

Chapter VIII

The Impact of War and Military Operations other than War on the Marine Environment: Policy Making on the Frontiers of Knowledge

Dr. Ronald A. DeMarco and
Commander John P. Quinn, JAGC, U.S. Navy*

Introduction

In recent years, the Navy and other military services have increasingly evidenced an environmental stewardship ethic in their operations. The impetus for this new priority is of both internal and external origin. As microcosms of society, the military services are comprised mainly of young Americans for whom environmental responsibility is an imbued value. As these individuals have assumed leadership positions, the military services have incrementally adopted an environmental protection ethic.

An equal or greater impetus, however, stems from sources external to the military services. Domestic law, including that which executes international agreements, has substantially increased the environmental protection responsibilities of military commanders. While such responsibilities are understandably more visible in Military Operations Other Than War (MOOTW) than in combat, under all circumstances the environmental consequences of military operations remain a legal, moral and public relations concern of the military commander.

Today, environmental concerns are a significant factor in the calculus of war and MOOTW. The emergence of this new concern has in turn highlighted what may be a critical data gap for military commanders and national policy makers: from a scientific perspective, the impact of combat and of MOOTW on the marine environment is not well understood. Hence, military commanders and national policy makers are forced to make decisions based on less than complete information. Various approaches can be taken regarding this uncertainty. Some might advocate a precautionary approach, refraining from action unless and until the probable effects are known and determined to be acceptable. Others might strike a different balance, allowing unfettered military operations regardless of environmental consequences, perhaps tempered by control only when science can demonstrate with certainty unacceptable results. Still others might take a middle

course, adopting a broad policy of avoiding widespread, clearly evident degradation, based on the limited available scientific information.

Overlaying this uncertainty is the reality that in order to win during war, realistic training must constantly be conducted during peacetime. For purposes of this paper, peacetime training, whether in U.S. or foreign territorial waters or on the high seas, is considered a MOOTW. To a large extent, unless specific mitigation measures are instituted, the environmental risks and impacts of peacetime training are qualitatively much the same as the risks and impacts that can be anticipated during war. This begs the question whether different criteria should be applied to determine acceptable impacts of military operations on the environment during war versus during MOOTW. Perhaps surprisingly, in the context of U.S. environmental law, little distinction is made between acceptable conduct in war versus MOOTW.

This paper will focus on the impacts of combat and MOOTW in an attempt to resolve three questions. First, what *should* military commanders and policy makers know about the physical environment and the impacts of military operations thereon? This paper asserts that, as a minimum, military commanders and policy makers must achieve the level of knowledge that is required by legal regimes applicable to war and MOOTW. Part I of this paper explores the major knowledge requirements imposed on U.S. commanders by domestic law.

Part II of this paper addresses the question of what *do* we know about the impacts of war and MOOTW on the marine environment. Through a discussion of some of the known effects of weaponry, radiation, sound and oil pollution on the marine environment, it will be shown that our knowledge in these areas is far from complete.

In its final Part, this paper will suggest an approach for sound policy-making in the face of incomplete knowledge regarding the impacts of war and MOOTW on the marine environment.

PART I: WHAT SHOULD BE KNOWN ABOUT THE IMPACTS OF WAR AND MOOTW ON THE MARINE ENVIRONMENT?

Domestic U.S. law imposes significant knowledge requirements on federal agencies, including the military, whose actions may affect the marine environment. The discussion below focuses on the three major statutes imposing these knowledge requirements.

