Some Notes On Mitigation

I apologize for such a brief treatment of mitigation measures, but due to my attendance at the International Whaling Commission (IWC) meeting last week, I was unable to draft a more comprehensive examination of ocean noise mitigation practice for this Marine Mammal Commission hearing on Ocean Noise.

It is due in part to the unanimous acceptance by the IWC of the IWC Scientific Committee report on ocean noise that many of the running arguments given by the US Navy and the petroleum industry will need to be reconsidered. This was punctuated by the most recent acoustical-associated events in Hawaii and in the Canaries, and the developing situation in the Sakhalin area regarding seismic exploration and behavioral avoidance by the area's gray whale population.

It is clear that the last decade of ocean exploitation has wrought untenable damage on the marine environment. While this damage may have always been occurring and only recently been noticed, my suspicions are that some significant changes in ocean noise – in terms of quantity and quality – are largely responsible for the noticeable increase in noise related bio-catastrophic events.

These events are mostly measured in terms of whale and dolphin stranding incidents, though it s likely that the damage is not limited to marine mammals alone. Fish, mollusks ad other less mobile marine invertebrates are also subject to the same damaging noises; it's just that the evidence of this damage is less obvious and the legislative protections don't exist.

I believe that the quantitative changes responsible are a product of our increased industrialization of the marine environment, reaching farther and deeper out into national Exclusive Economic Zones. I understand that globally, at this moment, there are over 235 geological projects involving airgun blasting – in littoral waters, but extending out into water depths as deep as 10,000 feet. The quantitative changes are also a product of the increasing militarization of our society, accompanied by an increase in telemetric requirements for new military technologies. Advances in underwater telemetry include

newer, higher powered transmitters, particularly aggravating the burgeoning noise levels around naval operations.

The qualitative changes are also a product of the newer telemetry technologies. This change is significantly marked by a change from older “Frequency Shift Key” (FSK) and equivalent frequency modulation (FM) CODEC schemes to digital signal CODECs. This change is particularly troubling because while the noise levels may be in the same volume range of the older FSK and FM technologies, the fast rise times and wave forms of the digital CODECs have a significantly higher ‘damage risk criteria’ than the earlier signals.

This is due to the fact that the FSK and FM signals are not too dissimilar from sounds found in nature, and thus more likely to key into animal adaptations to naturally occurring sounds. Meanwhile the digital sounds are unlike anything found in nature. The extremely fast rise times and abrupt vector changes can induce auditory defense mechanisms completely out of scale to the actual sound power levels of the signals. So when the Navy states that they have been using mid-range sonar at equivalent volume levels for 50 years, they are only partially correct. The sound power level may be equivalent, but the ‘damage risk criteria’ is significantly higher.

A third consideration involving the cumulative effects of ocean noise is more difficult to assess. We know that the overall levels of shipping noise in the open ocean has increased by at least 10 dB_{sl} over the last 40 years, and has increased significantly more in-and-around ports and harbors. While doubling the existing fleet of 85,000 commercial ships would theoretically only increase the noise floor by another 6 dB_{sl}, this simple assessment does not account for broader distribution of shipping and other ocean vessel noise. This includes regional transport ferries, small fishing boats and ‘personal water craft.’ The cumulative impact of these noise sources would be difficult to assess, but this difficulty should not prevent us from making some informed assumptions about communication masking and increased stress in the subjected animals.

It is unfortunate that we seem to have painted ourselves into a corner on our use of the sea. Given the military and economic priorities of our global society, we are unable to

just “stop” what we are doing, revert to regional economies and start ‘being nice’ to one another – even if this was the only way to save our species and the animals of the sea. But we can do much more (or less) than “signal ramping” or posting observers to monitor cetacean activity where we anticipate using destructive noise in the ocean.

Given the precarious state of the oceans indicated in the Pew Oceans Commission and the US Committee on Ocean Policy reports – along with the exponential increase in cetacean deaths connected to anthropogenic noise events, we need to immediately re-think our acoustical abuse of the sea. More benign technologies do exist that can replace many of our most damaging practices, but the responsible parties need to back down from their defensive positions and begin focusing on more realistic noise mitigation technologies.

Mitigation possibilities and suggestions:

Communication:

I believe that we will soon find that the digital signals are one of the most egregious problems in the new sonar technologies, therefore I suggest that we immediately abandon digital CODEC communication sonars in all frequency regimes and shift over to more benign communication sonars – either returning to the earlier technology, or shift to time correlated spread spectrum schemes. Spread spectrum techniques can employ “analog” waveforms and if done well, could permit communication down into levels approaching the noise floor. In the midrange sonar band it would sound more like a “jingling” noise as opposed to the nasty, roaring scrape of digital CODECs. It can be surreptitious and relatively immune to jamming. The best part from an environmental standpoint is that it can be significantly quieter with a much lower damage risk criteria.

Seismic:

Two of the challenges with seismic survey techniques are borne in the fact that the signal source – airguns – don’t work efficiently at or near the ocean bottom depths, and the geological survey methodology is rooted in scanning vast areas as fast as possible. The survey vessel is self-contained and will drag the source and receivers over a grid or matrix pattern. An alternate technology might involve using mobile, bottom mounted

mechanical sources with surface trawled receivers. This change will cost more in terms of time and equipment, and require more acute metrics to cull the received signals for useful data. These technologies are not beyond our grasp and while the cost of deployment may be higher, but if the cost to marine mammals, and the health of our ocean food supply needs to be entered into the equation, the overall cost will be significantly lower.

Cumulative effects of vessel noise:

Mitigating the cumulative effects of ocean craft traffic is a broader discussion involving noise control at the source. It will require noise criteria legislation tailored to the various vessel classes – from personal water crafts to supertankers. Hull noise, mechanical noise coupled to the hull, and propeller cavitation will each require their own mitigation practices.

Chemical anti-fouling agents and the cost of periodic hull cleaning currently limit Hull noise from friction, but hull coupled mechanical noise can be scaled down significantly by way of vibration isolation of hull mounted equipment. Propeller cavitation may be significantly attenuated through the use of emerging technology, low cavitation propeller designs. Again, these techniques are not beyond our grasp; in most cases they have not been employed because heretofore, noise criteria has not been a design consideration.

Summary:

Given the precarious state of the oceans indicated in the Pew Commission and USCOP reports, and the exponential increase in cetacean deaths coincident to anthropogenic noise events, we need to immediately re-think our acoustical abuse of the sea. More benign technologies exist that can replace many of our most damaging practices, but the responsible parties need to back down from their defensive positions and begin focusing on more realistic mitigation technologies.

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