

Supporting Information for the Killer Whale section of the Northwest Wildlife Response Plan, Chapter 9970 of the NWACP

I. This document is intended to provide contacts and supporting information for use by spill responders when implementing or testing the Killer Whale – Monitoring and Hazing Plan for Oil Spill Response. Tables 1. thru 3. contain contact information for knowledgeable personnel and equipment. This is followed by a practicality analysis that supports the hazing method priority table contained in the Monitoring and Hazing Plan and a section that describes the general advantages and disadvantages of each hazing method.

A. Table 1: Groups or individuals who are able to identify killer whales to ecotype, pod and individual

| Name | Contact Number |
|------------------------------------|----------------|
| Cascadia Research Collective | (360) 943-7325 |
| Center for Whale Research | (360) 378-5835 |
| Department of Fisheries and Oceans | (250) 729-8375 |
| Lifeforce Foundation | (604) 649-5258 |
| Northwest Fisheries Science Center | (206) 860-3220 |
| Whale Museum | (800) 562-8832 |

B. Table 2: Regional whale sighting networks

| Resource | Phone Number | Contact Person |
|------------------------------|-----------------------------------|--|
| BC Cetacean Sighting Network | (866) I-SAW-ONE | |
| Cascadia Research Collective | (800) 747-7329 or (360) 943-7325 | John Calambokidis, Erin Falcone or Robin Baird |
| Center for Whale Research | (360) 378-5835 | Ken Balcolmb |

| | | |
|--|---|---------------------------------------|
| Fisheries & Oceans Canada – British Columbia Marine Response Network | (800) 465-4336 | Marine Mammal Incident Coordinator |
| Lifeforce Whale and Dolphin Hotline | (604) 649-5258 | Peter Hamilton |
| Northwest Fisheries Science Center | (206) 860-3220 | Brad Hanson or Dawn Noren |
| Orca Network | (360) 678-3451 | Susan Berta or Howard Garrett |
| Whale Museum Sighting Hotline and acoustic array | (800) 562-8832 | Jenny Akinson or Amy Traxler |
| Pacific Whale Watch Association | (360) 661-5830 (cell) or (360) 293-2428 (office) | Shane Aggargard, President |

C. Table 3: Resources available for deterring killer whales from an oil spill

| Resource | Location | Contact Name | Contact Number |
|--|---------------------------------|---------------------------------|-------------------------------------|
| Oikomi Pipes (12) | NOAA Sand Point Facility | Brent Norberg or Lynne Barre | (206) 526-6550 or (206) 526-4745 |
| Seal Control Devices | NOAA | Brent Norberg or Lynne Barre | (206) 526-6550 or (206) 526-4745 |
| AHDs and ADDs | NOAA | Brent Norberg or Lynne Barre | (206) 526-6550 or (206) 526-4745 |
| 44' shallow draft boat with licensed captains and capabilities for safe use 24-7 (including night vision capability and underwater speakers with onboard amplifiers) | Global Research and Rescue | Bob Wood | (206) 954-5192 |
| 27' Pacific aluminum skiff with center console | NOAA/NWFSC, Seattle | Dawn Noren | (206) 302-2439 |
| 26' Olympic XL boat with cabin and cockpit | SeaDoc Society, Orcas Island | Joseph Gaydos | (360) 376-3910 or (360) 914-1083 |
| 24' ProLine center console boat | NOAA | Brent Norberg or Lynne Barre | (206) 526-6550 or (206) 526-4745 |

| | | | |
|---|---|--|--|
| 19' SAFE Boat | Whale Museum | Jenny Akinson | (800) 562-8832 |
| 18' rigid-hulled inflatable boats (n=2) | Cascadia Research, Olympia | John Calambokidis, Erin Falcone or Robin Baird | (360) 943-7325 or (360) 280-8349 |
| 18' Campion boat with 150 HP outboard, large open cockpit with optional full canvas camper cover. | Lifeforce Foundation, Vancouver, BC | Peter Hamilton | (604) 649-5258 |
| Killer Whale Call Recordings | Center for Whale Research | Ken Balcomb | (360) 378-5835 |
| Killer Whale Call Recordings | Department of Fisheries and Oceans, BC | John Ford | (250) 729-8375 |
| Underwater Playback Systems (n=2) and Killer Whale Call Recordings | Lifeforce Foundation, Vancouver, BC | Peter Hamilton | (604) 649-5258 |
| Numerous boats of varying size | Whale Watch Operators Association Northwest | Shane Aggargard, President | (360) 661-5830 (cell) or (360) 293-2428 (office) |

