

## **Acoustic Pollution in the Puget Sound and its effects on Marine Mammals**

### **Executive Summary**

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Samish Indian Nation and The Friends of the San Juans

Acoustic or noise pollution in marine habitats has become an increasing concern for conservationists and policymakers. In 1972 the U.S. federal government enacted the Marine Mammal Protection Act, a law guaranteeing that marine mammals would not be detrimentally harassed by human activities. However acoustic pollution under the marine mammal protection act is unclearly defined and nearly impossible to enforce, yet, noise pollution in our oceans is a real threat to the survival of many marine mammals. "The MMPA cannot deal broadly with the source levels that polluters generate or with the total amount of noise produced in a given area."<sup>1</sup>

Acoustic pollution is problematic, because unlike land mammals, marine mammals greatly depend on their hearing to survive. Acoustic pollution becomes an especially difficult issue when marine mammals and human economic interests collide. The Puget Sound Region, for example, is not only the home of various forms of marine life and habitats but it is also the home to major economic shipping routes. The vessel entries and transits for 2002 in the Haro Strait, Strait of Juan de Fuca, and Georgia basin totaled over 5221 cargo and passenger vessels including oil tankers.<sup>2</sup> These figures do not include the 336-entering factory fishing vessels<sup>3</sup> or the numerous recreational vessels in the waters. All of this human economic activity creates noise in the waters and presumably constant levels of noise have the potential to negatively impact marine life in heavily trafficked waters. If marine mammals experience hearing loss due to excessive manmade noise, then not only are the lives of individual mammals in danger but also in some cases an entire species may be at risk. It is not a question of whether or not noise affects these animals but how much and to what degree.

In respect to acoustic pollution there are at least five major areas of concern that need immediate attention: (1) Navy mid frequency and low frequency sonar testing. Even though naval testing of these sonar systems thus far has been intermittent it does have the potential to create long-term noise effects on marine mammals. (2) Vessel noise impacts, (3) acoustic harassment devices otherwise known as AHD's, (3) oil drilling or general seismic blasting projects, and (5) acoustic thermometry a method of testing global warming. .

### **Low Frequency and Mid-Frequency Active Sonar:**

Low Frequency Sonar or *Towed Array Sensor System Low Frequency Active Sonar* produces powerful waves of energy that can spread across thousands of square miles of ocean worldwide. Its main purpose is to find enemy submarines that may be otherwise invisible on more passive sonar screens. Mid-Frequency sonar differs only in that it is better matched to the hearing of marine mammals and at close range may have serious implications on their health and survival. There have been several incidences of obvious marine mammal harassment that even led to the deaths of marine mammals because of the navy sonar testing. Although the Navy eventually agreed to do an environmental impact study of their sonar systems to determine if they adversely affect marine mammals, there are researchers and non-governmental

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<sup>1</sup> NRDC: Executive Summary, *Sounding the Depths*

<sup>2</sup> Stratton, L. 2002, *Vessel Entries and Transits for Washington Waters*.

<sup>3</sup> Stratton, L. 2002, *Vessel Entries and Transits for Washington Waters*.

organizations like Ken Balcomb from the Center for Whale Research and the Natural Resources Defense Council who feel that this study did not completely address the sonar's deadly capability and only tested a small range of the sonar's design and function. Despite these valid concerns from researchers and conservationist organizations the Navy has continued to test their systems.

The most recent case of sonar testing has led to one of the most obvious displays of how LFA sonar negatively impacts marine mammals. On May 5, 2003 Ken Balcomb of the Center for Whale Research stated, "the U.S. Navy Guided Missile Destroyer Shoup DDG 86 conducted sonar operations for five hours in the Strait of Juan de Fuca and in Haro Strait between Vancouver Island, creating one of the most obvious displays of marine mammal harassment that experienced observers have ever seen."<sup>4</sup> In addition, Val Veirs from Colorado College measured the intensity of this sonar exercise and found received levels greater than 149dB re 1 microPa.<sup>5</sup> Currently the porpoises corpses are being stored on San Juan Island for necropsies to be performed in order to determine if the sonar testing caused their death. While federal oversight into these necropsies is important, it also takes time. Furthermore, members of congress are pushing for an authorization bill before the results of the exams are fully completed, which if passed will give the Department of Defense carte blanche for tactical testing of systems like the Low Frequency and Mid Frequency sonar systems. Once passed this bill would make the necropsies nearly useless as military would have the right to test systems that are known to be harmful to marine animals and their habitat. In addition, other nations like Canada and Japan will pursue their own versions of these sonar systems and marine mammals everywhere will be constantly bombarded by its disastrous effects.