National Environmental Policy Act

The National Environmental Policy Act (NEPA) mandates formal documentation and full consideration of the environmental impacts of any proposal for "major federal actions significantly affecting the quality of the human environment."¹ In documenting such impacts, federal agencies must document

and consider an extremely broad universe of effects, including those that are direct, indirect, cumulative and connected, whether or not such effects are adverse or beneficial to the environment.² Recognizing that in some cases adequate scientific information may not be readily available, the regulations further require agencies to obtain the necessary information (*i.e.*, do the scientific studies) if the costs thereof are not “exorbitant.”³ If the costs are exorbitant, or if the means to ascertain the information are unknown, then the agency must attempt to evaluate such impacts based on theoretical approaches or generally accepted scientific research methods.⁴

The NEPA statute includes no enforcement provisions. Agency compliance with NEPA, however, is subject to judicial review through “citizens’ suits”—lawsuits brought by private citizens or groups against federal agencies. Accordingly, when preparing environmental documentation, federal agencies strive mightily and at great expense to include sufficient scientific information to survive judicial review.

Closely related to NEPA is Executive Order 12114,⁵ which requires environmental impact analysis for certain federal actions significantly affecting the environment of the global commons or of foreign nations. Although extremely broad in geographic scope, the Order contains numerous exemptions from, and qualifications to its requirements, which in effect substantially circumscribe its mandate. The Order specifically disavows creation of any right of action, hence the threat of potential legal action has not been an inducement for federal agency action under the Order. Nevertheless, the Order remains a mandate for collection and consideration of information regarding the effects of military activities on the marine environment.

In response to the mandates of NEPA and Executive Order 12114, the Navy and Marine Corps have conducted numerous environmental studies, large and small, of the effect of military training operations on the marine environment. The costs of these studies may range from the low thousands to several million dollars.

Endangered Species Act

U.S. species protection statutes impose very significant scientific knowledge requirements on federal entities, including military commanders. The Endangered Species Act (ESA) prohibits federal agencies, including the military, from undertaking any action that would jeopardize the continued existence of endangered species, or adversely affect their “critical habitat,” meaning that geographic habitat area necessary for the recovery of the species from endangered status. In order to determine the potential impacts of their activities on endangered species and critical habitat, federal agencies must conduct *biological assessments* of their activities.⁶ These assessments generally involve both literature search and field study.

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Biological assessments are then provided to the cognizant wildlife agency, which in turn will issue a *biological opinion* on the probable impacts of the activity on endangered species or critical habitat. The biological opinion may indicate that the proposed action may have no effect, that it will have no effect provided specified mitigation measures are undertaken, or that the action will jeopardize species and cannot be mitigated to avoid such impact. A federal action may not proceed in the face of a *jeopardy opinion*, unless relief is granted by the Endangered Species Committee, discussed below.

The ESA's prohibition on "taking" certain species expressly applies to persons subject to U.S. jurisdiction "upon the high seas",⁷ creating a virtually world-wide regulatory regime. The statute requires that information developed for consultation be the "best scientific and commercial data available."⁸ As mandated by the ESA, the Navy has undertaken a number of consultations to ensure that operations at sea do not violate statutory requirements.

Marine Mammal Protection Act

Like the ESA, the Marine Mammal Protection Act (MMPA) prohibits the "take" of any marine mammal on the high seas. Under the Act, "harassment" of a marine mammal is a form of "take." MMPA defines "harassment," in part, as ". . . any act of pursuit, torment or annoyance which . . . has the potential to disturb a marine mammal . . . in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding or sheltering."⁹ Given the breadth of this definition, virtually any military action at sea, including routine vessel traffic, could result in a "take." In the preamble to a draft rule establishing procedures for granting marine mammal harassment permits, the National Marine Fisheries Service (NMFS) specifically cited generation of marine sound as activity that might require a harassment permit.¹⁰ The draft regulations themselves contemplate ship noise as a potential source of harassment.¹¹ The draft regulations require permit applicants to submit scientific information such as: the species and numbers of marine mammals likely to be found in the vicinity of the activity and, for those likely to be affected, a breakdown of such animals by age, sex and reproductive condition; the anticipated impact of the activity on the animals and on their food sources and habitat; and a monitoring plan to evaluate the actual impact of the activity on marine mammals.¹² NMFS must then consider the "best scientific evidence" in determining the probable effect of the activity on marine mammals.¹³

Knowledge Requirements in War v. Military Operations Other Than War

As discussed above, U.S. statutes impose significant requirements regarding the collection and consideration of information relative to military operations in the marine environment. A related issue is whether this burden is different in

combat situations than in other scenarios. Common sense suggests, of course, that during war U.S. commanders should not be required to prepare environmental impact statements for amphibious assaults, nor obtain a permit for whale harassment before conducting an attack on enemy shipping.

