helicopter hazing and enter the oil, monitoring should continue if possible to document the exposure of whales to the oil (record individuals in oil and length of exposure to oil).

Reporting – Aerial hazing is harassment and any animals subjected to this technique must be included in a take report to be delivered to the NOAA Fisheries representative in the Wildlife Branch. Reports should include the number of animals subjected to the hazing, date, location, information on any photos taken, and response of the animals to the hazing. Take reports will be compiled by NOAA Fisheries and communicated to the Branch Director for use by the Unified Command and for use in reporting activities under Permit 932-1905 and for emergency consultation under Section 7 of the ESA. Monitoring information on exposure of individuals to oil should be reported to the Natural Resource Damage Assessment team.

Oikami Pipes

Background - Oikami pipes, reverberating pipes suspended from a vessel into the water and struck with a hammer, have been effective tools for herding/moving small cetaceans and killer whales in near-shore or enclosed waters. This technique should be accompanied by monitoring and observations of whale behavior (direction of travel, rate of speed, pod cohesion etc.) and vessel

deployment configuration. The expected response is aversion or avoidance of the approaching line of noisy vessels. The stimulus that triggers the response is sound from the pipes, but vessel presence and engine noise may contribute to the effect. Sound transmission from the pipes is assumed to be omni-directional but killer whales are capable of resolving the position of the source, so orientation and spacing of the vessels and pipes is likely to be important.

Safety First – For personnel - Oikami pipes are deployed over the side of small boats and operated manually by striking with a hammer or rounded metal bar. The pipe can be struck on top or on the side of the pipe exposed above the water. Vessels selected as platforms should be large enough for safe operation under the existing environmental conditions, while providing a stable platform that is close enough to the water so that personnel can work safely at the gunnel for extended periods. Caution should be used when deploying vessel less than 18 feet in length or with very low freeboard to insure stability with the pipe deployed in the anticipated sea conditions.Vessels need to be equipped with a means of suspending the oikomi pipes far enough over the side of the vessel that they do not touch the hull. The top 1.5 to 2 feet of the pipe should remain above the water's surface and care should be taken to avoid flooding the pipes. Flooded pipes need to be recovered and drained prior to redeployment. Crew members aboard hazing vessels must be equipped with appropriate personal protection equipment for the level of spill exposure that may be encountered during deployment this should include PFDs for all crew and hearing and eye protection for the pipe striker. Since hazing operation may need to be sustained for extended periods of time the person striking the pipe should be positioned in an ergonomic way that minimizes reaching and stretching to strike the pipe. Movements of multiple vessels should be closely coordinated for safe operation. *For the whales* – The potential for whale injury using this technique is low. Sound levels from the banging pipes transmitted into the water will be most intense within a few yards of the pipes but source levels are not sufficient to injure whale hearing. No physical contact with whales is anticipated. Vessels deploying pipes should be operated at slow displacement speed when in proximity to whales to minimize the risk of collision. Engines should be shifted to neutral (no spinning prop) within 100 yards of whales.

Operational Instructions – The minimum operating unit for oikami pipe hazing is three vessels each deploying a single pipe and the minimum personnel complement for this unit is seven. During hazing, each vessel should have a driver and a pipe banger. A hazing team leader will accompany the unit to coordinate vessel maneuvers within the unit, maintain communications with other units, and serve as an observer/data recorder to monitor the animals, record notes of the encounter including pre-, during, and post-hazing observations, and take identification photographs. Additional pipe bangers can be assigned to vessels for relief of the pipe banger or if multiple pipes are deployed from each boat. A field hazing supervisor should be assigned to coordinate maneuvers if more than one hazing unit is deployed. It is vital to establish an effective means of communication between the field hazing supervisor, the hazing team leader(s) and all participating vessels. The use of VHF radio on an appropriate working frequency is recommended. It is further recommended that all vessels be identified with a visible number/letter for easy field identification and that when possible the vessels be deployed in numerical or alphabetical order. This will facilitate the field hazing supervisor with providing effective direction to the vessel for maintain the position of the vessels.

To attempt a herding maneuver to divert the whale's path, the hazing unit(s) should approach the whales from the direction of the spill and intercept the whales' path. Vessels should be positioned

beam to beam at no more than 200 yard intervals. To establish the initial position and orientation of the hazing barrier, vessels may be assigned a specific latitude and longitude and be directed to maintain that position using GPS. Banging should commence in unison but does not need to remain synchronized when vessels are in position approximately 800 yards (1/2 mile) ahead of the whales. The recommended strike interval is two seconds but may be altered as dictated by the whale's response. The distance to the whales may gradually be reduced while assessing their direction of travel and response behavior.

