

DAVID Y. IGE
GOVERNOR OF HAWAII



STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES

POST OFFICE BOX 621
HONOLULU, HAWAII 96809

Testimony of
SUZANNE D. CASE
Chairperson

Before the House Committee on
WATER & LAND

Tuesday, March 23, 2021
8:30 AM

State Capitol, Via Videoconference, Conference Room 430

In consideration of
HOUSE CONCURRENT RESOLUTION 159/HOUSE RESOLUTION 135
STRONGLY URGING THE DEPARTMENT OF LAND AND NATURAL RESOURCES
TO WORK WITH THE INTERNATIONAL DIALOGUE ON UNDERWATER
MUNITIONS' INTERNATIONAL SCIENTIFIC AND TECHNOLOGY ADVISORY
BOARD ON UNDERWATER MUNITIONS TO SEEK AND SECURE FEDERAL
FUNDING FOR THE NON-DESTRUCTIVE DISPOSAL OF THOUSANDS OF TONS
OF UNDERWATER MUNITIONS DUMPED, LOST, OR ABANDONED IN HAWAIIAN
WATERS.

House Concurrent Resolution 159/House Resolution 135 strongly urges the Department of Land and Natural Resources (Department) to work with the International Dialogue on Underwater Munitions' International Scientific and Technology Advisory Board on Underwater Munitions to seek and secure federal funding for the non-destructive disposal of thousands of tons of underwater munitions dumped, lost, or abandoned in Hawaiian waters. **The Department supports these measures and offers the following comments.**

Hawaii is facing major threats to our marine resources while climate change takes hold. Hawaii has experienced repeated coral bleaching events recently, resulting in significant coral loss throughout the State. Therefore, there is an increasing need to better mitigate the threats of underwater munitions in Hawaii. When underwater munitions are reported, the State of Hawaii is faced with the decision to choose between potential harm to human health and safety if the munitions are left in place, and clear harm to marine species, including protected species such as whales and corals, if munitions are detonated for removal. In addition, the U.S. Military offers no environmental consultation or mitigative options to remove or secure underwater munitions.

SUZANNE D. CASE
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

ROBERT K. MASUDA
FIRST DEPUTY

M. KALEO MANUEL
DEPUTY DIRECTOR - WATER

AQUATIC RESOURCES
BOATING AND OCEAN RECREATION
BUREAU OF CONVEYANCES
COMMISSION ON WATER RESOURCE MANAGEMENT
CONSERVATION AND COASTAL LANDS
CONSERVATION AND RESOURCES ENFORCEMENT
ENGINEERING
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION
KAHOOLAWE ISLAND RESERVE COMMISSION
LAND
STATE PARKS

The issue is larger than a single agency can address, and there is a great need for collaborative expertise, technology, and funding to adequately address this important issue. Working with the International Dialogue on Underwater Munitions' International Scientific and Technology Advisory Board on Underwater Munitions and other experts to develop techniques and secure funding for more environmentally sensitive options for disposing or securing underwater munitions will benefit the people of Hawaii and our sensitive marine ecosystems.

Thank you for the opportunity to comment on these measures.

Testimony Before the House Committee on Water and Land
Chair: David A. Tarnas
Vice-Chair: Patrick Pihana Branco

Resolution Number HR135 and HCR159

Tuesday, 23 March 2021

8:30am via Videoconference,
Conference Room 430, State Capital, 415 South Beretania St.

Aloha Chair Tarnas, Vice-Chair Branco, and Members of the Committee,

My name is Dr. Alex Souchen and I am submitting written testimony on behalf of the International Dialogue on Underwater Munitions (IDUM) **in support of HR135 and HCR159**. I am a professional military and environmental historian with expertise in the history of munitions disposal after World War II. I have published a peer reviewed book on the subject, and several other scholarly articles and publications on underwater munitions. My work examines the political, economic, and scientific contexts that informed past dumping policies in the United States, Britain, and Canada from 1918-1972, and the concerning health and environmental consequences of munitions for humans, marine ecosystems, and the offshore economy. Since 2015, I have sat on the IDUM's Scientific and Technology Advisory Board, where I regularly consult on historical and archival research matters.

Currently, there are over 90,000 military personnel and civilian employees stationed in Hawaii, and while this influx of defense dollars adds value to the state's economy, the military's presence carries an enormous and concerning environmental footprint. The military owns or leases over 400,000 acres of land, that comprise over 100 bases and installations, and occupies roughly 6% of Hawaii's total land mass – including about 22% of Oahu. The military has also designated over 50,000 square miles of the surrounding Pacific Ocean and airspace for military purposes. Military operations, training, and maintenance has resulted in immense air, soil, and water pollution, including several Superfund sites located in Pearl Harbor.

The pollution of military activities includes unexploded ordnance on land and at sea, as well as the old and expired munitions that were intentionally dumped into the oceans. From the 1910s to the 1970s, the militaries of almost every industrialized country used ocean dumping as the primary disposal method for surplus conventional and chemical munitions. Consequently, hundreds of millions of tons were sunk worldwide. Unfortunately, dumping did not eliminate the dangers, it merely dispersed them across time and space. As a major naval base, Pearl Harbor and Hawaii played a prominent role in the history of munitions dumping. Ships leaving the port littered Hawaiian waters with munitions: deep water dumpsites now contain an estimated 32,000 tons, while many other shallow water dumpsites exist along shorelines. In some places, the bombs and ammunition are so concentrated that local residents have integrated the dangers into place names, such as Ordnance Reef. Underwater munitions represent a clear and present danger to public safety and marine environments. Corroded munitions are known to poison food chains with carcinogens

and toxic chemicals, threaten fish health and coral reefs, injure fishermen and beachgoers, and impede offshore economic developments in the energy, tourist, and transportation sectors.

As someone who has spent most of my career researching the history of dumping policies and programs, I have logged countless hours in the archives. I have analyzed thousands of documents and other historical sources in an effort to better understand past decision-making processes, operational requirements, and scientific knowledge about dilution and ocean ecosystems. So far, these efforts have revealed a complex and shocking history of contamination and exposure. Dumping was not some haphazard strategy used by officials on a whim or in isolated instances: it was a product of clearly defined policies and procedures, and undertaken over successive decades by concerted efforts from multiple stakeholders – including, the military, government departments, private contractors, and scientists. At the present time, the scale of this history can be only partially reconstructed and understood. For every file I open and read, I uncover new information about potential dumpsites. Quite simply: the more we look, the more we find.

In order to comprehensively address the problem of underwater munitions and eliminate the dangers, we need to mobilize many different types of experts. We need scientists and engineers; we need military officers and explosive disposal technicians; we need advanced technologies and qualified operators; but we also need more historians and social scientists. Interdisciplinary approaches are vital to knowledge mobilization and remediation. Professionally trained historians can deploy their expertise to assess the vast troves of records in archives and interview impacted communities and individuals in order to locate new dumpsites and identify ordnance types. Experts from the disciplines of communication studies, education, information science, political science, and the digital humanities can deploy their expertise to collect, store, analyze, and disseminate new forms of knowledge and materials about underwater munitions.

As a multi-national umbrella organization, comprised of independent scientists and dedicated professionals, the IDUM is the only institution in the world capable of mobilizing the expertise, science, and technology to independently address the underwater munitions problem in Hawaii.

The Hawaiian government has an immense opportunity here. Partnering with the IDUM will eliminate major threats to public health and offshore economic development, paving the way for new tourist attractions, green energy platforms, safer beaches, and healthier coral reefs and fish stocks. The investment would provide access to the IDUM's cadre of international expertise, training, and experience, in order to building local capacities by creating new jobs and opportunities for Hawaiian citizens.

Thank you for your time and consideration.

