INTERPRETING RESEARCH RESULTS: GOVERNMENT REGULATION
OF ANTHROPOGENIC NOISE SOURCES

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INTRODUCTION

The Precautionary Principle advocates taking anticipatory, protective management action in the absence of complete proof of harm. It also argues against using the absence of scientific knowledge to justify management decisions favoring resource use. Conversely, it does not support broadly applying limited scientific research results to justify permissive policy. The Precautionary Principle is embedded in several US environmental laws, including the Marine Mammal Protection Act (MMPA). However, in practice, it is often ignored. To illustrate this, this presentation will briefly examine three recent MMPA management actions, made or proposed by the National Marine Fisheries Service (NMFS), regarding the impact of acoustic activities to be conducted by the military and academic institutions.

Regulating acoustic activities is difficult, given that little is known about the impact of anthropogenic noise on marine mammals. Despite this dearth of knowledge, such noise impacts are widely acknowledged to be an issue of serious concern (Richardson *et al.* 1995; NRC 2000). In an effort to increase knowledge and build toward certainty regarding the impacts of anthropogenic noise on the marine environment, recent research on noise impacts has focused on behavioral responses of free-ranging baleen whales (mysticetes) and the auditory responses of captive toothed whales (odontocetes) and pinnipeds. These studies addressed limited hypotheses and used limited methodologies, but NMFS has broadly interpreted their results to justify sweeping regulatory decisions. These decisions, therefore, run counter to the Precautionary Principle and are arguably illegal under the MMPA, as well as other statutes.

BACKGROUND

Three recent requests to authorize incidental take of marine mammals under the MMPA due to proposed acoustic activities illustrate how NMFS has over-interpreted limited research results to justify regulatory decisions.

The US Navy applied for a Letter of Authorization (LOA) to take a small number of marine mammals by incidental harassment, injury, or mortality in January 2000 in conjunction with ship shock trials for the USS Winston S. Churchill, a new class of destroyer. (Ship shock trials involve the at-sea detonation of explosives of various sizes likely to be encountered under combat conditions to test the battle-worthiness of a new vessel design.) The North Pacific Acoustic Laboratory (NPAL) applied for a LOA in May 2000, to take a small number of marine mammals by incidental harassment during

the operation of a low frequency sound source utilized in oceanographic research off the coast of Kauai, Hawaii. Both the Churchill and NPAL requests were approved through final rules published in May 2001 and August 2001 respectively. The Navy also applied for a LOA in August 1999, to take a small number of marine mammals by incidental harassment during the use of Surveillance Towed Array Sensor System (SURTASS) Low Frequency Active (LFA) sonar. The proposed rule for LFA sonar, published in March 2001, has yet to be finalized. All three of these activities involve low frequency noise impacts on marine mammals – the first through explosive sound and the second and third through the use of intermittent/continuous sound.

Recent research, largely inspired by the public controversy over LFA sonar (which first arose in the mid-1990s) and largely funded by the Office of Naval Research (ONR), has attempted to address the impact of anthropogenic noise of various frequencies on a small number of marine mammal species, both in field and captive settings (*e.g.,* Croll *et al.* 2001; Kastak *et al.* 1999; Miller *et al.* 2000; Nachtigall *et al.* 2001; Ridgway *et al.* 1997; Schlundt *et al.* 2000; Tyack and Clark 1998). In all cases, these studies have focused on narrowly defined hypotheses, examining either behavioral responses or temporary threshold shift (TTS) after exposure to controlled sound sources.

Results from these studies can be seen as preliminary steps toward reaching an understanding of the impacts of anthropogenic noise on marine mammals. However, given the narrowly-defined attributes of the sounds used (*e.g.,* intermittent low frequency sonar transmissions at relatively low sound pressure levels [SPLs], 1-second pure tones), the small number of species examined (*e.g.,* two species of odontocete, four species of mysticete, three species of pinniped) and the fact that many tested animals were captive rather than free-ranging, the small sample sizes within species (often only one or two individuals), and the short time spans over which individual reactions and impacts were observed and assessed (on the order of minutes or hours as opposed to days, weeks, or months), these preliminary results are of limited utility when attempting to assess the long-term impact of specific types of sounds at relatively high SPLs on all marine mammals, let alone all marine protected species. Clearly a great deal more work will be required, observing reactions from a larger sample of animals over long periods of time, before a more complete picture of impacts will begin to emerge.