In reality, U.S. laws imposing information collection and consideration requirements make little distinction in environmental requirements between peacetime and wartime requirements. NEPA provides no war or national emergency exemption. Implementing regulations provide merely that if emergency circumstances make it necessary to take action without observance of NEPA requirements, the agency should consult the Council on Environmental Quality.¹⁴

Neither the Marine Mammal Protection Act nor its implementing regulations provide a war or national emergency exemption. The U.S. Supreme Court has held that the ESA's prohibition against taking endangered species "reveals a conscious decision by Congress to give endangered species priority over the 'primary missions' of federal agencies."¹⁵ In recent litigation, the United States Coast Guard argued that its mission has priority over endangered species. The U.S. District Court judge, in response, threatened an adverse judgment in order to "disabuse the Coast Guard of its mistaken understanding of the unequivocal message of the ESA."¹⁶

In the landmark case of *Tennessee Valley Authority v. Hill*,¹⁷ the Supreme Court upheld an injunction against completion and operation of a dam costing more than \$100 million. Shortly after that case was decided, however, Congress created the Endangered Species Committee as a safety valve for relief from the draconian effects of the ESA. The Committee, consisting of seven Cabinet-level officials, is empowered to exempt a federal action from ESA requirements upon finding that there are no reasonable and prudent alternatives to the action, and that the benefits of the action outweigh the benefits of conserving the species.¹⁸ In recognition that ESA mandates could adversely impact military operations, the Act provides that the Committee must grant an exemption if the Secretary of Defense finds that an exemption is necessary in the interests of national defense.¹⁹ Under existing law and regulation, however, such exemption could be granted only after considerable administrative effort, including preparation of a biological assessment and consultation with the cognizant wildlife agency. These efforts could take weeks or months. Thus, the availability of the exemption for use in defense related emergency circumstances, even during war, is not certain.

In summary, the information collection and consideration requirements of U.S. domestic law are substantial. These responsibilities do not disappear, at least for purposes of U.S. domestic law, upon the commencement of hostilities.

PART II: SCIENTIFIC KNOWLEDGE REGARDING THE IMPACTS OF WAR AND MOOTW ON THE MARINE ENVIRONMENT

Having described some of the requirements for scientific information on this subject, this portion of the paper will now discuss the availability of that information.

Certain data regarding anticipated effects of combat on the marine environment is available. For example, information is available on the expected lethal blast radii of various ordnance, the anticipated persistence in seawater of chemical and biological weapon agents, and the impact of petroleum in the ocean environment.²⁰ The actual impact of any given military operation on the marine environment, of course, would be time and location-specific. Hence, reliance on existing scientific data in the making of global policy is problematic.

Another difficulty encountered relative to scientific data collection in the marine environment is the vastness and complexity of the ocean environment itself. By way of illustration, below are discussed three case studies in which considerable scientific effort has been expended to assess the impacts of three different types of potential impacts on the marine environment: radionuclide release, oil pollution, and sound propagation.

Radionuclide Release in the Arctic

In 1993, the former-Soviet Union released information pertaining to the dumping of radioactive waste into the Arctic Seas. A paper known as the Yablokov Report or the "White Paper" was published containing data on both source locations and the amount and type of solid and liquid waste, high-level waste in the form of spent nuclear fuel, unfueled nuclear reactors, and discarded vessels containing radioactive waste.