Sincerely,

Dr. Alex Souchen
Historian, International Dialogue on Underwater Munitions

Testimony Before the House Committee on Water and Land (WAL)

Chair: David A. Tarnas
Vice-Chair: Patrick Pihana Branco

Resolution Number HR135 and HCR159 Tuesday-23-March-2021

Chair Tarnas, Vice-Chair Branco, and respected Committee Members

I am Dr. James W. Porter, Professor of Ecology & Marine Sciences at the University of Georgia. I am also a member of the International Science & Technology Advisory Board (ISTAB) of the International Dialogue on Underwater Munitions (IDUM). I am pleased to submit both written and oral testimony in favor of Resolutions HR135 and HCR159.

I have studied coral reefs for more than 50 years. I am an expert on the effects of underwater munitions on coral reefs.

Underwater munitions are point-source emitters of a host of highly toxic compounds which poison coral reefs and the people who use them. To give you a very brief overview, I attach Abstracts for two papers that describe these poisons and the effects they have on reef organisms and the health of fishing communities that depend on them.

I also attach President Barack Obama's letter to the people of Vieques, Puerto Rico regarding his commitment "to achieve an environmentally acceptable clean-up" of former munitions sites on the land and coral reefs of Vieques, Puerto Rico.

As you may be aware, coral reefs are found within the territorial boundaries of 94 sovereign nations. World-wide coral reefs generate more than \$9.9 trillion per year (the gross domestic product of Switzerland) and more than \$835 million per year in Hawai'i alone. Across the planet, coral reefs provide protein and income for more than 500 million people. In Hawai'i they create more than 8,000 full-time jobs. In the last two years, coral reefs have been the source of drugs that can cure prostate cancer (Bryostatins – from coral reef bryozoa) and breast cancer (Prostaglandin – from coral reef sea fans). In addition, two more coral reef drugs are under development that reduce the rate of heart attack in elderly Americans and kill the H.I.V.-A.I.D.S. virus more effectively than AZT.

Hawaiian coral reefs add immeasurably to the natural and cultural wealth of the world and the State. Hawai'i's coral reefs also provide shoreline protection against coastal zone damage from tsunamis and cyclones. They generate the sand for Hawai'i's world-famous tourist beaches.

Coral reefs are unique among all marine ecosystems because of their [1] high topographical complexity (like the trees in a forest, corals build the extraordinary three-dimensionality of this habitat), [2] high biodiversity (25% of all marine plants and animal species are found there), and [3] high productivity (2,000 dry grams C/m²/yr.). All three of these hallmark characteristics are diminished by toxins from decaying underwater munitions (Porter *et al.*, 2011 – see submitted Research Abstract 1).

Military activities on coral reefs have three main effects, in line with all three of the characteristics mentioned above: by severely reducing topographical complexity [Item 1 above], they secondarily also reduce the local biodiversity [Item 2 above] which is dependent on this topographical complexity. Most high-explosives are made with nitrogen compounds (e.g., TNT). Therefore, in addition to introducing toxins, explosives also release nutrients into these otherwise low-nutrient environments [Item 3 above]. In the marine environment generally, but especially on coral reefs, nitrogen is the limiting nutrient. Therefore small increases in nutrient concentrations reduce coral cover and increase algal abundance.

In recent decades coral reefs world-wide have been decimated by coral bleaching. Hawai'i has not been spared from this scourge either.

While most bleaching can be attributed to rising temperatures, a growing body of evidence identifies elevated nitrogen as another *causative* agent of bleaching

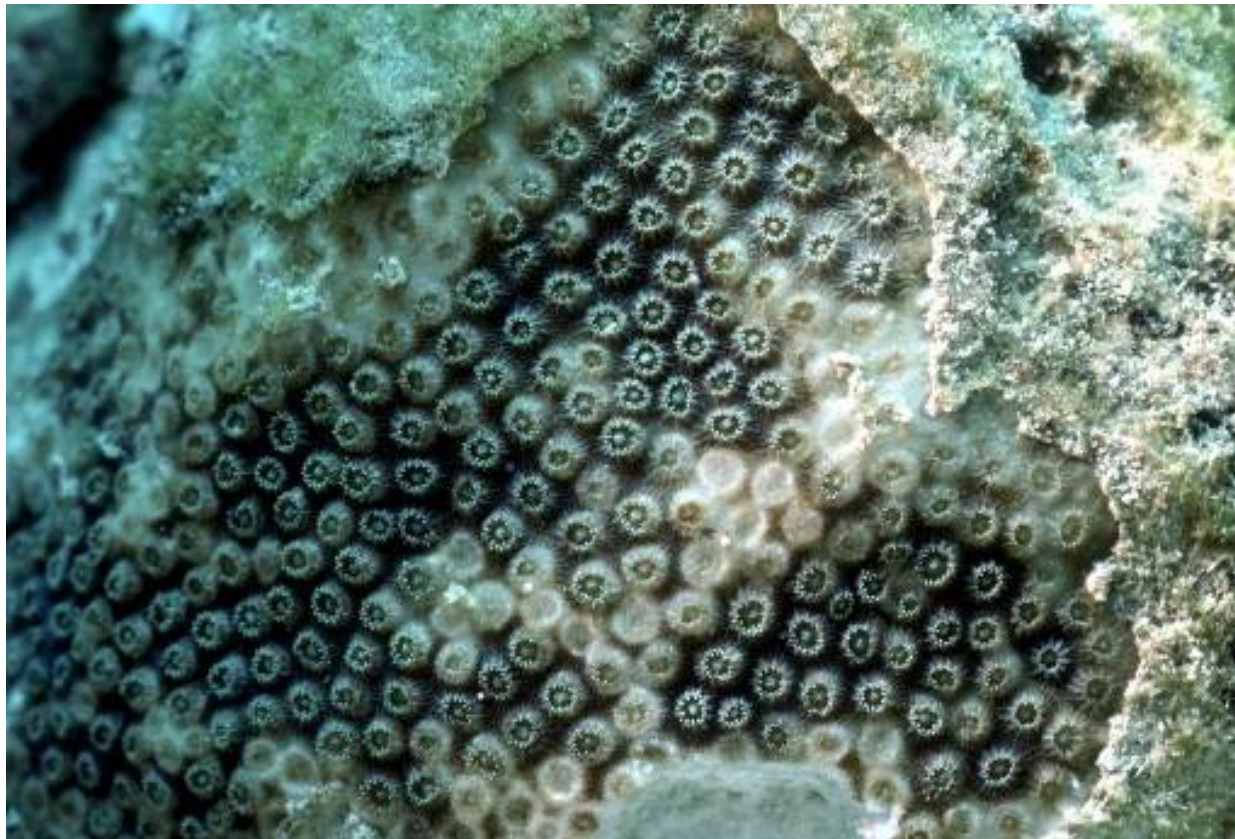


Figure 1. Bleached coral from Vieques Puerto Rico. All corals in physical contact with leaching ordnance (UWUXO) were bleached, whereas no coral without physical contact with live ordnance exhibited bleaching.

On Vieques in Puerto Rico, every coral in physical contact with corroding ordnance exhibited **BOTH** elevated tissue-nitrogen levels (up to 800 ppm of TNT) **AND** coral bleaching (Figure 1). Nitrogenous compounds in the coral tissue had the same chemical composition as the TNT leaching from the adjacent ordnance.