The team leader should monitor closely for a response from the whales and coordinate vessel maneuvers as necessary to obstruct paths to the oil. Pursuing the whales and closing the distance to the whales is permissible to maintain their retreat with vessel maneuvering (circling, zigzagging) and occasional banging as required to reinforce the direction of travel away from the oil. Banging should cease immediately if the whales cross the line of vessels (penetrate the barrier). If whales penetrate the barrier, units should be repositioned in the path ahead of the whales between the whales and the oil. Vessels should retrieve their pipes before getting underway and stay at least ½ mile away from the whales while en route to the next deployment location. Once whales have established a path away from the spill hazard, gradually increase distance from the whales (remaining stationary or retreating toward the spill), and continue monitoring effort. If the whales do not respond to the hazing and continue travel along their original path unimpeded, notify the Branch Director of the whales' last position, direction and proximity to spill before leaving the whales to arrange for continued monitoring as whales approach the oil and/or deployment of alternate hazing resources. If the pod fragments during hazing, notify the WBD and pass the available information to inform subsequent hazing activities. Vessels involved in hazing/monitoring should remain on scene with the whales until they are a) directed to leave; b) replaced by other hazing/monitoring units; or c) the whales are more than 20 miles from the oil or trajectory (reconnaissance buffer); or conditions are unsafe for continued activity. If whales do not respond to hazing and enter the oil, monitoring should continue if possible to document the exposure of whales to the oil (record individuals in oil and length of exposure to oil).

Reporting – Oikami pipe hazing is harassment and any animals subjected to this technique must be included in a take report to be delivered to the NOAA Fisheries representative in the Wildlife Branch. Reports should include the number of animals subjected to the hazing, date, location, information on any photos taken, and response of the animals to the hazing. Take reports will be compiled by NOAA Fisheries and communicated to the Branch Director for use by the Unified Command and for use in reporting activities under Permit 932-1905 and for emergency consultation under Section 7 of the ESA. Monitoring information on exposure of individuals to oil should be reported to the Natural Resource Damage Assessment team.

Underwater Firecrackers

Background - Underwater firecrackers (or seal bombs) are primarily used as an intentional form of harassment for pinnipeds, but have also been effective tools for herding small cetaceans and killer whales. This technique should be accompanied by monitoring and observations of whale behavior (direction of travel, rate of speed, pod cohesion etc.) and detailed descriptions of deployment. The expected response is aversion or avoidance of the vicinity where detonations are occurring. The stimulus that triggers the response is sound from detonation that propagates well over a long

distance. Sound transmission from a detonation is omni-directional but the intense sound may be subject to reverberation or reflection from sub-surface topography.

Safety First – For personnel - Seal bombs are Class 1.4E explosives, UN number 0471, marketed as explosive pest control devices, and controlled as "high explosives" under the jurisdiction of the Bureau of Alcohol, Tobacco, and Firearms. Seal bombs have a charge similar to an "M-80" firecracker and detonate with an **explosive force capable of causing severe injury or death** to personnel. Personnel must attend a safety briefing before going to the field to familiarize them with the units and with safe handling procedures. While in the field, seal bombs should be kept in a container away from ignition sources and accessed one at a time to avoid accidental ignition. Hearing protection should be worn to avoid direct exposure to "in air" detonation that may cause permanent hearing loss. Once ignited, seal bombs should immediately be thrown overboard into the water on the downwind side of the vessel. Ignition torches should be extinguished when not in use. Avoid using sources of ignition near fuel storage tanks or vent lines or in locations where explosive fumes or flammable spilled product may be concentrated. Crew members aboard hazing vessels must be equipped with appropriate personal protection equipment for the level of spill exposure that may be encountered during deployment. *For the Whales* – There is some potential for whale injury using this technique. Seal bombs produce intense sound pressures (200 -220dB re 1 µPa or more at 1 meter from the source) and have the potential to damage whale hearing at close range (within a few meters). Seal bombs should not be deployed within 200 yards of killer whales to avoid inducing long-term hearing impairment.

Operational Instructions – The minimum operating unit for deploying seal bombs is two vessels and the minimum personnel complement for this unit is five. During hazing each vessel should have a driver and a bombardier that will deploy bombs. A hazing team leader will accompany the unit to coordinate vessel maneuvers within the unit, maintain communications with other units, and serve as an observer/data recorder to monitor the animals, record notes of the encounter including pre-, during, and post-hazing observations, and take identification photographs. A field hazing supervisor should be assigned to coordinate maneuvers if more than one hazing unit is deployed. To attempt a herding maneuver to divert the whale's path, position the hazing unit(s) to approach the whales from the direction of the spill and intercept the whales' path. Vessels should be positioned beam to beam at 200 yard intervals. The first bomb should be deployed at a distance greater than 1/2 mile ahead of the whales. (Note: The acoustic harassment threshold for disturbance is approximately 1000 yards from the point of detonation.) It is recommended that bombs be used sparingly. After the initial detonation, the hazing team leader should observe the reaction of the whales to determine whether they have responded by changing direction, if the pod has coalesced or scattered. While an orderly retreat from the area is the desired response, it is possible that the bombs could cause panic flight of whales in multiple directions.

Once the initial reaction has been determined the hazing unit should move to intercept and obstruct paths to the oil. Pursuing the whales and closing the distance to the whales is permissible to maintain their retreat with vessel maneuvering (circling, zigzagging) and occasional detonations as required to reinforce the direction of travel away from the oil. Vessels should avoid deploying bombs within 400 yards of whales unless the whales exhibit growing tolerance or reluctance to maintain a course away from the oil. Bombs should not be deployed within 200 yards of the whales. Bombing activity should cease immediately if whales penetrate the hazing line and are seen between the hazing teams and the oil. If whales evade the hazing team and are on course

toward the oil, hazing units should be repositioned in the path ahead of the whales between the whales and the oil. Vessels should stay at least ½ mile away from the whales while en route to the next deployment location. Once whales have established a path away from the spill hazard, gradually increase distance from the whales (remaining stationary or retreating toward the spill), and continue monitoring effort. If the whales do not respond to the hazing and continue travel along their original path unimpeded, notify the WBD of the whales' last position, direction and proximity to spill. Vessels involved in hazing/monitoring should remain on scene with the whales until they are a) directed to leave; b) replaced by other hazing/monitoring units; or c) the whales are more than 20 miles from the oil or trajectory (reconnaissance buffer); or conditions are unsafe for continued activity. If whales do not respond to hazing and enter the oil, monitoring should continue if possible to document the exposure of whales to the oil (record individuals in oil and length of exposure to oil).