D. Hazing Method Practicality Analysis

As detailed in the table below a practicality analysis of the various hazing methods considered was conducted by enumerating values for the efficacy, speed of deployment, risk of injury to the whales, level of training requirements for crews using the method, number of people required to implement the method and equipment availability. There is no one hazing technique that will work in all situations. The potential benefit of employing a technique will be a product of the current circumstances, how the technique is employed, the experience of the people employing the technique and the degree to which whales are attracted to an area. The risk of killer whale exposure to oil must be considered relative to the risk associated with hazing.

| Ranked Practicality of Various Hazing Methods | | | | | | | |
|---|----------------------------|-------|----------------|-----------------------|--------------------|-----------------|-------|
| Method | Efficacy (double score) | Speed | Risk of Injury | Training Requirements | Personnel Required | Equip Available | Total |
| Oikomi Pipes | 4 (8) | 3 | 4 | 3 | 1 | 4 | 23 |
| Seal control devices | 4 (8) | 3 | 2 | 2 | 3 | 4 | 22 |
| Aircraft | 3 (6) | 4 | 4 | 0 * | 4 | 4 | 22 |
| Experimental Methods | 1 (2) | 2 | 3 | 3 | 4 | 3 ** | 18 |

| | | | | | | | |
|-----------------------------|-------|--------|--------|--------|---|---|----------|
| Acoustic Deterrent Devices | 1 (2) | 3 | 4 | 3 | 2 | 2 | 16 |
| Fire Hoses | 1 (2) | 3 | 2 | 2 | 3 | 3 | 15 |
| Acoustic Harassment Devices | 1 (2) | 2 | 2 | 2 | 4 | 2 | 14 |
| Vessel Traffic | 1 (2) | 3 | 2 | 2 *** | 2 | 3 | 14 |
| Killer Whale Calls | 0 (0) | 2 to 3 | 3 to 4 | 0 | 4 | 4 | 13 to 15 |
| Mid-frequency sonar | 3 (6) | 0 | 2 | 0 | 0 | 0 | 8 |
| Air guns | 1 (2) | 0 | 2 | 0 **** | 2 | 0 | 6 |

***Not hazing is always an option to consider**

| Key to Values in Table: | | | |
|--------------------------------|---|--|--|
| Numeric value | <u>Assessment of efficacy</u> | <u>Estimated time to deploy</u> | <u>Risk of injury to SRKW</u> |
| 0 | Unlikely to work on SRKW | More than 48 hrs | Previously documented injuries |
| 1 | unknown efficacy | within 48 hrs | suspected injury |
| 2 | Judged likely to work | within 24 hrs | injury if misused |
| 3 | anecdotal evidence of efficacy | within 8 hrs | injury unlikely but not well studied |
| 4 | Documented experience of efficacy | within 2 hrs | injury unlikely |
| Numeric value | <u>Time required to train participants</u> | <u># of people required</u> | <u>Equipment Availability</u> |
| 0 | Greater than one day | More than 50 | Requires 3rd party approval (Navy, City, etc.) |
| 1 | 1 day training | 21 to 50 | High cost |
| 2 | less than 2 hours training | 11 to 20 | No local vendor |
| 3 | verbal instruction given at time | 5 to 10 | Easily purchased or available locally |
| 4 | Non -required | 1 to 4 | Available in stock or stored |

| <u>COMMENTS</u> |
|--|
| Method |
| Oikomi Pipes - Limited number (12) stored, but materials for fabrication are readily available |
| Acoustic Harassment and Deterrent Devices - None stored |
| Speed |
| Killer Whale Calls - There are limited sources for recordings |
| Risk of Injury |
| Killer Whale Calls - Limited experience indicates that response is unpredictable and possibly aggressive |