On Vieques, Puerto Rico, our research group tested sea water, marine sediment, and biotic samples from nearshore localities (some less than 100' from public beaches). This investigation revealed that every animal tested on the seaward reef of Vieques near unexploded ordnance (UWUXO) contained at least one carcinogenic compound leaching from these submerged bombs, bullets, and artillery shells (Figure 2). For instance, we found the following carcinogens: (1) 1,3,5-Trinitrobenzene; (2) 1,3-Dinitrobenzene; (3) 2,4-Dinitrotoluene + 2,6-Dinitrotoluene; (4) 1,3-Dinitrobenzene; (5) 4-Nitrotoluene; (6) 2,4,6-Trinitrotoluene; (7) 2-Nitrotoluene; and (8) Hexahydro-1,3,5-Trinitrotriazine leaking from UWUXO. Some of these leached compounds were in very high concentrations near the UWUXO, greatly exceeding EPA's Risk-Based-Level for Cancer. Our data show, unequivocally, that toxic substances leaching from UWUXO enter the marine food web and are passed up the food chain.



Figure 2 Leachate from UWUXO on Vieques, Puerto Rico resembled TNT compounds found in bleached coral physically adjacent to this ordnance.

Although little is known about the disease-causing potential of toxic materials leaching from UWUXO, anecdotal observations on Vieques, Puerto Rico identified high rates of disease among sea fans living within a meter of UWUXO, but no disease among sea fans living more than a meter away (Figures 3a & b). The “Black Spot Disease” visible on sea fans growing near ordnance is known to be stimulated by elevated nitrogen concentrations, further suggesting that nitrogen-derived compounds from UWUXO can contribute to reduced coral reef health.

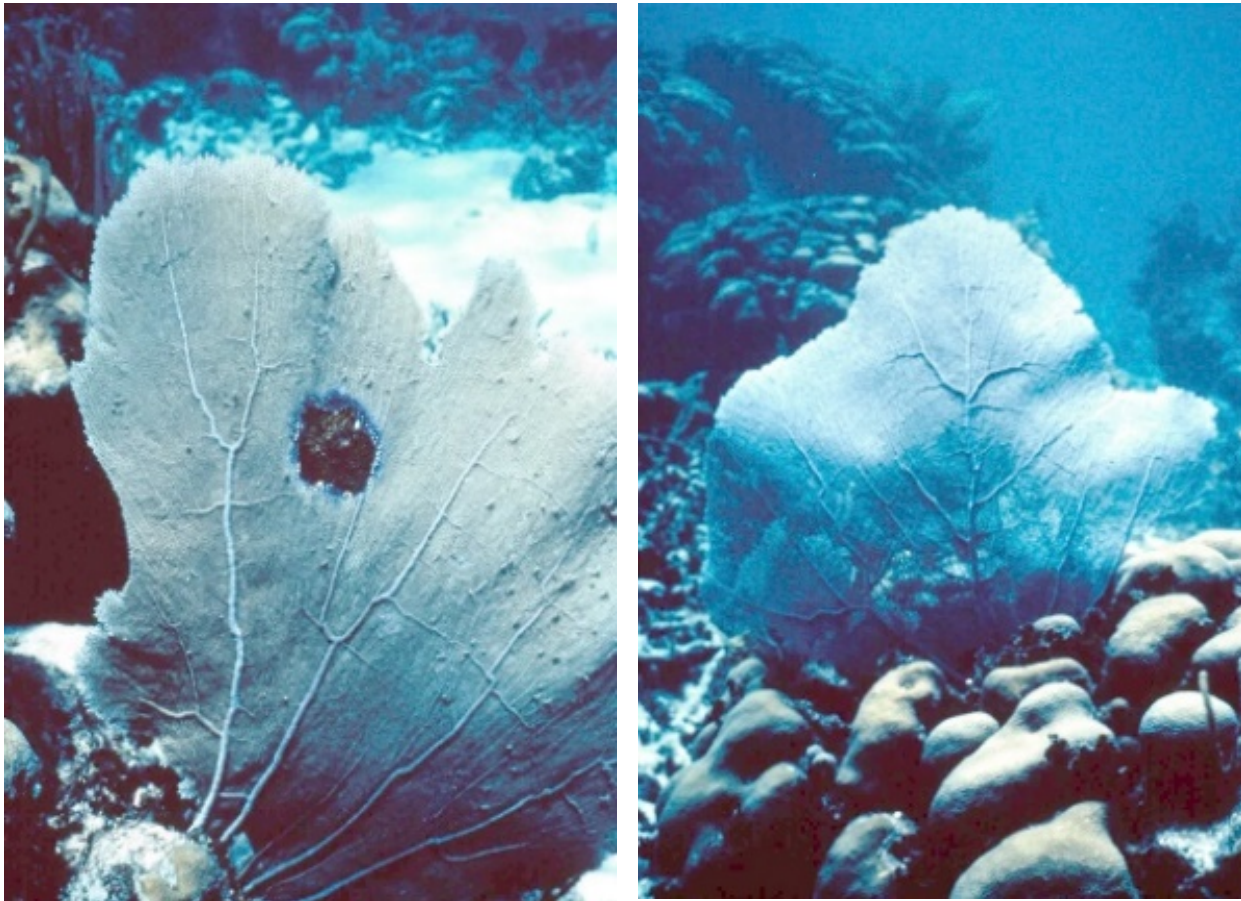


Figure 3a & b. Diseased (left) and healthy (right) sea fans (*Gorgonia ventalina*) from Vieques Puerto Rico from within close proximity (< 1m) to UWUXO (left) and from outside (> 1m) this area, respectively.

Health data for long-term residents of Vieques show significantly elevated levels of cancer and several other types of chronic illnesses (hypertension, asthma, and cirrhosis of the liver) (See submitted Research Abstract 2). The types of cancers and the timing of their appearance are all consistent with a causal relationship between the carcinogenic compounds released on the island during military exercises and the expressions of cancer among the island's residents.

I urge you to pass Resolutions HR135 & HCR159. I urge you to partner with IDUM to rid Hawaiian coral reefs of underwater munitions. I urge you to take these actions to help restore and preserve Hawai'i's precious coral reefs.

Respectfully submitted,

James W. Porter, Ph.D.

Supporting Material For the Testimony of Dr. James W. Porter

Before the House Committee on Water and Land (WAL)

Chair: David A. Tarnas
Vice-Chair: Patrick Pihana Branco

Resolution Number HR135 and HCR159
Tuesday-23-March-2021

Supporting Material Item 1 Abstract of:

Porter, J.W., J.V. Barton, C. Torres. 2011. Ecological, radiological, and toxicological effects of naval bombardment on the coral reefs of Isla de Vieques, Puerto Rico. In: G.E. Machlis *et al.* (eds.), *Warfare Ecology: A New Synthesis for Peace and Security*, 65 NATO Science for Peace and Security Series C: Environmental Security. Springer Science+Business Media, Holland. DOI 10.1007/978-94-007-1214-0_8

Supporting Material Item 2 Abstract of:

Sanderson, H., P. Fauser, R.S. Stauber, J. Christensen, P. Løfstrøm, and T. Becker. 2017. Civilian exposure to munitions-specific carcinogens and resulting cancer risks for civilians on the Puerto Rican island of Vieques following military exercises from 1947 to 1998. *Global Security: Health, Science and Policy* 2:1, 40-61, DOI: 10.1080/23779497.2017.1369358 (<https://doi.org/10.1080/23779497.2017.1369358>)

Supporting Material Item 3 Letter:

Obama, B. 2008. Letter to Mr. Acevedo Vila, Governor of Puerto Rico.

Ecological, Radiological, and Toxicological Effects of Naval Bombardment on the Coral Reefs of Isla de Vieques, Puerto Rico

James W. Porter, James V. Barton, and Cecilia Torres

Abstract Between 1943 and 2003, land and sea areas on the eastern end of Isla de Vieques, Puerto Rico were used as a naval gunnery and bombing range. Viequean coral reefs are littered with leaking and unexploded ordnance (UXO). Radiological, biological, and chemical surveys were conducted to assay the health of these coral reefs.

Biotic surveys revealed a statistically significant inverse correlation between the density of military ordnance and several measures of coral reef health, including (a) the number of coral species ($p=0.007$), (b) the number of coral colonies ($p=0.02$), and (c) coral species diversity (H') ($p=0.0005$). Reefs with the highest concentrations of bombs and bomb fragments have the lowest health indices.