Reporting – Deploying seal bombs within 1000 yards of a marine mammal may constitute harassment and any animals subjected to this technique must be included in a take report to be delivered to the NOAA Fisheries representative in the Wildlife Branch. Reports should include the number of animals subjected to the hazing, date, location, information on any photos taken, and response of the animals to the hazing. Take reports will be compiled by NOAA Fisheries and communicated to the Branch Director for use by the Unified Command and for use in reporting activities under Permit 932-1905 and for emergency consultation under Section 7 of the ESA. Monitoring information on exposure of individuals to oil should be reported to the Natural Resource Damage Assessment team.

IV. Hazing Team Instructions

This section contains hazing team instructions for implementing each of the three pre-approved techniques described above are attached to this implementation plan. The instructions are short outlines include brief description of each hazing activity, safety precautions for personnel and whales, hazing unit staffing recommendations, abbreviated operational instructions, and reporting formats. Copies of the instructions should be given to each field team, during the pre-deployment and safety briefing, to be carried into field as a ready reference.

A. Hazing Team Instruction - Helicopter hazing

The purpose of helicopter hazing is to intercept whales that are approaching the oil and change their direction to avoid oil exposure. The desired outcome is that maneuvers result in an orderly change in the whale's direction of travel and that as a result they move a sufficient distance from the oil to allow re-engagement by hazing assets as necessary to block the whale's path to the oil. If whales are already in the oil slick, maintain altitude greater than 500 feet, collect photographs of the whales that are present in the oil, for later identification. Contact the Branch Director (or designee) to report observations and receive instructions before attempting hazing maneuvers.

Human Safety precautions

Hazing whales with a helicopter requires low altitude maneuvering and hovering low over the water. Assess environmental conditions (visibility, turbulence etc.), surrounding air traffic (search and rescue, media), and surface vessel proximity to determine if it is safe to proceed with this technique.

Whale Safety precautions

The potential for whale injury using this technique is low sound levels from the helicopter will not be sufficient to injure whale hearing. No physical contact with whales is anticipated. Aerial hazing could affect pod cohesion if different whales in the group respond differently to the helicopter and group information should be recorded to assess impacts to the whales.

Operating unit size and configuration

Optimum unit size: three

1) pilot,
2) lead observer to continuously monitor the animals, provide whale information to the pilot and direct maneuvering, and
3) data recorder/photographer to record notes of the encounter including pre and post hazing observations and identification photographs.

If fewer personnel are used, the observer will assume data collection and photography duties.

Beginning position

Position the helicopter to approach the whales from the direction of the spill. If safe to do so the helicopter should begin maneuvering at an altitude of 300 to 500 feet approximately ¼ to ½ mile from the whales. Noise transmission into the water is most efficient in a circle below the helicopter roughly ½ the diameter of the flight altitude (for altitudes below 1000 feet).

Approach to divert path of the whales

Maintain a position between the whales and the oiled area, gradually reducing the distance to the whales and altitude.

Once whales have established and are maintaining a path away from the spill hazard, gradually increase distance from the whales (retreating toward the spill), increase altitude, and resume monitoring effort to document post-hazing movements. If possible, avoid leaving the whales in the vicinity of the spill if other monitoring/hazing assets are not available to intercept the whale's path should they turn again toward the spill. Contact the Branch Director (or designee) to determine the availability of other monitoring assets prior to leaving the area.

Contingencies

If the whales do not respond to the helicopter and continue travel along their original path unimpeded, notify the Branch Director (or designee) before leaving the whales to arrange for continued monitoring as whales approach the oil and/or deployment of alternate hazing resources. If the pod fragments when the helicopter approaches, record the response and notify the Branch Director (or designee) to pass along the available information. If whales do not respond to hazing and enter the oil, monitoring should continue if possible to document the exposure of whales to the oil (record individuals in oil and length of exposure to oil).

Monitoring and take reports

Monitoring of whale's position and exposure:

Date/time	# whales	Location of whales	Whale heading	Group spread	Photos taken	Whales in oil?

When hazing is initiated:

Date/time	# whales	Location of hazing unit	Distance to whales	Response of whales	Photos taken

B. Hazing Team Instruction - Oikami Pipes

The purpose of oikami pipe hazing is to intercept whales that are approaching the oil and change their direction to avoid oil exposure. The desired outcome is that maneuvers result in an orderly change in the whale's direction of travel and that as a result they move a sufficient distance from the oil to allow re-engagement by hazing assets as necessary to block the whale's path to the oil. If whales are already in the oil slick, vessels should maintain a distance greater than 200 yards, collect photographs of the whales that are present in the oil, for later identification. Contact the Branch Director (or designee) to report observations and receive instructions before attempting hazing maneuvers.