Subsequently, the U. S. Naval Research Laboratory modeled the dispersion of those radioactive contaminants in the Arctic and its marginal seas. Source locations and total amounts of disposed radioactive material are based on the Yablokov Report. The Navy model investigates only the dispersion of contaminants once they have entered the water column. Model coverage extends from the pole to approximately 30 degrees North latitude using a grid resolution of 0.28 degrees. Several different ten-year model simulations are examined using the following source types and locations:

Low level solid and liquid waste dumped in both the Kara and Barents Seas;

High level waste, including spent nuclear fuel from reactors dumped along the Novaya Zemlya coast in the Kara Sea; and

Rivers emptying into the Kara and Barents Seas; and waste dumped from the nuclear power plant at Sellafield in the Irish Sea.

Comparisons of the model's results to recent data indicate that both the river and the Sellafield sources can account for a majority of the radioactivity recently observed in the Kara Sea. However, when high level radioactive waste is used as the source in the model, resulting concentrations of radioactivity are predicted approximately an order of magnitude higher than those actually observed. In contrast to the predicted impact, these results imply that sources of high level waste are not leaking significantly into the water column.²¹ Were policy development based only on the initial effects and the predicted impact, inaccurate limits may be established.

In addition, other sources of radioactive waste from Russia have led to development of international policy. In 1993, 237,000 gallons of low-level radioactive waste were dumped by Russia into the Sea of Japan. An international meeting of 37 countries led to a prohibition on the dumping of radioactive waste at sea, with a scientific review and reassessment to be performed after 25 years. This prohibition was adopted notwithstanding environmental monitoring indicating no observable adverse effects as a result of the Russian dumping.

Gulf War Oil Pollution

The Gulf War oil pollution episode is an example of how even the best scientific methods may not provide accurate predictions of future ecological effects. Studies of the Gulf War demonstrate that the effects on the environment were not as severe as first anticipated. Numerous studies were also done on the effects of the war from both a socio-economic perspective and an ecosystem management perspective, taking into account the diverse political regimes in the Gulf that would have to cooperate to effectively manage the region as an ecosystem.

During the Gulf War, a total of 660 million barrels of crude oil were released into the atmosphere, onto the desert, and into the water. Of the 660 million, 6 million to 11 million barrels of crude oil were intentionally released into the marine environment by the Iraqi troops, contributing to the world's largest oil spill to date.²² The focus of scientific study in the Gulf region has been on the oil slick caused by the intentional release, particularly because of the amount of oil that impacted the shoreline and the predictions of the long term impacts of a spill of such magnitude.

Concern for the environment was a part of the wartime operations, with mitigation of the slick commencing before fighting ceased. Originally, the slick was predicted to behave like the Norwuz spill of 1983 which exhibited massive sinking due to strong shamal winds blowing dust onto the oil, causing it to flocculate and sink. Since its specific gravity is less than 1.0 (the specific gravity of water), oil cannot physically sink unless it is mixed with sediments or particles

to make it heavier than water. Fortunately, the Gulf War oil spill did not sink due to uncharacteristic wind conditions which transported and contained the unrecovered oil against the eastern shorelines of Kuwait and Saudi Arabia. Also, the percentage of floating oil recovered by mechanical means was between 18-37 percent, greater than what is usually possible with mechanical cleanup (approximately 10 percent), thanks to an unprecedented international-scale effort in recovery operations. The spilled oil also had a high evaporation rate, estimated from 40-50 percent. The remaining amount was stranded on shorelines and in intertidal zones. Much of this was left to recover naturally, thus providing an opportunity to study the physical processes of weathering and effects of natural cleanup.²³

One year after the spill, the Gulf area provided a unique learning opportunity for the scientific community as a whole, leading to the largest cooperative scientific endeavor in the Gulf region. Known as the "Mt. Mitchell Expedition", a 100-day multi-disciplinary oceanographic research investigation was organized to form a comprehensive understanding of the Gulf region and to study the long term effects and impacts of the oil spill. The expedition was jointly sponsored by the Regional Organization for the Protection of the Marine Environment (ROPME), United Nations Environmental Programme (UNEP), U.S. National Oceanic and Atmospheric Administration (NOAA), and Marine Spill Response Corporation (MSRC) with the participation of 140 marine scientists from 15 countries. Lasting from 15 January to 13 July 1992, the expedition facilitated much of the data collection and synthesis that has been done on the fate and effects of the spill. It provided a consolidation point and information management system for science-related studies in the Gulf region and has led to a better understanding of the effects of the war on the marine environment. The expedition's success was measured not only by the wealth of scientific data collected, but also in "the strides made in local, regional, and international environmental awareness and political cooperation in the Gulf."²⁴