Nevertheless, the results of these studies have been broadly (and inconsistently) interpreted to justify recent regulatory decisions regarding noise impacts on marine animals. For the rest of this presentation, I will discuss specific examples of this.

USS WINSTON S. CHURCHILL

For the Churchill LOA request, the Navy proposed using a 182 dB $\mu Pa^2 \cdot sec$ energy flux criterion (due to the explosive sound source involved) rather than a received sound pressure level criterion when determining exposure standards. Despite the fact that there is no scientific evidence that an energy flux criterion, which was derived from research using four captive bottlenose dolphins and 1-second pure tones (Ridgway *et al.* 1997), is applicable to mysticetes, pinnipeds, sea turtles, or other odontocetes for a broadband explosive source, NMFS nevertheless concurred with the Navy's proposal.

NMFS acknowledged the speculative nature of the analysis leading to the energy flux criterion for explosive sources: "…NMFS agrees that the SPL that would cause TTS in cetaceans by explosives has not been tested empirically on live cetaceans…"

While Ridgway *et al.* (1997) may have represented the best science on hearing thresholds and TTS for cetaceans at the time of the Churchill LOA request, "best" is not the same as "good." The best available scientific information on TTS in cetaceans (as well as pinnipeds) is still both clearly preliminary and extremely limited in scope. Agencies should therefore limit its application and should not use it to establish broad regulatory standards for all marine protected species.

NORTH PACIFIC ACOUSTIC LABORATORY

In March 2000, a number of beaked whales and at least two minke whales live stranded in the Bahamas. These strandings, which resulted in several deaths, occurred during and after the transit of US and allied naval vessels, some of which had mid-frequency active sonars engaged (NMFS 2000; Balcomb and Claridge 2001). Public comment submitted during the advance notice of publication of a proposed rule for NPAL's LOA request pointed out that preliminary results from the investigation into the Bahamas incident should be considered when processing LOA requests for activities that involve loud, low or mid-frequency noises. In its proposed rule, NMFS rejected these comments by saying "Since these sonars [used by the Navy in the Bahamas] do not have signal and operational characteristics similar to the NPAL source, [the Office of Naval Research] does not believe it is appropriate for either the DEIS or the small take application to analyze those strandings. NMFS concurs."

In a contradiction of this stance, however, NMFS felt it was appropriate to base acoustic standards for the Churchill's broad-band, low frequency, explosive sounds and NPAL's broad-band, low frequency, intermittent sounds on work using single, 1-second pure tones at various frequencies (*i.e.,* Schlundt *et al.* 2000). (In addition, the agency felt it was appropriate to apply standards based on the hearing responses of two odontocete species, which are high-frequency specialists, to all mysticete species, which are likely to be low frequency specialists.) If it would be inappropriate to consider the *actual negative impacts* of sound that differs in character from the NPAL sound source, then it should be even more inappropriate to consider the *mere positive implications* of work using sound that differs in character from the NPAL sound source.

SURTASS LFA SONAR

For the LFA sonar environmental impact statement (EIS), the Navy conducted a low frequency sound scientific research program (LFS SRP), in response to public criticism that there was not enough information on anthropogenic noise impacts on marine mammals. While The HSUS agreed with the need for such research at the time the LFS SRP was proposed, we have consistently pointed out the limitations of any research carried out under this program. While this research was a reasonable beginning, it was never designed to adequately inform the regulatory process – the results from the LFS SRP were clearly incapable of providing adequate information to make careful management decisions or to conclude that the use of LFA sonar would have negligible

impacts on marine life. A study of far greater scope, both in terms of species examined and years pursued, would be necessary before any solid conclusions regarding significant impacts could possibly be made. Nevertheless, the Navy and NMFS have in fact concluded that LFA sonar, operated under the mitigations found in NMFS' March proposed rule, is to all intents and purposes risk-free.

The LFS SRP examined certain short-term behavioral responses of four species of baleen whales to playbacks of LFA transmissions at SPLs greatly reduced from operational levels. In all three phases of the program, focusing on feeding, migrating, and breeding baleen whales, behavioral responses *were* observed, ranging from short-distance displacement to reduced vocalization rates (*e.g.,* Croll *et al.* 2001; Miller *et al.* 2000; Tyack and Clark 1998). While most whales resumed previously observed behaviors soon after transmissions were discontinued, no long-term observations were made of individuals exposed to the playbacks. No whales were exposed to SPLs greater than approximately 155 dB re 1μPa.