Human Safety precautions

Oikami pipes are deployed over the side of small boats and operated manually by striking with a hammer. Vessels selected as platforms should large enough for safe operation under the existing environmental conditions while providing a stable platform that is close enough to the water so that personnel can work safely at the gunnel for extended periods.

Whale Safety precautions

Sound from the banging pipes and transmitted into the water will be most intense within a few yards of the pipes but will not be sufficient to injure whale hearing. No physical contact with whales is anticipated. Vessels deploying pipes should be operated at slow displacement speed when in proximity to whales to minimize the risk of collision. Engines should be shifted to neutral (no spinning prop) if within 100 yards of whales.

Operating unit size and configuration

Hazing unit size: three vessels
Optimum crew size per unit: seven

1) three boat drivers (one per boat),
2) three pipe bangers (one per boat),
3) one hazing team leader, coordinate vessel maneuvers within the unit, maintain communications with other units, and serve as an observer/data recorder to monitor the animals, and to record notes of the encounter including pre and post hazing observations and identification photographs.

Additional pipe bangers can be assigned to vessels if multiple pipes are deployed from each boat. A field hazing supervisor should be assigned to coordinate maneuvers if more than one hazing unit is deployed.

Beginning position

Position the hazing unit(s) to approach the whales from the direction of the spill and intercept the whale's path. Vessels should be positioned beam to beam at 200 yard intervals. Banging should commence in unison when vessels are in position approximately 800 yards (1/2 mile) ahead of the whales. The recommended strike interval is two seconds but may be altered as dictated by the whale's response.

Approach to divert path of the whales

The distance to the whales may gradually be reduced while assessing their direction of travel and response behavior. Monitor closely for a response from the whales and maneuver as necessary to

obstruct paths to the oil. Pursuing the whales and closing the distance to the whales is permissible to maintain their retreat with vessel maneuvering (circling, zigzagging) and occasional banging as required to reinforce the direction of travel away from the oil.

Once whales have established a path away from the spill hazard, gradually increase distance from the whales (remaining stationary or retreating toward the spill), and resume monitoring effort to document post-hazing movements. If possible, avoid leaving the whales in the vicinity of the spill if other monitoring/hazing assets are not available to intercept the whale's path should they turn again toward the spill. Contact the Branch Director (or designee) to determine the availability of other monitoring assets prior to leaving the area.

Contingencies

Banging should cease immediately if the whales cross the line of vessels (penetrate the barrier). If whales penetrate the barrier, units should be repositioned in the path ahead of the whales between the whales and the oil. Vessels should retrieve their pipes before getting underway and stay at least ½ mile away from the whales while en route to the next deployment location.

If the whales do not respond to the hazing and continue travel along their original path unimpeded, notify the Branch Director (or designee) before leaving the whales to arrange for continued monitoring as whales approach the oil and/or deployment of alternate hazing resources. If the pod fragments, record the response and notify the Branch Director (or designee) to pass along the available information. If whales do not respond to hazing and enter the oil, monitoring should continue if possible to document the exposure of whales to the oil (record individuals in oil and length of exposure to oil).

Monitoring and take reports

Monitoring of whale's position and exposure:

Date/time	# whales	Location of whales	Whale heading	Group spread	Photos taken	Whales in oil?

When hazing is initiated:

Date/time	# whales	Location of hazing unit	Distance to whales	Response of whales	Photos taken

C. Hazing Team Instruction - Underwater Firecrackers

The purpose of underwater firecracker hazing is to deter whales from entering the oil and drive them away from the oil to avoid oil exposure. The desired outcome is aversion or avoidance of the vicinity where detonations are occurring. (Panic flight is a less desirable response from the whales than orderly retreat from the area.) The stimulus that triggers the response is intense sound from detonation that propagates well over a long distance. If whales are already in the oil slick, vessels should maintain a distance greater than 200 yards, collect photographs of the whales that are present in the oil, for later identification. Contact the Branch Director (or designee) to report observations and receive instructions before attempting hazing maneuvers.

Human Safety precautions

Seal bombs have a charge similar to an "M-80" firecracker and detonate with an **explosive force capable of causing severe injury or death** to personnel. Personnel should be given a safety briefing before going to the field to familiarize them with the units and with safe handling procedures.

Whale Safety precautions

Seal bombs produce intense sound pressures (200 -220dB re 1 µPa or more at 1 meter from the source) and have the potential to damage whale hearing at close range. Seal bombs should not be deployed within 200 yards of killer whales to avoid inducing temporary hearing impairment.

Operating unit size and configuration

Hazing unit size: two vessels

Optimum crew size per unit: five

1) two boat drivers (one per boat),
2) two bombardiers (one per boat),
3) one hazing team leader, coordinate vessel maneuvers within the unit, maintain communications with other units, and serve as an observer/data recorder to monitor the animals, and to record notes of the encounter including pre and post hazing observations and identification photographs.

A field hazing supervisor should be assigned to coordinate maneuvers if more than one hazing unit is deployed.

Beginning position

Position the hazing unit(s) to approach the whales from the direction of the spill and intercept the whales' path. Vessels should be positioned beam to beam at 200 yard intervals. The first bomb should be deployed at a distance greater than 1/2 mile ahead of the whales. (Note: The acoustic harassment threshold for disturbance is approximately 1000 yards from the point of detonation.) It is recommended that bombs be used sparingly.