The oil was expected to cause gross contamination to the subtidal biological communities of the Gulf. However, the oil did not behave in the hypothesized manner. This was largely due to the rapid oil movement and stranding in the intertidal zone which kept the oil from sinking, and acclimation of the Gulf marine ecosystem to high petroleum impacts. In the Gulf area, microbial populations have been regularly exposed to natural seepages of oil that occur in the region. Rapid oil degradation and transformation rates exist due to the extreme high temperatures in the region. Significant photo-oxidation of polyaromatic petroleum compounds also occurs due to the strong solar radiation intensity.²⁵

Overall, studies confirmed that there was very little "sinking" of the oil as originally predicted. Through subtidal sampling conducted during the Mt. Mitchell Expedition it was documented that little contamination exists in subtidal

areas above background levels, relative to the intertidal areas.²⁶ This leg of the expedition showed: 1) no evidence of large scale sinking as a result of the spill; 2) high levels of contamination in muddy, sheltered basins with low wave energy; and 3) oil initially stranded in the intertidal zone did not appear to accumulate in the subtidal, near shore regions, as might have been expected. Often it was difficult to differentiate whether the source of contamination that was measurable in the subtidal regions was from the Gulf War spill (intentional release), oil from sunken vessels, or oil residue from previous spills.²⁷

In reviewing the compilation of data and analyses of scientific studies on the effects of the Gulf War on the environment, it was found that interpretations of the overall "impact" are varied. But taken as a whole, we cannot say definitively either way that there was a catastrophic "effect," or any effect at all. The answer lies somewhere in between and is dependent upon the particular parameter being measured and the assumptions being made. One must be careful in trying to make an overarching statement in the extremes, particularly when trying to determine the effects of something as complex as the Gulf War. Some of the long term effects are not fully known; more time is needed to determine if the Gulf ecosystem will recover to its pre-war state. Most experts speculate that it will not return to its original state, although complete data on the initial conditions of the Gulf ecosystem is also limited. The NOAA chief scientist explained the Gulf situation best in stating that "the Gulf (environment) has changed because of the 1991 conflict; how dramatically it has changed still remains to be seen."²⁸

Sound Propagation in the Marine Environment: The Acoustic Thermometry of Ocean Climate (ATOC) Project

In many cases, the Department of Defense (DOD) and Navy are leading research to determine the environmental effect of military operations. The Congress established the Strategic Environmental Research and Development Program (SERDP) on November 5, 1990 through Public Law 101-510 to address environmental matters of concern to the DOD and Department of Environment (DOE). It is conducted as a tri-agency program with participation from the DOD, DOE, and the Environmental Protection Agency. The SERDP identifies and develops technology to enhance capabilities to meet environmental commitments, and fosters the exchange of scientific information and technologies among governmental agencies and the private sector. Funding for the SERDP has stabilized at about \$50M per year for Fiscal Years 1995 and 1996.

Under the aegis of the SERDP, there are several programs directly addressing concerns articulated at this Symposium. Over \$50M of SERDP funds are encumbered by the Acoustic Thermometry of Ocean Climate (ATOC) project.²⁹ By sending pulses of underwater sound through the deep ocean basins, scientists hope to settle the question of whether the predicted "greenhouse effect" has begun