Testing needs to halt until further long term research can effectively determine the relationship between these stranding's and navy sonar testing. The United States needs to be a leader in an international campaign against the use of these systems as they pose a potentially dangerous threat to our oceans. If the United States comes forward admitting that there are real dangers to marine life due to these sonar systems, then they can more effectively deter other countries from using the sonar and effectively protect vital national security concerns.

### **Vessel Impact:**

the Puget Sound is home to major Pacific Northwest shipping routes; literally thousands of vessels enter and leave the major ports of Washington State and British Columbia. In addition, to cargo ships, vacation cruise lines, and fishing vessels that travel on a regular basis throughout the region there are scores of recreational vehicles, ferry traffic, and whale watching boats. Researchers have lately been interested in the question of how vessel impact affects marine animals and their habitat.

Since 1995, nearly everyone has noted an alarming decrease in the Southern Resident Orca populations and are concerned that a direct link exists between this decline and the increased vessel activity in Haro Strait. "The population declined from 99 in 1995 to 83 in 2000. Biologists have grouped the causes of this large decline into three main areas: toxins; declining salmon populations; and effects of vessel traffic"<sup>6</sup> While long-term studies are needed to better understand the impact of vessel traffic on marine mammals like whales, short-term research has already begun and findings suggest that boat noise directly affects the behavior of marine

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<sup>4</sup> Balcomb, K. 5/12/03, *US Navy Sonar blasts Pacific Northwest Killer Whales.*

<sup>5</sup> Veirs, V. 2003, Colorado College Department of Physics Orca Vocalization and Localization Project.

<sup>6</sup> McGinnis. 2003, *The Effects of boat noise on the vocalization density and diversity of southern resident killer whales (Orcinus orca) in Haro Strait.*

mammals. For example, the Ocean Mammal Institute completed a five-year study on vessel impact involving humpbacked whales. They were careful to include in their study a baseline account of how the whales interact when there were no boats and then an experimental vessel was radioed in to approach the animals at ten knots up to the 100-yard limit. Their data thus far has shown that the, “boat’s engine and the rate of change in noise level significantly affected the whales’ swimming speed. Whales swam three times faster around the loudest boat which had an intensity level slightly above 120dB when recorded at 100 yards.”<sup>7</sup>

In terms of vessel impact on humpbacked whales, researchers have noted that the traditional breeding grounds for this species preferred shallow protected waters for calving. Yet, data collected from the mid eighties suggests that, “cow/calf pods have been moving offshore since 1977.”<sup>8</sup> As vessel impact increases in sensitive marine habitats such as humpback breeding grounds, the whales may have already been forced to abandon their preferred protected near shore waters, which could be one critical reason why humpback recovery is threatened. The data collected shows that in one way or another vessel noise does affect the behavior of marine mammals, further long-term study must be pursued in order to determine what unintended consequences these noise disturbances create for the animals.

However, despite the lack of significant long-term research on vessel noise there are ways of lessening the acoustic impact on marine habitats right now. First of all, regular boat maintenance can help reduce noise levels in the water. If ships are regularly maintained, gears oiled, and failing parts replaced noise levels caused by ships can be greatly decreased. “Failure to scrape barnacles from the propeller blades and fasten loose components may, over time, boost emissions by 10 decibels or more.”<sup>9</sup>

Second, new and inventive ways of making vessels quieter are constantly being designed, if new ships were required to come equipped with quieter engines and propellers in time ocean noise would greatly decrease as cavitations from propellers are minimized through new technology. For example, by fitting “the propellers with a nozzle the hiss will keep to two directions, fore and aft, clearing a zone of relative quiet along the sides.”<sup>10</sup> Finally, one other simple solution to boat noise is to reduce the speed of vessels entering known marine rich habitats such as Haro Strait. With reduced speed the engines do not create as much noise under the water and may help lessen the constant noise levels in certain marine habitats at critical seasons.