Approach to divert path of the whales

After the initial detonation, the hazing team leader should observe the reaction of the whales to determine whether they have responded by changing direction, if the pod has coalesced or scattered. Once the initial reaction has been determined the hazing unit should move to intercept and obstruct paths to the oil. Pursuing the whales and closing the distance to the whales is permissible to maintain their retreat with vessel maneuvering (circling, zigzagging) using occasional detonations as required to reinforce the direction of travel away from the oil. Vessels should avoid deploying

bombs within 400 yards of whales unless the whales exhibit growing tolerance or reluctance to maintain a course away from the oil.

Once whales have established a path away from the spill hazard, gradually increase distance from the whales (remaining stationary or retreating toward the spill), and resume monitoring effort to document post-hazing movements. If possible, avoid leaving the whales in the vicinity of the spill if other monitoring/hazing assets are not available to intercept the whale's path should they turn again toward the spill. Contact the Branch Director (or designee) to determine the availability of other monitoring assets prior to leaving the area.

Contingencies

Bombing activity should cease immediately if whales are seen between the hazing teams and the oil. If whales evade the hazing team and are on course toward the oil, hazing units should be repositioned in the path ahead of the whales between the whales and the oil. Vessels should stay at least ½ mile away from the whales while en route to the next deployment location. If the whales do not respond to the hazing and continue travel along their original path unimpeded, notify the Branch Director (or designee) before leaving the whales to arrange for continued monitoring as whales approach the oil and/or deployment of alternate hazing resources. If the pod fragments during hazing, notify the Branch Director (or designee) and pass the available information. If whales do not respond to hazing and enter the oil, monitoring should continue if possible to document the exposure of whales to the oil (record individuals in oil and length of exposure to oil).

Monitoring and take reports

Monitoring of whale's position and exposure:

Date/time	# whales	Location of whales	Whale heading	Group spread	Photos taken	Whales in oil?

When hazing is initiated:

Date/time	# whales	Location of hazing unit	Distance to whales	Response of whales	Photos taken

V. Other Hazing Methods (not pre-approved)

As explained above, If NOAA Fisheries cannot be reached or the emergent nature of the event requires immediate intervention to protect endangered whales from oil exposure, the Wildlife Branch Director will coordinate with the Federal On-Scene Coordinator to implement hazing activities as authorized in the [date] delegation letter issued under MMPA/ESA Research and Enhancement Permit Number 932-1905. Only pre-approved hazing techniques will be considered in this case. In the event that other forms of take, (harassment (hazing using non pre-approved techniques), capture (rescue), or humane euthanasia) are considered, the Unified Command (Wildlife Branch Director, Federal On-Scene Coordinator) will consult with NOAA Fisheries (Regional Marine Mammal Staff and/or the Permit Holder (Dr. Teri Rowles, Marine Mammal Health and Stranding Response Program) to indentify and plan for alternative marine mammal response activities. NOAA Fisheries concurrence with proposed response plans is required before take can be authorized under Permit 932-1905.

If NOAA Fisheries marine mammal staff are assigned to the spill response, all marine mammal take activities including pre-approved and alternative hazing strategies will be discussed between the Wildlife Branch Director and NOAA Fisheries marine mammal staff before initiating field activities. Alternative hazing strategies, monitoring guidance, and resources lists can be found in the Northwest Area Contingency Plan Appendix, Killer Whale – Monitoring and Hazing Plan for Oil Spill Response in Washington and Oregon State.

VI. References

Matkin, C.O., E. L. Saulitis, G. M. Ellis, P. Olesiuk, and S. D. Rices. 2008. Ongoing population-level impacts on killer whales *Orcinus orca* following the 'Exxon Valdez' oil spill in Prince William Sound, Alaska. Marine Ecology Progress Series, Vol. 356: 269-281.

National Marine Fisheries Service. 2008. Recovery Plan for Southern Resident Killer Whales (*Orcinus orca*). National Marine Fisheries Service, Northwest Region, Seattle, Washington.

Appendix 2: Task Force Members and workshop attendees

Task Force Members

Name	Entity
Matt Bissell	WA Ecology
Karen Denny	WA Ecology
LCDR Brian Dykens	USCG
Jeff Foster	The Sanctuary Project
Alanna Frayne	Soundwatch – The Whale Museum
Tara Galuska	WA RCO
Deborah Giles	Wild Orca
Max Gordon	WA Ecology
Atalie Grant	WA Ecology
Todd Hass	Puget Sound Partnership
Christopher Johnston, CWO-2	USCG
Faith Knighton	NOAA
Brian MacDonald	WA Ecology
Montana Mcleod	WDFW
Hanna Miller	NOAA Fisheries
Lori Muller	EPA
Jess Newley	Friends of the San Juans
Don Noviello	WDFW
Lovel Pratt	Friends of the San Juans
Michael O'Leary	
Frances Robertson	San Juan County
Jenny Schlieps	Focas Wildlife
Artie Seaman	
Kyle Vincent	NOAA
Margaret Woodbridge, LCDR	USCG