The SRP scientists concluded that exposure to low frequency sound below 155 dB did not appear to have any short-term biologically significant impacts on whales. Appropriately for this limited work, this is a limited conclusion. The team cautioned that these results were preliminary and of limited application. In subsequent publications, certain team members indicated some concern about LFA sonar, concluding that behavioral changes observed during playbacks of LFA transmissions "might affect demographic parameters or [they] could represent a strategy to compensate for interference from the sonar" (Miller *et al.* 2000). In none of their publications did SRP team members conclude that exposure to operational levels of LFA sonar would have no significant biological impact on cetaceans (let alone all other marine animals). This sweeping conclusion was found solely in the Navy's EIS (and then copied in NMFS' proposed rule), although the EIS points to the SRP results for support.

None of the LFS SRP playback experiments could disprove an alternate hypothesis – that feeding, migrating, and breeding are so important to blue, fin, gray, and humpback whales that exposure to reduced levels of LFA sonar noise is an insufficient stimulus to cause them to abandon these activities. In short, perhaps all the whales in these experiments were negatively impacted – perhaps they were partially deafened – but they nevertheless chose to continue their vital life processes. No one can say if this conclusion is any more or less the truth than the Navy's conclusion that there was no negative impact. If adequate prey are few and far between, predator-free migratory corridors narrow, or safe breeding sites limited, then the introduction of a source of noise pollution, however damaging, may be a minor consideration for these animals.

Ultimately, the Phases of the LFS SRP were designed to test a single and simple hypothesis: "It is doubtful that many marine mammals would remain for long in areas where received levels of continuous underwater noise are 140+ dB at frequencies to which the animals are most sensitive" (Richardson *et al.* 1995). The results of the LFS SRP disproved this hypothesis up to 155 dB for most species examined, although in the case of breeding humpback whales, there was displacement to neighboring areas. Very little else was accomplished and certainly the hypothesis that LFA transmissions will have a negligible impact at a received level of 180 dB re 1 μPa was not proved (nor was any

evidence provided to support it). Science of course does not prove hypotheses – it disproves them, through an incremental, step-by-step approach. NMFS and the Navy have shown impatience with the scientific process that belies their claim of making regulatory decisions based on sound science.

From the LFS SRP, we know that baleen whales exposed to low frequency sounds up to 155 dB changed their vocalization rates, deviated from their migratory paths, displaced themselves from one coastal area to another while engaged in breeding behavior, and lengthened their mating songs. These were all observable, short-term behavioral changes. There is no way from these results that anyone can conclude that exposure to sounds almost 1000 times more intense will have no greater effect, particularly if these effects are difficult or even impossible to detect without closer examination (for example, hearing damage) or only become apparent in the longer term. In fact, there is no way to conclude from these results *what* effect such exposure would have on these whale species – to conclude that the effect will be negligible is simply arbitrary.

CONCLUSION

The HSUS believes it is premature to conclude that acoustic activities such as ship shock, NPAL, and LFA sonar will have (and have had) only negligible impacts on marine life. We believe that the results, preliminary and limited in nature, of acoustic research have been over-interpreted and inappropriately applied to all marine species. We believe that there is compelling evidence that certain acoustic activities, particularly active sonar, will in fact have significant negative impacts on the marine environment, most of which may not become apparent for years and even decades. We also believe that NMFS' recent regulatory decisions clearly violate the Precautionary Principle and are likely in violation of the MMPA and other statutes.

The pursuit of carefully designed research on the impacts of noise on the marine environment is important, but the interpretation of results, particularly for management purposes, is not done in a societal vacuum. It is subject to political and economic pressures, often coming from the military and industries such as oil and gas corporations. These pressures cast doubt on the conservation value of a great deal of on-going acoustic research and seem to frequently encourage non-precautionary regulatory decisions. Facts are facts and are presented as such in scientific fora such as this conference, but when translated into the policy arena, these facts are often inappropriately applied and interpreted. This is not necessarily meant as a condemnation of the research or its scientific conclusions, but of the consideration of its results by regulators, legislators, and invested parties.

Thank you for inviting me to speak at the ASA conference on these vital issues.

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