### **Acoustic Harassment Devices:**

The use of acoustic deterrence devices over the years has increased and many fear that there is a danger that these devices are being overused and driving marine animals away from native habitat thus increasing the risk of low birth numbers and general species decline. In addition, louder AHD’s can create a problem of habituation. Habituation to noise is demonstrated through repeated exposure of a “signal” or “stimulus” over a given period of time.<sup>11</sup> Prolonged exposure to AHD’s that emit up to 200dB of sound in the 5-30 kHz range can cause hearing loss in the animals ranging from temporary threshold shift to permanent threshold

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<sup>7</sup> OMI: Vessel Impact Study, *OMI Completes Five Year Experimental Vessel Impact Study on Humpback Whales.*

<sup>8</sup> Green & Green. 1990, *Short Term Impact of Vessel Traffic on the Hawaiian Humpback Whale.*

<sup>9</sup> NRDC: *Sounding the Depths-CH.3*

<sup>10</sup> NRDC. *Sounding the Depts-CH.3*

<sup>11</sup> NRC. 2003, *Ocean Noise and Marine Mammals.*

shift and an increase in pathological stress.<sup>12</sup> As a result the animals are more likely to be separated from their young, who in turn, will become easier prey for natural predators.

Alexandra B. Morton and Helena K. Symonds found that the AHD's are the cause of displacement of Orca whales from their native habitat because of direct introduction to noise in their environment. It has already been noted by others that Killer Whales have the most sensitive hearing of odontocetes and are more vulnerable to the intrusion of AHD's in their environment. Morton and Symonds research concludes that the decline of Killer Whales corresponds with the introduction of AHD's into their natural habitat of the Johnson Strait area. Furthermore, that the whales did not abandon the entire region but a specific portion of their natural habitat because it appears that they were driven from it by the persistent use of AHD's.

Local, state, and federal agencies like the National Marine Fisheries Service, should regulate the use of intrusive AHD's by closely monitoring their use by commercial fisheries. Also, this regulation should include safeguards that restrict AHD sound levels and cycles of transmission during specific hours in a day and during certain seasons in species rich environments. Especially for those marine habitats that are significant to dwindling marine mammal populations, such as, the Southern Resident Orca found in the Puget Sound area. Furthermore, AHD use should only be attempted after all other less intrusive methods of deterrence have failed. By doing so marine mammals are less likely to abandon precious natural habitat that might endanger their populations and they run less risk of habituating to the intense noise in order to feed in profitable water.

### **Seismic Blasting and Oil Drilling Exploration:**

It has been noted that, "Seismic blasting is highly intrusive and damages and kills fish, whales and other marine life in close proximity to the guns. At greater distances, it can cause disorientation and interfere with communication."<sup>13</sup> Yet, long-term studies done to ascertain acoustic effects of noise damage are still relatively difficult to find. Many policymakers and seismic exploration experts continue to rely on general short term studies that in some cases may have been manipulated by third parties or that simply do not adequately reflect the realities of seismic blasting in marine environments. Moreover, short term evidence that demonstrates how damaging underwater blasting is to marine animals is either ignored or misunderstood by those who favor more economic development as opposed to a balanced approach in dealing with economic and environmental issues.

The fact that government officials are basing regulations on sketchy generic short-term evidence only clouds the issue. Long term research on auditory effects of marine animals is imperative in the face of so much seismic blasting in and around sensitive marine habitats. Furthermore, it is important to remember that it is not only oil exploration and drilling that is a leading factor of seismic blasting but it occurs in a number of forms. For example, seismic blasting can include laying pipelines, cables, and creating underwater tunnels for mining or other geophysical purposes.

Industry should be the friend of environmental impact studies because in the long run it may benefit them more than hinder their projects. Government and industry can step in by providing funding to research institutions to develop methods of screening noise caused by seismic blasting. In time it may be possible to reduce destructive exposure of seismic blasting and help to save marine mammals while allowing economic development of underwater areas.

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<sup>12</sup> NRC. 2003, *Ocean Noise and Marine Mammals*.

<sup>13</sup> Canadian Parks and Wilderness Society, 5/21/03 *Oceans under fire*

Meanwhile, government should be cautious in allowing seismic exploration and drilling to continue in known sensitive marine habitats. It should be the goal of science, government, and industry to seek a balance in marine mammal protection and economic development. As it currently stands economic development currently has an unfair advantage over the protection of marine animals and their habitat.

### **Acoustic Thermometry:**

Acoustic Thermometry is a method of researching and testing global warming. “Sound waves move slightly faster in warm water than in cold water, so by measuring the time it takes sound to travel underwater between two points, scientists can figure out the average temperature along that path.”<sup>14</sup> When San Diego scientists initiated the research they stationed two transmitters one off the coast of Hawaii and one off the coast of California pumping 195dB of sound across the Pacific Ocean. Essentially the sound energy spreads out in a narrow depth range over the entire ocean basin and is less loud at greater distances. At 1000km from the source the intensity will be one-millionth as loud as at one meter from the source. But the concern is not long range exposure of the noise so much as it is exposure next to sensitive marine environments. This created serious concern for conservationists who worried about constant levels of 195dB of sound transmitted near humpback breeding grounds in Hawaii and a newly established marine reserve in California.