Workshop Attendees

Name	Entity	Area of Expertise
David Bain	Orca Conservancy	SRKW Expertise
Sarah Benovic	US Navy	
Matt Bissell *	WA Ecology	Spill Response and Prevention
Paul Cottrell**	Canadian DFO	SRKW & Deterrence Expertise
Justin Dummitt	The Whale Museum	Marine Mammal Stranding and Response
LCDR Brian Dykens*	USCG	Spill Response, TF Lead
Candice Emmons	NWFSC	SRKW Expertise
Jeff Foster*	The Sanctuary Project	SRKW & Deterrence Expertise
Amy Fowler	US Navy	
Deborah Giles*	Wild Orca	SRKW Expertise, TF Lead
Erin Gless	PWWA	SRKW Expertise
Brad Hanson	NWFSC	SRKW Expertise
Todd Hass*	Puget Sound Partnership	SRKW
Jeff Hogan	Killer Whale Tales	SRKW Expertise
Marla Holt	NWFSC	SRKW & Acoustic Expertise
Pema Kitaeff	UW FHL	Workshop note taker
Chloe Kotik	Orca Conservancy	
Brian MacDonald*	WA Ecology	Spill response and wildlife response
Montana Mcleod*	WDFW	Spill response and wildlife response
Hanna Miller*	NOAA Fisheries	Marine Mammal expert and response
Alexis Morrigan	The Whale Museum	Marine mammal stranding and response
Jess Newley*	Friends of the San Juans	SRKW Expertise
Don Noviello*	WDFW	Spill response and wildlife response
Lovel Pratt*	Friends of the San Juans	Marine Policy
Michael O'Leary*		
Frances Robertson*	San Juan County	SRKW Expertise, marine policy, TF Lead
Jenny Schlieps*	Focas Wildlife	Wildlife response
Jessica Stocking*	WDFW	SRKW Expertise
Philip Thorson	US Navy	
Jared Towers**		Killer whale & deterrence expertise
Val Viers	Beam Reach	SRKW & Acoustic Expertise
Monika Wieland	Orca Behavior Institute	SRKW Expertise
Jason Wood	SMRU Consulting	SRKW & Acoustic Expertise

*Task Force members

** Participated virtually

Appendix 3. Workshop Agenda

RRT/NWAC
REGION 10 REGIONAL RESPONSE TEAM and the NORTHWEST AREA COMMITTEE

UW Friday Harbor Labs, San Juan Island

14 & 15 December

NWAC Whale Deterrence Task Force Workshop

Agenda

Day 1: December 14

8:00 – 8:45	Arrive, light breakfast refreshments
8:45 – 9:15	Acknowledgement Introductions and Expectations *Setting the Goals and Framework of the workshop* *Frances Robertson, San Juan County and Brian Dykens LCDR USCG*
9:15 – 9:30	The Incident Command Structure and where wildlife response & whale deterrence fit. *Don Noviello, WDFW*
9:30 – 10:00	Review of the current NOAA SRKW authorized hazing tools and implementation *Hanna Miller, NOAA*
10:00 – 10:15	*Q&A Discussion*
10:15 – 10:25	***Coffee Break***
10:25 – 10:35	Review of the Aleutian Isle Incident *Hanna Miller, NOAA*
10:35 – 10:55	*A*coustic analysis of Okami pipe use during Aleutian Isle response *Jason Wood, SMRU Consulting*
10:55 – 11:15	General discussion on AI Response *Facilitated by Don Noviello and Hanna Miller*
11:15 – 12:00	**Break-out stations** (participants rotate through 3 stations in groups) Station 1: Review response teams/vessel types/locations – goal to identify which groups are missing from lists, identify where equipment is located, could be located and other gaps. Station 2: Identify challenges and gaps in response plans and suggest solutions Station 3: Identify seasons/months, spatial scales, or marine regions where there are gaps for deterrence deployment.
12:00 - 12:45	*** LUNCH***
12:45 – 13:00	Recap on what was identified at the breakout stations *Discussion facilitated by Giles and Frances*
13:00 – 13:15	Preparation requirements presentation (training, drills, equipment) *Montanna McLeod, WDFW*
13:15 – 13:25	Q&A discussion

13:25 – 14:15	Overview of funding structure for response needs and discussion around how to fund responders in incidents where vessels or spill source unknown *Matt Bissel, WA Ecology, Brian Dykens LCDR USCG,*
14:15 – 14:30	***** Coffee Break *****
14:30 – 16:00	Recommendations discussion based on currently authorized tools based on presentations and discussions had throughout the day *Discussion facilitated by Giles and Frances*
16:00 - 16:15	Round up for the day and layout for day two.

Day 2: December 15

8:00 – 8:45	Arrive, coffee, light refreshments
8:45 – 9:10	– Recap of day one and review of the current authorized tools and the potential for alternatives: what is effective whale deterrence? *Don Noviello, WDFW*
9:10 – 9:55	Learning from other deterrence events – what worked, what didn't work *Hybrid Panel: Dave Bain, Orca Conservancy, Paul Cottrel, DFO, and Jeff Foster, extensive experience in marine mammal behavior, capture, rescue, and rehab, and possibly Jared Towers*
9:55 – 10:10	Q&A Discussion
10:10 – 10:20	***** Coffee Break*****
10:20 – 10:50	Review of SKRW variables that may influence effectiveness *Led by Deborah Giles, Wild Orca*
10:50 – 11:20	Facilitated discussion around whale variables, environmental conditions, and these impact the success of tools and implementation. *Discussion facilitated by Giles and Frances*
11:20 – 11:50	Facilitated discussion surrounding alternative tools for deterrence – pros and cons of identified alternatives. *Discussion facilitated by Giles and Frances*
12:00 – 12:45	***** Lunch *****
12:45 – 13:00	Recap of morning session Giles, Frances, and Brian
13:00 – 14:00	Facilitated discussion to identify recommendations related to pursuing research into the effectiveness and availability of alternative deterrence tools for consideration for future authorization.
14:00 – 14:20	Workshop sum up and close