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| Training Requirements |
| *Aircraft - Operation of aircraft in pursuit of wildlife requires extensive training |
| ****Air Guns - Operation of seismic exploration equipment requires extensive training |
| ***Vessel Traffic - Assumes vessel operators are pre-qualified to drive boats |
| Mid-frequency Sonar - Operation of sonar equipment requires extensive training |
| |
| Personnel Required |
| The number of personnel required is highly dependent on the scale of the exercise and basic work unit size must be defined for each method |
| |
| Equipment Available |
| Aircraft - Assumes that aircraft used for reconnaissance are also available for limited hazing efforts |
| Acoustic Deterrent Devices (Pingers) - Recommend stockpiling a supply of these locally |
| ** Experimental Methods - Highly dependent on technique |

E. Hazing Method Advantages and Disadvantages

Potential deterrent options were evaluated by Killer Whale experts and oil spill response personnel (see More Detailed Information below) and are listed with their associated positive and negative benefits to provide a range of options to be considered under the circumstances. In addition to weighing the hazing options provided, the Wildlife Branch also must consider the costs and benefits associated with taking no hazing action.

- i. Close-range hazing techniques
 1. Oikomi Pipes: Oikomi pipes are reverberant metal; usually a pipe with a cap on the top. A handle on the top of the pipe and a cone at the bottom of the pipe improves reverberation. When numerous pipes are used in multiple lines, they have been effective at moving killer whales at close range.
 - o Advantages: Oikomi pipes have been used and are very effective at herding whales. This is safe for the whales and would have a high public acceptance level.
 - o Disadvantages: This technique would be most effective for herding of animals and might not be as efficacious for keeping animals out of a very large area (such as in the middle of Juan de Fuca Strait). Deployment requires coordination of multiple vessels and could be dangerous at night or during poor sea conditions.
 2. Seal control devices: These are explosive devices that put out a pulse of noise and previously were used effectively to drive whales during the live captures in Puget Sound in the 1970's.
 - a. Advantages: They worked from about 1 mile away during whale captures. They are not very expensive and readily available.

- b. Disadvantages: There could be concerns about using these explosive devices where highly volatile oil was located. These could cause fish mortality.
3. Acoustic Deterrent Devices (ADDs): ADDs make sound not loud enough to cause pain, but which is audible to marine mammals. ADDs are often called net pingers.
 - a. Advantages: They are readily available and could be easily deployed on oil booms or vessels.
 - b. Disadvantages: They may not have sufficient power to deter whales and whales may habituate quickly.
4. Killer Whale Calls: Prerecorded calls can be played from a small boat to theoretically either attract whales away from an area or deter them from entering an area.
 - a. Advantages: Prerecorded calls and broadcasting equipment are readily available and could be deployed from a highly mobile small vessel. This is not dangerous to whales or other species in the area. This technique needs further study.
 - b. Disadvantages: There have been no rigorous studies showing that calls will consistently cause whales to avoid or be attracted to the source. It is likely that animals could habituate to this relatively quickly.
5. Vessel Traffic: The noise and motion of boat traffic could be used drive whales from an area or deter them from entering one.
 - a. Advantages: Small boats are potentially available for this activity.
 - b. Disadvantages: Boats have very little value in long-range displacement of killer whales, especially the highly conditioned southern resident killer whales.
6. Aircraft: Helicopters can generate a fair amount of noise and wave movement at close range and could produce a startle or avoidance response.
 - a. Advantages: This might be very effective initially because whales are not used to it. It can be quickly mobilized and could provide real-time tracking of whales. Also, it could simultaneously be used to deploy additional deterrent devices such as seal control devices.
 - b. Disadvantages: There is no guarantee that helicopters will be able to control whale movement and whales would likely habituate to helicopters quickly. Because of the above-water nature of this deterrent it would affect the behavior of birds and other animals in a way that might not be beneficial (i.e. scare birds off un-oiled shorelines with the chance they will land in oiled areas). If helicopter hazing were used in combination with other hazing methods, such as launching of explosives, then this would require the development of specific safety protocols and perhaps special safety equipment such as a launcher.
7. Fire hoses: Fire hoses could be used to direct streams of water at whales on the surface at extremely close range.