Water, sediment, and biotic samples revealed that: (a) every animal tested on the seaward reef of Vieques near unexploded ordnance contained at least one potentially toxic compound leaking from *in situ* ordnance [1,3,5-Trinitrobenzene; 1,3-Dinitrobenzene; 2,4,6-Trinitrotoluene; 2,4-Dinitrotoluene + 2,6-Dinitrotoluene; 4-Nitrotoluene; 2-Nitrotoluene; Hexahydro-1,3,5-Trinitro-1,3,5-Triazine]; (b) concentrations of these substances in fish and lobster tested do not exceed EPA's Risk Based Concentrations for commercially edible seafood, but (c) concentrations of these substances in several of the non-commercial species tested (e.g. feather duster worms, corals, and sea urchins) greatly exceed these concentrations. For chromium in sediments, and for TNT in both water and sediment, there is an exponential decline with increasing distance from unexploded ordnance. An organism's mobility and proximity to UXO determine its body burden of toxic compounds: (1) the

J.W. Porter (✉)

Odum School of Ecology, University of Georgia, Athens, GA, USA
e-mail: jporter@uga.edu

J.V. Barton

Underwater Ordnance Recovery, Inc., Norfolk, VA, USA

C. Torres

European Economic Union Environmental Program, Berlin, Germany

closer an organism is to a leaking bomb, the higher its body burden will be, and (2) the less mobile (and therefore more sessile) an organism is, the higher the concentration of toxic substances will be.

Our data show unequivocally that toxic substances leaching from UXO have entered the coral reef marine food web. Since the concentration of explosive compounds is highest near unexploded ordnance, we recommend that surface UXO on the Vieques coral reef be picked up and removed. We assert that this action will have an immediate and beneficial effect on the coral reef ecosystem by removing these point sources of pollution from the environment. Existing technology can perform this required action easily.

Keywords Coral reefs • Ecotoxicology • Carcinogens • Explosive compounds • Underwater ordnance • UXO • Puerto Rico • Vieques

Introduction

Both the preparation for and conduct of war are environmentally destructive. While the financial and human costs of war are readily acknowledged, the environmental costs of war are rarely recognized, let alone quantified. Machlis and Hanson [50] point out that in the past two decades there have been 122 armed conflicts and that 85% of the 192 sovereign nations on earth maintain standing armies [38, 50, 51]. Further, the preparation for war consumes 6% of raw materials and produces as much as 10% of global carbon emissions annually [17, 18, 50, 51]. Bidlack [17] estimates that military installations and bombing ranges cover 15 million km² of the earth's surface.

Isla de Vieques, Puerto Rico is one of these places. Vieques is situated off the eastern end of Puerto Rico and lies within the 100 m depth contour of the Puerto Rican rise. Vieques is substantially larger than St. Thomas and only slightly smaller than St. Croix, US Virgin Islands. The island is partitioned into three sectors (Fig. 1 [top]): the Eastern Naval Area, on the eastern end of the island (Fig. 1 [bottom]), the Naval Ammunition Facility on the western end, and the Civilian Area in the middle. With almost two-thirds of the island designated as restricted areas, the island is unique in the Caribbean in having almost 100 miles of uninhabited coastline. Vieques has been used for naval training exercises since 1941. Beginning in 1999, formal requests were made by the Puerto Rican government to the US Navy to cease military operations on Vieques [11]; naval exercises ceased entirely in May, 2003 [15].

Air-Dropped Bombs and Artillery Shells

The amount of bombs and other explosives dropped and detonated on the eastern end of Vieques is staggering (Table 1). US Navy Vice Admiral Hohn Shanahan



Fig. 4 (*Upper left*) Underwater unexploded ordnance (UWUXO) in high concentrations litters the seafloor in many areas around the world. Photograph shows a 2,000 lb General Purpose air-dropped bomb located at Site 3 (Fig. 1 [bottom]) just south of Roca Alcatraz within the US Naval bombing range, Isla de Vieques, P.R. This ordnance had several corrosion holes located in its mid-section exposing the contents of the bomb to the surrounding seawater. (Photograph by Dr. James W. Porter) (*Upper right*) Bomb craters pock mark coral reefs on the seaward side of Bahia Salina del Sur, Isla de Vieques, P.R. All craters investigated in the magnetometer survey were perfectly symmetrical holes, approximately 14 m in diameter and 1.5 m deep, such as this typical crater 50 m south of Roca Alcatraz (18° 07' 21.60" N; 065° 18' 03.50" W). (Photograph by Dr. James W. Porter) (*Lower left*) High explosives from within the cavities of a corroding bomb on the Vieques coral reef spill and leach out onto the surrounding reef. The granular material from these unexploded munitions was analyzed for TNT, Semtex, C-4, and other high explosive compounds. (Photograph by Dr. James W. Porter) (*Lower right*) Diseased colony of the mountainous star coral (*Montastraea faveolata*) in physical contact with a leaking bomb. Samples of this colony detected the presence of exceptionally high concentrations of explosive compounds. (Photograph by Dr. James W. Porter)

rocket fin assemblies, machine-gun bullets, and unexploded battleship artillery rounds. Later studies attempted to quantify the impact as a function of distance from the epicenter of military activity [66, 67]. Local [24, 32, 39, 45] and region-wide comparisons followed [72].



Civilian exposure to munitions-specific carcinogens and resulting cancer risks for civilians on the Puerto Rican island of Vieques following military exercises from 1947 to 1998

Hans Sanderson, Patrik Fauser, Ricky Steven Stauber, Jesper Christensen, Per Løfstrøm & Thomas Becker

To cite this article: Hans Sanderson, Patrik Fauser, Ricky Steven Stauber, Jesper Christensen, Per Løfstrøm & Thomas Becker (2017) Civilian exposure to munitions-specific carcinogens and resulting cancer risks for civilians on the Puerto Rican island of Vieques following military exercises from 1947 to 1998, *Global Security: Health, Science and Policy*, 2:1, 40-61, DOI: [10.1080/23779497.2017.1369358](https://doi.org/10.1080/23779497.2017.1369358)

To link to this article: <https://doi.org/10.1080/23779497.2017.1369358>



© 2017 The Author(s). Published by Informa UK Limited, trading as Taylor & Francis Group



[View supplementary material](#)



Published online: 14 Sep 2017.



[Submit your article to this journal](#)



Article views: 3912





[View related articles](#)



[View Crossmark data](#)

Civilian exposure to munitions-specific carcinogens and resulting cancer risks for civilians on the Puerto Rican island of Vieques following military exercises from 1947 to 1998

Hans Sanderson^a , Patrik Fauser^a, Ricky Steven Stauber^b, Jesper Christensen^a , Per Løfstrøm^a and Thomas Becker^a

^aDepartment of Environmental Science, Aarhus University, Roskilde, Denmark; ^bIndependent Consultant, Waldorf, MD, USA

ABSTRACT

Estimation of legacy public health risks from munitions residues near or at former military test ranges has for the past decades been a challenge to health authorities. Parts of the island of Vieques (PR) were for six decades used for military training, and these are now declared as a Superfund site. ATSDR has conducted site assessments there and found no cause for public health concerns. The reports and findings of ATSDR have since been heavily contested and disputed. This paper provides a case study on cancer risk screening of munitions-specific carcinogens for the full period of military training on Vieques. Added cancer risks and Margins of Exposure for the different carcinogens for each year were derived. We found that there is a potential for cancer risk concern related to BaP exposures. Furthermore, there were health risks from TNT exposures. The primary exposure route of these compounds was oral. The period 1992–1997 showed a significantly elevated lung and bronchus cancer incidence rate in Vieques compared to Puerto Rico mainland mainly among women <50 yr and men 50–64 yr. These correlate with high munitions exposures in the period 1977–1984.