Appendix 4: Updated potential responder contact list

The organizations listed here were identified by participants in the December 2023 workshop as those with the capabilities to undertake whale deterrence (Tier 1), on water (Tier 2), or land based reconnaissance (Tier 3). This list has been provided to the WDFW Oil Spills Team who will undertake the task to contact and confirm the level of response that each organization is able to provide. Additionally, WDFW's Oil Spills Team is providing training for confirmed Tier 1 responder organizations starting in August 2024. Once confirmed these organizations will be added to the oilspills101.org website.

Entity	Type	Location	Monitoring	Deterrence	Potential Primary Response Org*
Cascadia Research	NGO	Olympia, WA	UNK	YES	Tier 1
Center for Whale Research	NGO	San Juan Island, WA	YES	UNK	UNK
Makah Tribe	Tribe	Neah Bay, WA	UNK	UNK	UNK
MarEcoTel	NGO	Seabeck, WA	UNK	UNK	Tier 1
NOAA	Federal	Seattle, WA	UNK	YES	Tier 1
		Port Angeles, WA	YES	YES	Tier 1
Orca Behavior Institute	NGO	San Juan Island, WA	YES	NO	Tier 3
Orca Network	NGO	Whidby Island, WA	YES	NO	Tier 3
Pacific Whale Watch Association	Industry	Bellingham, WA	YES	NO	Tier 2
		Flounder Bay, WA	YES	NO	
		Fidalgo Island, WA	YES	NO	
		Port Townsend, WA	YES	NO	
		Edmonds, WA	YES	NO	
		Seattle, WA	YES	NO	
		Victoria, BC	YES	NO	
		Sooke, BC	YES	NO	
		Cordova Spit, BC	YES	NO	
		Port Angeles, WA	YES	NO	
		Deception Pass, WA	YES	NO	
PacMam	NGO	Anacortes, WA	YES	YES	Tier 1
SJC Marine Mammal Stranding Network	NGO	San Juan Island, WA	YES	YES	Tier 1
Sea Doc Society	NGO	Orcas Island, WA	UNK	YES	Tier 1
Sealife Response Rehabilitation and Rescue	NGO	Stuart Island/San Juan Island, WA	YES	YES	Tier 1
		Des Moines, WA	YES	YES	Tier 1
Soundwatch Boater Education Program	NGO	San Juan Island, WA	YES	YES	Tier 1
The Whale Museum	NGO	San Juan Island, WA	YES	NO	Tier 3
US Coast Guard	Federal	Neah Bay, WA	UNK	YES	Tier 1

Entity	Type	Location	Monitoring	Deterrence	Potential Primary Response Org*
		Port Angeles, WA Bellingham, WA Everett, WA Discovery Bay, WA Seattle, WA	UNK UNK UNK UNK UNK	YES YES YES YES YES	
US Navy	Federal	Bangor, WA Bremerton, WA	UNK UNK	YES YES	UNK
WDFW	State	Lakewood, WA Port Townsend, WA	UNK UNK	YES YES	Tier 1 Tier 1
Wild Orca	NGO	San Juan Island, WA	YES	YES	Tier 1

**Where a Tier 1 Primary Response Organization is one with whale expertise and whose personnel have undergone regular training and drills to ensure they are prepared in the event of a spill event.*

Appendix 5: Full list of recommendations from the workshop

Recommendations related to response assets (teams and equipment)

	Recommendation	Agency Lead	Support	Score	Ranked priority
1	**Identify potential primary responder teams in advance, including a list of whale experts in the region that can be approved by NOAA to lead deterrence operations.**		**OBI, USCG, PWWA, NMFS, WDFW, SJC**	**6**	**3**
2	Continue to establish a relationship with PWWA for reconnaissance operations during an incident.	USCG, PWWA, TWM	NMFS, WDFW, ECOLOGY	0	-
3	Explore how enforcement (e.g., WDFW and NOAA enforcement teams that monitor for whale regulations) can be included as responders, especially to fill gaps in deterrence teams.	WDFW	USCG, NMFS, SJC	0	-
4	**Identify opportunities to have USCG fill geographical gaps in the short-term during an incident response – e.g., the Olympic Peninsula has been identified as a gap for responder location.**	**USCG**	**USCG**	**4**	**5**
5	Compile updated list of potential primary responder teams including locations and contact details for inclusion in response plans.		USCG, NMFS, WDFW, TWM, ECOLOGY	2	7
6	Finalize deterrence resource layer for ERMA to map locations of deterrence assets by type (bird, marine mammal, vessel), (e.g., response teams and deterrence tools).	WDFW	NOAA R&R	0	-
7	Purchase more oikomi pipes and/or identify additional locations to store pipes.	NMFS, PSP	USCG, WDFW, TWM	1	8
8	Explore possibility of including caches of pipes with existing Ecology oil spill response trailers.	USCG, TWM, ECOLOGY	USCG, WDFW, ECOLOGY	0	-
9	Expand hydrophone network within the Salish Sea to improve reconnaissance efforts.	PSP, SMRU	OBI, CWR	1	8