to warm the planet. This experiment exploits the fact that the speed of sound in water depends on the water's temperature; the warmer the water, the faster sound propagates through it. Any significant change in the speed at which sound traverses several thousand miles of seawater would mean a change in the average temperature of the water through which the sound passed. By careful measurements repeated over a decade or so, it can be demonstrated that seasonal and annual trends are dampened and average global and/or basin scale ocean temperature changes could be resolved with sufficient accuracy to validate or discount greenhouse effect estimates. The generally accepted estimate of greenhouse warming at the ocean-atmosphere boundary is 20 millidegrees Celsius per year, decreasing exponentially to 5 millidegrees per year at the depth of the Deep Sound Channel. The ATOC experiment has the potential to demonstrate that a single quantitative global warming signal of 4-5 millidegrees per year at 1 kilometer ocean depth (average Deep Sound Channel depth) could be confirmed at the 95% statistical confidence level in a ten-year observation period.³⁰ Concurrently, a detailed picture of ocean thermal patterns can be deduced which has a direct bearing on the effectiveness of naval systems.

A strong marine biology program is tightly coupled to the ATOC research effort. Although permits from the National Marine Fisheries Service (NMFS) were in process, project execution was delayed in 1994 when protests from the Sierra Club Legal Defense Fund and the Natural Resources Defense Council forced the NMFS to reconsider and require full Environmental Impact Statements (EIS). Opinions regarding the effects of the experiment greatly varied. Hal Whitehead, a whale researcher at Dalhousie University in Nova Scotia, stated that "the effects of the sounds on marine mammals could range from deafening, through hearing loss, to disturbances in feeding or socializing, to long-term psychological effects."³¹ Most scientists are convinced that there is no evidence that even extremely loud low-frequency noises emitted by supertanker propellers or the underwater blasts from offshore oil explorers and drilling platforms cause damage to marine mammals. The animals may be "annoyed" by the sounds, but they are certainly not endangered. Further, a report from the Ocean Studies Board of the National Academy of Sciences states that although there is an absence of hard data, "it appears that low-frequency sound, even at high levels, is barely audible to them."³² As a calibration point, ATOC proposed transmitting a 260 watt, 60 to 90 Hertz pulsed signal 2% of the time - 20 minutes on, 4 hours off, every fourth day at a depth of 1000 meters. This noise signal is about one-tenth as powerful as the sound emitted by a typical supertanker.³³

After nearly two years of discussion, the Marine Mammal Protection Act permit for an ATOC source in California was granted in the Spring of 1995. A permit for the Hawaii source remains in process. This situation is a typical example of policy and regulation that has proceeded without sufficient or reasonable knowledge of

actual effects. These regulatory events result in decreased National Security capabilities at increasing cost, without significantly improving the basis to construct a reasonable and workable policy.

The previous case studies illustrate the importance of a complete knowledge base in forming a complete assessment of the environmental threat of any type of marine operation. This knowledge base should consist of known initial environmental conditions, short and long term effects, and the actual impacts. After evaluating the case studies, an evaluation of the knowledge base concerning the environmental threat of military operations can be performed. This knowledge base is in fact very thin and, with few exceptions, contains a great deal of uncertainty. Thus, it is not surprising that very little capability exists to make adequate impact assessments except where there is a similar activity in the civilian or commercial sectors. For the most part, military research has focused upon the military effectiveness of weapons systems, rather than on the environmental effects thereof.

PART III: COPING WITH SCIENTIFIC UNCERTAINTY REGARDING THE IMPACT OF WAR AND MOOTW ON THE MARINE ENVIRONMENT

As the above discussion indicates, collection and analysis of data regarding the impacts of combat on the marine environment is a massive and complex undertaking. Even with concerted study efforts over time, it remains difficult to predict with a great deal of certainty the long term impacts of combat on the marine environment. Because decisions regarding military impacts on the marine environment will necessarily be made, by default if not through deliberate process, some means of dealing with this scientific uncertainty is required.