ARTICLE HISTORY

Received 4 January 2017
Accepted 14 August 2017

KEYWORDS


Munitions; Vieques; cancer; munitions residues; military training area

Introduction

Estimating the human health risks from historical and legacy distributed munitions residues from military test ranges has for the past decades been a challenge to authorities (Phillips & Perry, 2002). This is because there generally is little information available regarding estimating the public health risks of military-unique releases to humans via environmental pathways from past activities (Phillips & Perry, 2002). The aim of this paper is therefore to provide an example of how a risk assessment can be developed to help prioritise further empirical risk research with an emphasis on cancer risks. We chose the Puerto Rican island of Vieques, which has been used as a military test area for more than six decades by the U.S. military. The Navy engaged two-thirds of the island's 9000 acres where military exercises tested live ammunition. Testing was open on average 180 days per year (AJPH, 2001). Meanwhile, between 9000 and 14000, inhabitants lived eight miles away from the ranges during the period. The first large-scale war games took place in 1948 involving more than 60 war ships, 350 planes and 50,000 troops from all branches of the military. In the

early 1980s, an average of 3400 bombs were deployed, 158 days of naval bombardment, 200 days of air-to-ground combat exercises and 21 days of marines practising invasions per year on the island. Over 15 years from 1983 to 1998, the military deployed more than 17.7 million kg of munitions on Vieques (Davis, Hayes-Conroy, & Jones, 2007). In 2005, the United States Environmental Protection Agency (USEPA) listed the Vieques bombing range as a Superfund site (Davis et al., 2007). After the closure and the Superfund status, the US EPA commissioned an assessment of ecological and human health risks. The current conclusion regarding human health risks is that the exposure is not under control – meaning that; (1) contamination has been detected at a site at an unsafe level; and (2) a reasonable expectation exists that people may be exposed to the contamination (US EPA, 2016b). The remedial efforts have so far resulted in surface clearance of more than 10.25 km² cleared of munitions; over 38,000 munitions items have been removed and destroyed. Sub-surface clearance includes a total of 15.3 km of roads cleared (includes a 7.5 m buffer on either side) and 17 km of beaches cleared.

CONTACT Hans Sanderson  sanderson@envs.au.dk

 Supplemental data for this article can be accessed <https://doi.org/10.1080/23779497.2017.1369358>.

© 2017 The Author(s). Published by Informa UK Limited, trading as Taylor & Francis Group.

This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0/>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

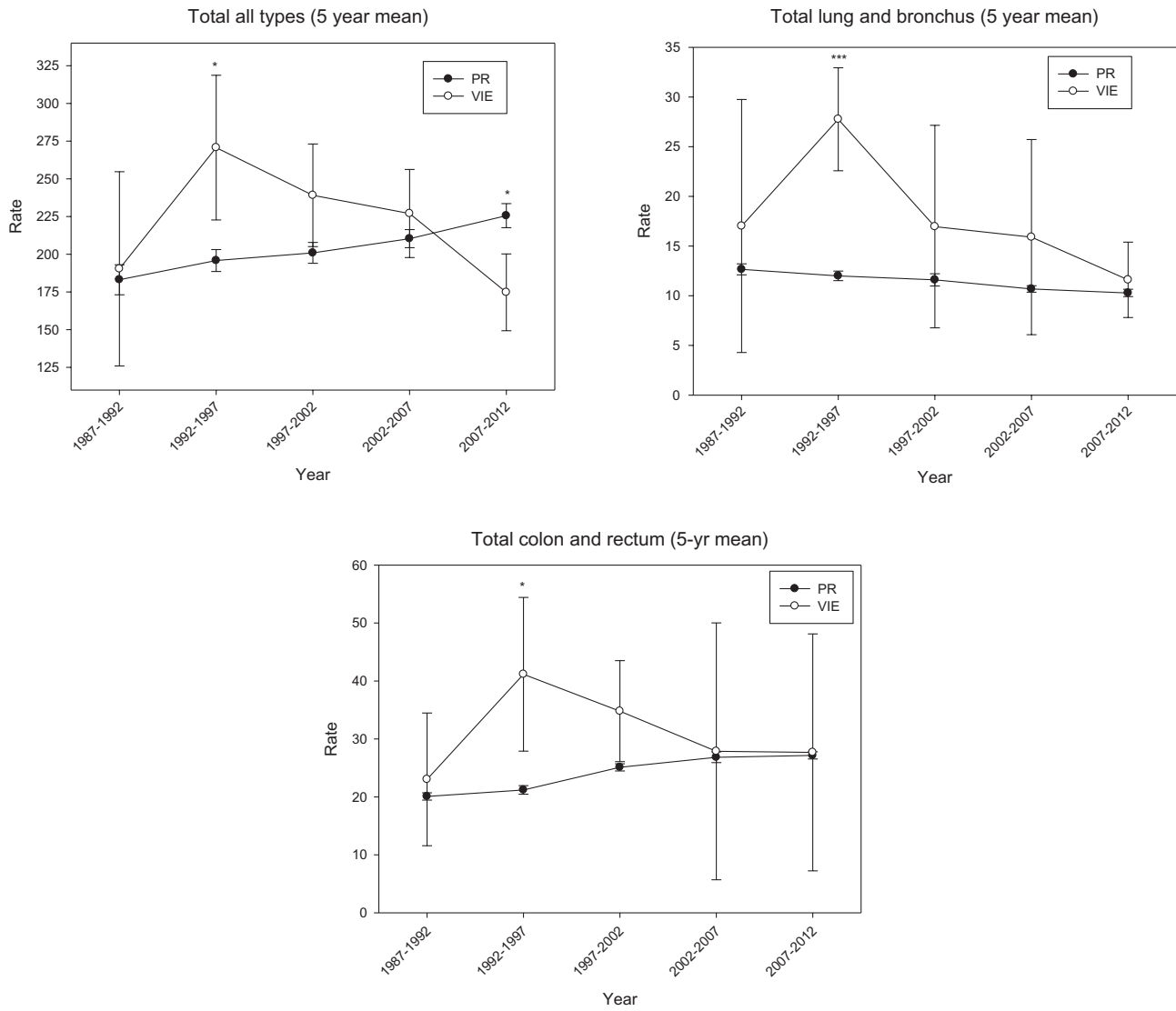


Figure 9 (a-c). Five-year mean cancer incidence rates for Puerto Rico (PR) and Vieques (VIE), 1987–2012. Note: * = $p < 0.05$; *** = $p < 0.001$.

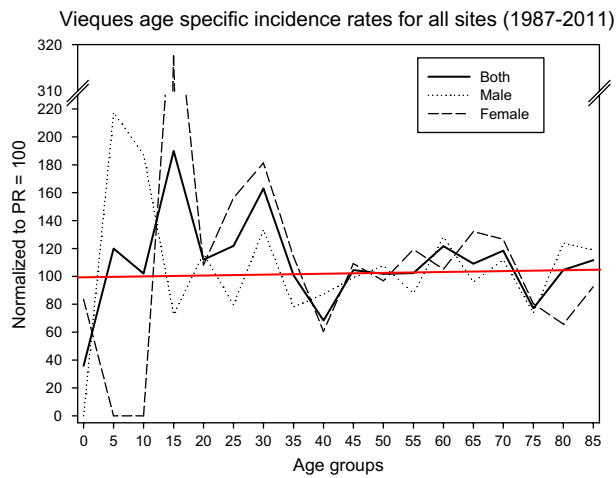


Figure 10. Relative overall cancer incidence rates for specific age groups per year normalised to Puerto Rico. Note: Red line = 100.