Recommendations related to training and drills

	Recommendation	Agency Lead	Support	Score	Ranked Priority
10	**Train primary responders as those that are able to deploy during first initial response.**	**WDFW, TWM**	**USCG, FOCUS**	**8**	**1**
11	Identify training standards for primary responders (e.g., should include ICS 100 & 200m, and 8 or 24 hr HAZWOPER to equip responders with a better understanding of how whale deterrence fits within the Wildlife Response of a Unified Command Structure).	WDFW	NMFS, WDFW, FOCUS, TWM, SJC	0	-
12	Include whale deterrence incidents in industry drills.	USCG, ECOLOGY	USCG, NMFS, WDFW, FOCUS, NOAA R&R, ECOLOGY	2	7
13	Engage Canadian partners in implementing a transboundary drill – set the goal to run the drill in 2026.	USCG, ECOLOGY	USCG, NMFS, WDFW, PSP, FOCUS, ECOLOGY	3	6
14	**Identify sustainable funding opportunities to ensure regular training and drills of response teams.**		**FOSJ**	**5**	**4**

Recommendations related to response structure and communications

	Recommendation	Agency Lead	Support	Score	Ranke Priority
15	Create a BMP (Best Management Practice) for authorized deterrence tools, e.g., for the oikomi Pipes – include in RRT 9310.	NMFS	NMFS, WDFW, CWR, NOAA R&R	0	-
16	Ensure contact lists of responders and deterrence tool information is updated regularly – establish responsibility for and timeline for updates.		USCG, NMFS, TWM, CWR, FOCUS, ECOLOGY, SJC	0	-
17	Annual exchange of information and authorizations between key stakeholders, especially if whales are present. Include contact list to be verified annually.		USCG, PWWA, WDFW, CWR, NOAA R&R	0	-
18	Formalize and streamline communications within the strict ICS structure and with responders.	USCG, WDFW	USCG, PWWA, NMFS, FOCUS, TWM	0	-
19	Update Response Plans with identified response resources and teams (RRTS e.g. 9310, and spills101.org)	USCG	WDFW, FOCUS, SJC	1	8
20	Utilize existing secure online systems to store response documents that may include contact information of response teams to ensure that it is available to the Wildlife Branch and USCG in the event of an incident but not to the public.		WDFW	0	-

. Recommendations related to deterrence methods

	Recommendation	Agency Lead	Support	Score	Ranked Priority
21	Continue the discussion between NOAA and USCG regarding use of Seal Bombs and whether they continue to be listed as a preapproved tool (though continue to keep them as part of a broader deterrence toolbox).	USCG, NMFS		0	-
22	Have Paul Cottrell write up a white paper on the use of underwater speakers for playbacks and explore their use in the US.	NMFS	CWR, PSP, SMRU	1	8
23	*Have SMRU Consulting finalize their 2022 recordings of Oikami pipe use from the F/V Aleutian Isle into a short report.*	*NMFS, SMRU*	*CWR*	*COMPLETE*	
24	Choke points to deploy deterrence to keep whales away or turn them around have been proposed. Map proposed chokepoints and compare to SRKW movements and examine local conditions (environmental and shipping) that may influence the effectiveness of chokepoints.		OBI, PWWA, WDFW, CWR	3	6
25	Once suitable chokepoints determined link with the GRPs and associated notifications.			0	-
26	**Research different deterrence methods – e.g., Hukilau surface deterrence, Acoustic Harassment Devices, Genus-wave device, Bluebell speakers and playbacks.**	**WDFW, CWR**	**OBI, CWR, SMRU**	**7**	**2**
27	Compile an acoustic library of sounds for playbacks.	SMRU	OBI, CWR	1	8
28	Compile the list of deterrence approaches/tools for mammals and birds to determine how they may interact, e.g., are there tools that should not be considered for mammals if they will interact or interfere with the deterrence activities to protect birds?	CWR FOCUS	NMFS, FOCUS	2	7
29	Consider including water cannons as an authorized deterrence tool (USCG vessels are equipped with water cannons).	NMFS, USCG			

Other recommendations

	Recommendation	Agency Lead	Support	Score	Ranked Priority
30	Create standing whale deterrence subgroup once Task Force sunsets	USCG	WDFW, CWR	1	8
31	Consult with tribes for input regarding whale deterrence – are there areas where certain tools are inappropriate for example. Tribes have the authority to deny the use of a specific deterrent tactic. This should be a on-time project, started as soon as possible and led by a government agency with support from others with expertise about whales and spill response	NMFS WDFW	SJC TWM CWR	0	-
32	Create a shared resources repository – both for the Task Force and in general.		ECOLOGY	0	-
33	Identify gaps between legislative authority and tasks that need to be done.	WDFW	FOSJ, TWM, ECOLOGY	0	-
34	Explore different ways to engage NGOs in deterrence work – e.g., implementing new technologies.		OBI, TWM	1	8
35	Review dispersant use guidelines with regards to use in areas near whale activity.		FOSJ, ECOLOGY	0	-