What are the ramifications of this scientific uncertainty on military commanders and policy makers? From a domestic law standpoint, the limited knowledge base creates a risk of being challenged for noncompliance with domestic requirements, with the ever-present possibility of disruptive enforcement action. From an international standpoint, the limited knowledge base creates other risks. With the benefit of historical hindsight, our activities at sea will be judged in light of actual long term impacts, whether adequately anticipated by the scientific community or not. It is the unavoidable burden of the policy maker to assume the risk of scientific uncertainty when striking the appropriate balance between unrestricted military operations and environmental protection.

Notes

*Dr. DeMarco is Director of Environmental Programs, Office of Naval Research. Commander Quinn is a Judge Advocate in the U.S. Navy.

1. 42 U.S.C. §4332(2)(C) (1970).
2. 40 C.F.R. §1508.5 (1978).

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3. 40 C.F.R. §1502.22 (1986).
4. *Id.*
5. Executive Order No. 12114, 3 C.F.R. 356 (1979).
6. 16 U.S.C. §1536(c) (1973).
7. 16 U.S.C. §1538 (1973).
8. 16 U.S.C. §1533(b)(1)(A) (1975).
9. 16 U.S.C. 1362(18) (1992).
10. 60 Fed. Reg. 28, 381 (1995).
11. Draft 50 C.F.R. §228.4(a)(5), at 60 Fed. Reg. 28, 384 (1995).
12. *Id.*
13. *Id.*
14. 40 C.F.R. §1506.11. During Operation Desert Storm, the Department of Defense did in fact consult with the Council on Environmental Quality regarding pursuit of various emergent military requirements in the United States without full NEPA compliance.
15. *Tennessee Valley Authority v. Hill*, 437 U.S. 153 at 185 (1978).
16. *Srahan v. Limmon*, Civil Action No. 94-11128-DPW, U.S. District Court, District of Massachusetts May 2, 1995.
17. *Supra* n. 15.
18. 16 U.S.C. §1536(h) (1973).
19. 16 U.S.C. §1536(j) (1973).
20. *See Warfare in a Fragile World*, Stockholm International Peace Research Institute, 1980, at 144-177; Westing, *Environmental Hazards of War*, International Peace Research Institute, Oslo Norway, 1990.
21. Preller, *An Overview of the NRL Large Scale Modeling Effort Studying the Dispersion of Radioactive Contaminants in the Arctic*, Proceedings of the Office of Naval Research/Naval Research Laboratory (ONR/NRL) Workshop on Modeling the Dispersion of Nuclear Contaminants in the Arctic Seas, Oct. 18-19, Monterey, CA.
22. Literathy. *Considerations for the Assessment of Environmental Consequences of the 1991 Gulf War*, 27 Marine Poll. Bull. 349-356 (1993).
23. Michel, Hayes, Kennan, Jensen & Narumalani, *Oil in Nearshore Subtidal Sediments of Saudi Arabia from the Gulf War Spill*, 1993 International Oil Spill Conference Proceedings, Tampa, FL, at 383-388.
24. Clark & Symons, *Mt. Mitchell Oceanographic Expedition in the Gulf*, 127 Marine Poll. Bull. 31-34 (1993).
25. Literathy, *supra* n. 22.
26. Michel, *et al.*, *supra* n. 23.
27. Hayes, Michel, Montello, Aurand, Sauer, Ahmed & Abdul. *Distribution and Weathering of Oil from the Iraq-Kuwait Conflict Oil Spill within Intertidal Habitats -Two Years Later*, 1995 International Oil Spill Conference Proceedings, Long Beach, CA, 1995, at 443-451.
28. Michel, *supra* n. 26.
29. The Strategic Environmental Research and Development Program (SERDP), *1994 Annual Report and Five Year Strategic Investment Plan*, 1994.
30. Munk, *et al.*, J. Acoustic Soc. America 96 (October 1994).
31. *Sound-wave Project Pits Scientist v. Scientist*, The Washington Times, Mar. 27 1994, at E-6.
32. *Low Frequency Sound and Marine Mammals -Current Knowledge and Research Needs*, National Research Council, National Academy Press, (1994).
33. Kumagai, *Physics Today*, Sept. 1994.