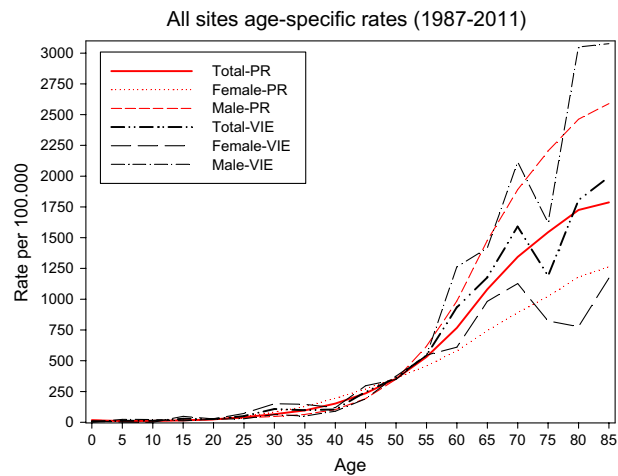


Figure 11. All site age-adjusted and age-specific absolute cancer rates for Puerto Rico and Vieques.

Barack Obama

February 12, 2008

Honorable Anibal Acevedo Vila
Governor
Commonwealth of Puerto Rico
La Fortaleza
San Juan, Puerto Rico 00901

Dear Governor Acevedo Vila:

Puerto Rico is a vitally important part of our country and Puerto Ricans have made immeasurable contributions to the United States. As President of the United States, I will pay close attention to issues that have an impact on the well-being of the people of Puerto Rico.

Puerto Rico's status must be based on the principle of self-determination. Puerto Rico has a proud history, an extraordinary culture, its own traditions, customs and

In addition, I will work closely with the government of Puerto Rico and Congress to enhance the participation of Puerto Rico in Medicaid and all federal health care assistance programs. My Administration will actively work with the Department of Defense as well to achieve an environmentally acceptable clean-up of the former U.S. Navy lands in Vieques, Puerto Rico. We will closely monitor the health of the people of Vieques and promote appropriate remedies to health conditions caused by military activities conducted by the U.S. Navy on Vieques. I will also work to evaluate and expand the existing land use plan for the former U.S. Navy lands to prioritize improving the lives of the Island's residents and the sustainable economic development of the people of Vieques.

Sincerely,



Barack Obama



Obama'08
BarackObama.com

Obama for America • PO Box 8210 • Chicago, IL 60680

Paid for by Obama for America

Testimony Before the House Committee on Water and Land (WAL)

Chair: David A. Tarnas

Vice-Chair: Patrick Pihana Branco

Resolution Number HR135 and HCR159

Tuesday-23-March-2021

Chair Tarnas, Vice-Chair Branco, and respected Committee Members

Chair Tarnas, Vice-Chair Branco, and respected Committee Members,

I am Dr. Christine Ward-Paige, a professional marine scientist with over 20 years of experience in coastal and marine ecology and pollution. I am also the CEO and Lead Scientist at eOceans Research and Consulting Inc. and a member of the International Science & Technology Advisory Board (ISTAB) of the International Dialogue on Underwater Munitions (IDUM).

I am writing to submit testimony in favor of Resolutions HR135 and HCR159. The purpose of this bill is to urge the Department of Land and Natural Resources to work with the IDUM's International Scientific and Technology Advisory Board on underwater munitions to seek and secure federal funding for the non-destructive disposal of thousands of tons of underwater munitions dumped, lost, or abandoned in Hawaiian waters.

Ocean assets are valued at [\\$24 Trillion](#), providing essential products and services to billions of people and providing a home to millions of species. Underwater munitions stand as an imminent and significant threat to this value and the communities that depend them. Munitions contain many different types of energetic materials and toxic chemicals that are, or will soon be, leaking into the ocean and risk contaminating fish and ecosystems as the metal casings corrode over time. Detonating them in place is not a viable option near coral reefs, nor will it remove the dangers associated with chemical releases or remediate the environmental damage. Blast-in-place solutions force authorities to close beaches and tourist attractions, while adding acute acoustic damage to marine organisms.

Compared to many well-funded activities for ocean restoration and protection, the actions and associated benefits of non-destructive disposal of underwater munitions is comparatively clear. As part of my research program, I actively track the growing blue economy and the success and value of restoration and protection plans. Most of these efforts tackle climate change, plastics, invasive species, habitat destruction, and illegal and overfishing, and all have significant uncertainty around the best plans of action and chance of success. In comparison, the non-destructive disposal of underwater munitions is a clear and well-developed solution with an explicit measurement of success – every munitions site that is non-destructively recovered minimizes the toxic chemicals that enter marine food webs.

I am particularly interested in seeing Hawaii lead this important initiative towards a global decontamination of this threat. As a multi-national umbrella organization, comprised of independent scientists and dedicated professionals, the IDUM is the institution capable of

mobilizing the expertise, science, and technology to address the underwater munitions problem

I urge you to pass Resolutions HR135 and HCR159. I urge you to partner with IDUM to rid Hawaiian coral reefs of underwater munitions and to lead the way towards this global effort.

Respectfully,

A handwritten signature in black ink, appearing to read 'CWPaige'.

Dr. Christine Ward-Paige

Christine A. Ward-Paige, Ph.D.
Independent Researcher
International Dialogues on Underwater Munitions (IDUM) &
International Science and Technology Advisory Board (ISTAB)
on Underwater Munitions (UWM's)
cward.paige@gmail.com
<https://www.linkedin.com/in/christinewardpaige/>

HR-135

Submitted on: 3/20/2021 3:16:38 PM

Testimony for WAL on 3/23/2021 8:30:00 AM

Submitted By	Organization	Testifier Position	Present at Hearing
Rhonda	Individual	Support	No

Comments:

Please support HR 135 to seek non-destructive disposal of underwater munitions in Hawaiian waters!

HR-135

Submitted on: 3/21/2021 6:06:34 PM

Testimony for WAL on 3/23/2021 8:30:00 AM

Submitted By	Organization	Testifier Position	Present at Hearing
Andrea Quinn	Individual	Support	No

Comments:

Dear Honorable Committee Members,

Please support HR135.

Thank you,

Andrea Quinn

Testimony Before the House Committee on Water and Land (WAL)

Chair: David A. Tarnas

Vice-Chair: Patrick Pihana Branco

Resolution Number HR135 and HCR159

Tuesday-23-March-2021

Chair Tarnas, Vice-Chair Branco, and respected Committee Members

Chair Tarnas, Vice-Chair Branco, and respected Committee Members,

I am Professor Valentine A. Nzengung, an Environmental Geochemist, and a fellow of the National Academies of Inventors. I am an inventor of multiple patented technologies for neutralization and destruction of explosives and chemical warfare agents and their precursors to non-hazardous end products. For over 25 years I have taught and conducted research at the University of Georgia on the development and evaluation of multiple technologies currently applied at the field scale. I am the founder, Chief Technology Officer and the Chief Executive Officer of MuniRem Environmental, LLC. I am also a member of the International Science & Technology Advisory Board (ISTAB) of the International Dialogue on Underwater Munitions (IDUM).

I am writing to submit testimony in favor of Resolutions HR135 and HCR159. The purpose of this bill is to urge the Department of Land and Natural Resources to work with the IDUM's International Scientific and Technology Advisory Board on underwater munitions to seek and secure federal funding for the non-destructive disposal of thousands of tons of underwater munitions dumped, lost, or abandoned in Hawaiian waters.