Even though short term research has been conducted into investigating the impact of acoustic thermometry on marine animals and the results so far are encouraging, researchers should not abandon their studies prematurely but should strive to answer the fundamental questions of its long-term effects on marine animals especially how this type of testing will affect coastal habitats. It may be much more beneficial to the survival of marine animals if the programs transmitters were pulled away from the coasts and placed farther out to sea. By reducing cycles of transmission and the decibel levels even further this could help reduce probable risks to marine mammals.<sup>15</sup> More research must be done to ascertain the effects of acoustic thermometry in the oceans. And while preliminary short term research has been promising there are simply too many unanswered research questions and too many unknowns about acoustic thermometry that should be answered before the program is put into place.

### **Concluding Recommendations:**

Man made ocean noise has undisputedly increased in the last century. Like many other forms of pollution, acoustic pollution has the capability of causing real harm to our marine mammals and other forms of marine life, however, at this point it is the job of scientific researchers to determine which noises affect marine animals the most. Science has yet to effectively determine if certain noises like acoustic thermometry or navy mid frequency and low frequency sonar affect the same level of damage to marine auditory senses, thus the dire need for long term environmental impact studies of acoustic pollution in marine habitats.

First, as a society it is better for us economically and environmentally to take more of a precautionary approach to habitat management. Wondrous advances in technology have allowed us to penetrate the treasures in the oceans to improve our standard of living; yet, this improvement should not come at the cost of severely damaging our environment. Our natural

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<sup>14</sup> Clark, C. 1992, *Effects of Human-made Sound on the Behavior of Whales; Acoustic Thermometry of Ocean Climate/Marine Mammal Research Program*.

<sup>15</sup> NRDC. *Sounding the Depths*. CH 3

resources are a treasure that cannot be renewed, should they be selfishly squandered by our need for instant gratification then not only will our marine environment suffer but in the long run our economy and our standard of living will suffer. We should anticipate problems that may arise due to the effects of acoustic pollution. We should not place economic advantages too high above the necessity of maintaining marine habitats; there should be an equal balance in our stewardship of the economy and the environment. By being cautious and keeping the integrity of marine habitats secure we are also securing our economic future.

Second, it is imperative that policy makers and researchers all admit that acoustic pollution is a problem for marine animals. As life forms they depend on their ability to hear their environment, just as seeing is detrimental for land animals, hearing for marine mammals is crucial for survival in nearly every aspect of their existence. It is conceivable that potential problems may increase for the animals if the issue is not addressed now. Later we will find that more drastic and forceful measures will have to be taken that would adversely impact economic gain in order to preserve marine mammals and their habitat.

Third, government agencies should willingly set aside needed budget dollars to peer reviewed researchers so that further long term research can be done on this subject. It may be found that certain habitats need to be preserved and boating activities or seismic exploration in that area needs to be restricted so as to maintain a level of quiet and calm for the animals. In addition, future research done on acoustic pollution should be accessed easily on a central database. A centrally regulated database can be extremely useful to both research scientist and government policymaker. As new information becomes available it is easier to determine what to do with regard to certain problems, also scientists interested in similar areas can easily find out what other professionals have already found in their respective studies.

Fourth, in the interim while long-term research is being conducted; government policymakers should continue to be cautious in allowing noisy marine activity to continue especially in known sensitive marine habitats like Haro Strait. It may be prudent to restrict or even ban certain activities like mid frequency and low frequency sonar systems until further inquiry can be made as to their potential harm to the environment.

Finally, federal regulatory laws regarding the protection of marine mammals should be revised to include clear language and clear consequences for law breaking. The current MMPA guidelines on marine protection have been considered vague and difficult to enforce. The language has been left in some cases ambiguous and not enough funding has been allocated to enforcing the existing regulations. Too often it is scientific research that finds it difficult to cut through red tape while economic investors bypass the many loopholes found in the MMPA.

By acknowledging that acoustic pollution is a problem for marine animals and their habitats and conducting the research needed to better understand how we can minimize its effects. Lawmakers who are entrusted in caring for, not only our economic future, but also our stewardships over these precious habitats can accomplish much if they act wisely today.

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