- a. Advantages: Boats could be equipped with pumping capacity and deployed on fairly short notice. High powered fire monitors mounted on some regional tug boats can send a stream over water over 100 yards.
 - b. Disadvantages: There are no data on the effectiveness of this technique and it is limited to very close range (approximate 100 yards).
8. Strobe lights, bubble curtains, booms or other experimental methods: Theoretically these could provide a visual deterrent and perhaps prevent killer whales from entering a spill.
- a. Advantages: Theoretically these could be used to fence off an area without risk of physical harm to the whales.
 - b. Disadvantages: Light and other visual stimuli will not penetrate water very far and no data are available on effectiveness. Similarly responses to bubble curtains and booms are not quantified.

ii. Longer-range techniques

1. Acoustic Harassment Devices (AHDs): AHDs produce noise loud enough that they are likely to cause pain in animals at a certain range (ADDs are not loud enough to cause pain, but can be heard). Airmar AHDs have a source level of 195 dB re 1 $\mu\text{Pa}_{\text{RMS}}$ and their peak energy at 10 kHz with higher harmonics. These are used at the Ballard Locks and they could be moved at low speed from small boats or could be hull mounted on boats to allow faster movement. They are designed with 4 transducers that alternate transmission. They can be battery operated, but need a continuous power source for long-term use.
 - o Advantages: It would not take long to train people to use them. They may deter killer whales up to 3 km away. This would be publicly acceptable at long range because it is estimated that injury would not be likely at distances over 10 meters.
 - o Disadvantages: The received levels needed to cause deterrence without acoustic trauma are unknown, however it is thought that killer whales react strongly at the 135 dB re 1 $\mu\text{Pa}_{\text{RMS}}$ received level. Additionally, it has been suggested that repeated exposures to AHD's in the same area could result in long-term displacement of killer whales from an area.
2. Air guns: This is a mechanical device that uses air that expands and contracts to give a strong pulse under water to map earthquake faults or for oil exploration. They are frequently used in arrays to give a higher source level. Depending on the size, the peak energy can be from 10 Hz to 1 kHz, but they produce broadband pulses with energy at frequencies ranging to over 100 kHz. The higher frequencies are less intense and attenuate faster. Intensity of output is controllable by the operator to account for distance from the subject.
 - o Advantages: Harbor porpoise have been seen moving away from them at 70 km so they could have impacts at great distances.

- Disadvantages: Because mysticetes hear low frequencies better, there is more concern with their use around mysticetes than odontocetes. There are no data on effectiveness in deterring killer whales. These are generally a towed array that is deployed behind a ship like the University of Washington's *R/V Thomas Thompson* so securing a ship to tow the array could be an issue. Use of a single gun would not pose this problem. There is concern about acoustic impacts to killer whales and other species including fish.
3. Mid-frequency sonar: This has caused behavioral changes in killer whales in Haro Strait during the *USS Shoup* transit episode in 2003. The source level was approximately 235 dB (exact level is classified) and frequency was 2.6-3.3 kHz over 1-2 second signals emitted every 28 seconds.
- Advantages: Mid-frequency sonar could be effective for over 25 km, which could be useful in a large spill and it can be operated at night.
 - Disadvantages: Received levels that were effective in causing a response during the *USS Shoup* incident are unknown. There are a very limited number of boats that have the capability to deploy this sonar and they are engaged in national security missions. Concerns with using sonar include the potential for acoustic trauma in killer whales and other marine mammals and a lower level of public acceptance as a deterrent device. Difficulty in limiting range makes this technique excessive for a small spill.
- iii. Further Information:** This information was gathered at a meeting jointly hosted by NOAA/NMFS, Northwest Region and the SeaDoc Society, a program of the UC Davis Wildlife Health Center, School of Veterinary Medicine. Detailed meeting notes including literature cited are available at:
http://www.vetmed.ucdavis.edu/whc/seadoc/pdfs/kw_mtg_notes_oct07.pdf