Land resources alone cannot sustain the world's population. To provide the oxygen, food and energy required to sustain life on this planet, we rely to a significant extent on our oceans. Our Oceans and other surface water bodies (e.g., lakes) make up a significant part of our natural capital that provides essential ecosystem services. Unfortunately, pollution of lands, oceans and lakes by unexploded ordnance and old and expired munitions intentionally dumped into our lakes and oceans threatens critical ecosystem services that they provide. The militaries of almost every industrialized country have used ocean dumping as the primary disposal method for surplus conventional and chemical munitions. Consequently, hundreds of millions of tons remain sunk in underwater environments worldwide. We are conscious of the fact that Pearl Harbor and Hawaii played a prominent role in the history of munitions dumping. Some munitions dump sites have even been given names by their communities, for example Ordnance Reef. Underwater munitions represent a clear and present danger to public safety and marine environments. Corroded munitions are known to poison food chains with carcinogens and toxic chemicals, threaten fish health and coral reefs, injure fishermen and beachgoers, and impede offshore economic developments in the energy, tourist, and transportation sectors.

As a scientist who has spent a good part of my professional career developing solutions to neutralize and destroy explosives on land and sea, I can say with certainty that there currently exist green solutions for the demilitarization of munitions in underwater environments. In a 2018

report titled “Alternatives for the Demilitarization of Conventional Munitions” submitted to the United States Senate and published for worldwide consumption, the National Academies of Sciences Engineering and Medicine (NASEM) identified many alternatives to the undesired and polluting disposal of munitions by open burning and open detonation. In a similar report published by the United States Environmental Protection Agency in 2019 titled “Alternative Treatment Technologies to Open Burning and Open Detonation of Energetic Hazardous Wastes”, the USEPA confirmed the existence of more environmentally friendly solutions for the disposal of munitions.

As an inventor of one of the alternative technologies to the disposal of munitions by open burning and open detonation (OB/OD) that is applied worldwide to support demilitarization and treatment of energetic hazardous waste, I can state that technologies for recovery and demilitarization of munitions dumbered at sea are ready for application at the field scale. For example, in support of the Savannah Harbor Expansion Project, an alternative technology to OB/OD was applied to demilitarize the discarded military munitions recovered from the ship channel. Technologies currently exist to demilitarize underwater munitions in-situ as well as on-site.

IDUM, a multi-national umbrella organization, comprised of independent scientists and dedicated professionals, is the only institution in the world capable of mobilizing a diverse team of experts, scientists, and technologists to independently address the underwater munitions problem in Hawaii.

I thank you and your fellow committee members for listening to my testimony. I urge you to pass Resolutions HR135 & HCR159. I urge you to support a partnership with IDUM to rid Hawaiian coral reefs of underwater munitions. Your actions today will help restore and preserve Hawaii’s precious aquatic ecosystems and coral reefs.

Respectfully submitted,
Valentine A. Nzengung, Ph.D.

Supporting Material

**For the
Testimony of
Dr. Valentine A. Nzungung**

Before the House Committee on Water and Land (WAL)

**Chair: David A. Tarnas
Vice-Chair: Patrick Pihana Branco
Resolution Number HR135 and HCR159**

Tuesday, March 23rd, 2021

Supporting Material Item #1

USEPA Office of Resource Conservation and Recovery Final Report published December 2009.
“Alternative Treatment Technologies to Open Burning and Open Detonation of Energetic
Hazardous Wastes.”. Cover page.

Supporting Material Item #2

National Academies of Sciences Engineering and Medicine (NASEM) 2018 “Alternatives for the
Demilitarization of Conventional Munitions” Cover page.

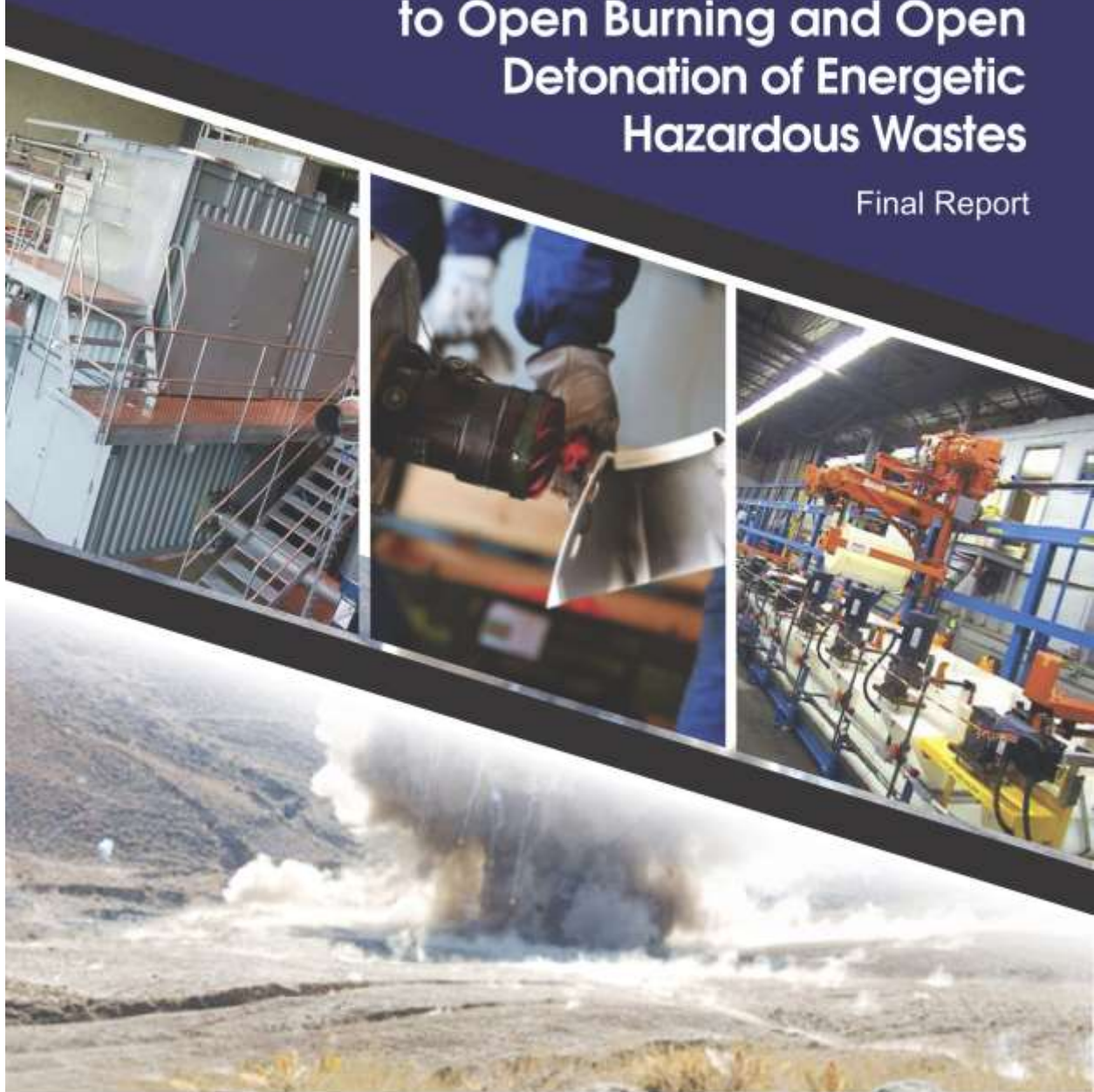
Supporting Material Item #3

Valentine Nzungung and Ben Redmond (2016) “On-site Neutralization of Civil War Munitions Recovered
from an Underwater Environment”
Journal of Marine Technology Society, Volume 50, Number, November/December 2016
Journal Cover page and Abstract Page.



Alternative Treatment Technologies to Open Burning and Open Detonation of Energetic Hazardous Wastes

Final Report



Office of Resource Conservation and Recovery (5303P) | EPA 530-R-19-007 | December 2019

This PDF is available at <http://nap.edu/25140>

SHARE    



Alternatives for the Demilitarization of Conventional Munitions

DETAILS

194 pages | 8.5 x 11 | PAPERBACK
ISBN 978-0-309-47732-1 | DOI 10.17226/25140

GET THIS BOOK

FIND RELATED TITLES

CONTRIBUTORS

Committee on Alternatives for the Demilitarization of Conventional Munitions;
Board on Army Science and Technology; Division on Engineering and Physical
Sciences; National Academies of Sciences, Engineering, and Medicine

Visit the National Academies Press at NAP.edu and login or register to get:

- Access to free PDF downloads of thousands of scientific reports
- 10% off the price of print titles
- Email or social media notifications of new titles related to your interests
- Special offers and discounts



Distribution, posting, or copying of this PDF is strictly prohibited without written permission of the National Academies Press. (Request Permission) Unless otherwise indicated, all materials in this PDF are copyrighted by the National Academy of Sciences.

Copyright © National Academy of Sciences. All rights reserved.



Cover images: All images can be found in this issue. **Front** (clockwise from top left): Nzengung & Raymond Figure 1; Rosen et al., Figure 8; Nzengung & Raymond Figures 4 and 3. **Back** (clockwise from top left): Sundar et al., Figure 4; Li et al., Figure 12; Rosen et al., Figure 4; Li et al., Figure 1.



Text: SPI
Cover and Graphics:
Michele A. Danoff, Graphics By Design

The Marine Technology Society Journal
(ISSN 0025-3324) is published by the Marine Technology Society, Inc., 1100 H Street NW, Suite LL-100 Washington, DC 20005

Annual Subscription Prices (all prices include shipping):
Online access to the MTS Journal (including 14 years of archives) is FREE for MTS members. Members can purchase the **printed Journal** for \$38 domestic, \$55 Canada, and \$125 international. Non-members and library subscriptions are: **Online only** (including 14 years of archives): \$465; **Online and print** (including 14 years of archives): \$499; **Print only**: \$155 domestic, \$175 Canada, and \$250 international. Single-issue (hardcopy) price is \$18 for members and \$20 for nonmembers, plus \$7 domestic shipping or \$14 international stepping for all single-issue orders. Pay-per-view (worldwide): \$26/article.
Postage for periodicals is paid at Washington, DC and additional mailing offices.

POSTMASTER:
Please send address changes to:

Marine Technology Society Journal
1100 H Street NW, Suite LL-100
Washington, DC 20005
Tel: (202) 717-8705; Fax: (202) 347-4302

Copyright © 2016 Marine Technology Society, Inc.

marine technology SOCIETY Journal

Volume 50, Number 6, November/December 2016

General Issue

In This Issue

5
Message From the *MTS Journal* Editor
Anni Vuorenkoski Dalgleish

6
Military Activities and the Oceans
Geoff Carton

8
Ocean Exploration:
A Supply-Demand Mismatch
Paul Gaffney

10
International Mine Action Standard
for Addressing Underwater
Explosive Ordnance
Justin O. Smith

15
On-Site Neutralization of Civil
War Munitions Recovered From an
Underwater Environment
Valentine A. Nzengung, Ben Redmond

23
Optimization and Field Demonstration
of a Passive Sampling Technology for
Monitoring Conventional Munition
Constituents in Aquatic Environments
Gunther Rosen, Bill Wild,
Robert D. George, Jason B. Belden,
Guilherme R. Lotufo

33
Performance Assessment of Indian
Meteorological Ocean Buoys With
INSAT Telemetry
Ranganathan Sundar,
Ramasamy Venkatesan,
Manickavasagam Arul Muthiah,
Narayanaswamy Vedachalam,
Malayath Aravindakshan Atmanand

40
Importance of Gas Hydrates for India
and Characterization of Methane Gas
Dissociation in the Krishna-Godavari
Basin Reservoir
Narayanaswamy Vedachalam,
Sethuraman Ramesh,
Arunachalam Umapathy,
Gidugu Ananda Ramadass

52
Realizing Reliable Lithium-Ion
Batteries for Critical Remote-Located
Offshore Systems
Narayanaswamy Vedachalam,
Gidugu Ananda Ramadass

58
Terminal Underwater Docking of an
Autonomous Underwater Vehicle Using
One Camera and One Light
Dejun Li, Tao Zhang, Canjun Yang

69
Development of Automated
Measurement Setup for Characterizing
Underwater Acoustic Transducers
Amitthalingam Malarkodi,
Peddinti SSR Sridhar, Ganesan Latha

Index to Volume 50

76
Author Index

79
Subject Index

On-Site Neutralization of Civil War Munitions Recovered From an Underwater Environment

AUTHORS

Valentine A. Nzengung
University of Georgia and MuniRem
Environmental, Athens, GA

Ben Redmond
Retired Master EOD Technician and
Munitions Consultant for MuniRem
Environmental, Oak Ridge, TN

Introduction

It was an internationally accepted practice in the early to middle 20th century to dispose of excess, obsolete, or unserviceable munitions, including chemical warfare materiel, at sea. Prior to the enactment and ratification by many countries of the 1972 London Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter at sea, millions of tons of munitions were known to have been disposed throughout the world's oceans (Carton & Jagusiewicz, 2009; Edwards, 2016). Many warships sunk during armed conflicts have also added to the inventory of underwater munitions. European and U.S. coastal waters have the largest number of underwater munition sites. So far, the U.S. Department of Defense (DoD) has identified more than 400 underwater sites potentially contaminated with discarded military munitions (DMMs) and unexploded ordnance (UXO) (SERDP-ESTCP Report, 2007). A worldwide increase in human consumption and development of marine

ABSTRACT

This paper describes the recovery, on-site nondestructive mechanical breaching, and chemical neutralization of munitions recovered from an underwater environment. The munitions were recovered during salvaging of the scuttled confederate states ship (CSS) *Georgia*, as part of the Savannah Harbor Expansion Project (SHEP). The *CSS Georgia* was scuttled on December 20, 1864. The *CSS Georgia* wreck site is on the Georgia and South Carolina border and covers an approximate area of 350 x 200 feet at a depth of about 36 feet. Because the *CSS Georgia* shipwreck site would obstruct the SHEP, the U.S. Army Corps of Engineers (USACE) entered into agreements to salvage some artifacts, including the munitions, for conservation. Due to the historical significance of the artifacts and the munitions among the *CSS Georgia* wreckage, the USACE required that the munitions be neutralized in the safest and least destructive manner possible. The munitions on board the scuttled *CSS Georgia* consisted of two types of civil war era projectiles, often described as cannon balls. A total of 185 munitions were removed from the *CSS Georgia* site in 2015. The majority of the recovered projectiles (170) were mechanically breached, and energetics were safely neutralized using MuniRem, an innovative chemical reduction reagent for explosives. After the black powder was completely flushed and neutralized, fuzes were unscrewed, if it could be done safely; otherwise, the explosive ordnance disposal technicians drilled into the fuzes at an angle. The contents of the fuze were neutralized in a solution of MuniRem before reattachment to the projectile. The neutralized black powder solids and wastewater were disposed as nonhazardous wastes. This project constitutes the largest on-site chemical neutralization of recovered confederate and underwater disposed military munitions from the U.S. civil war era.

Keywords: underwater, munitions, MuniRem, neutralization, confederate

resources has resulted in more frequent encounters with munitions dumped at sea.

During the American civil war of 1861–1865, the Confederate States Navy (CSN) constructed and deployed many warships to fight the U.S. Navy. Along the U.S. East Coast are many sites containing century-old munitions from ships sunken during the U.S. civil war. Among the

confederate warships, the ironclad steamer batteries were designed to provide coastal defense. The confederate states ship (CSS) *Georgia* was one of such ironclad gunboats, built specifically to defend the city of Savannah, Georgia. The 1,200-ton *CSS Georgia* was built and launched on May 20, 1862. The engines could not provide the power necessary to drive the heavy vessel against the Savanna