

**THE UNITED STATES NAVY AS A “HOLLOW FORCE”
AN ASSESSMENT OF NAVAL READINESS FROM 2010 TO 2017**

by
Justin H. Witwicki

A thesis submitted to Johns Hopkins University in conformity with the requirements for
the degree of Master of Arts in Government

Baltimore, Maryland
December 2019

© 2019 Justin Witwicki
All Rights Reserved

Abstract

From 2010 to 2017, at least six separate but interconnected factors damaged the military readiness of the United States Navy. This thesis explored the concepts of force readiness and force “hollowness” as qualitative measures of a military’s ability to execute its national security responsibilities. Through that lens, seven “force hollowing” indicators – which were defined in 1996 by the Center for Naval Analyses – were reconsidered in the context of the 2010-2017 Navy. Of those seven, five were accepted as applicable in modern context. Those five indicators were: pressure to cut defense spending, declining military pay, poor force morale, delays in fielding modern equipment, and inadequate maintenance of existing equipment. Thereafter, two additional readiness indicators – unsustainable operational tempo and the effects of global climate change – were added to those already existing in the academic literature. Both were deemed critical to a holistic understanding of naval readiness during the early- and mid-2010s. Unsustainable operational tempo was identified as a valid indicator of naval unreadiness from 2010 to 2017. An institutional culture which accepted a “normalization of deviance” facilitated a measurable rise in operational tempo and ultimately resulted in four at-sea mishaps that claimed 17 lives in the summer of 2017. In addition, climate change, although it was rejected as a chronic readiness challenge during the 2010s, was accepted as a clear threat to future readiness. Specifically, climate change will redefine future naval missions while degrading the resilience of naval infrastructure. The thesis concluded by offering seven specific recommendations for the Navy’s uniformed and civilian leadership, each aimed at promoting readiness recovery.

Thesis Readers: Dr. Adam Wolfson, Lieutenant Commander Ken Foos

Table of Contents

Abstract	ii
Disclaimer	v
List of Acronyms	v
List Tables	vi
List of Figures	vii
Introduction	1
Scope and Methodology	3
Key Findings	5
Chapter One: Applicability of Historical Readiness Indicators in Modern Context	11
Introduction	11
Literature Review	13
Public Support for the Military	22
Pressure to Cut Defense Spending	24
Recruiting and Retention	27
Declining Pay	31
Poor Morale	35
Delays in Fielding Modern Equipment	39
Inadequate Maintenance of Existing Equipment	42
Conclusion	45
Chapter Two: Operational Tempo as a Readiness Indicator	48
Introduction	48
Literature Review	49
U.S. Navy Operational Tempo, 2010-2017: Doing More With Less	57
Competing Systems for Creating Ready Forces: Managing Operational Tempo ..	60
The Consequences of Unsustainable Operational Tempo	65
Normalization of Deviance in the U.S. Navy	68
Conclusion	71
Chapter Three: The Effects of Global Climate Change on Naval Readiness	73
Introduction	73
Literature Review	74
Methodology	82
Climate Change Impacts on Naval Missions	83
Climate Change Impacts on Naval Installations	90
Conclusion	95
Conclusions and Recommendations	97
Evaluation of Readiness Indicators	97
Relationship Between Readiness Indicators	104
Recommendations for the Department of Defense	107
Recommendations for the President and the National Security Council	110
Recommendations for the United States Congress	111
Conclusion	111
Appendix	114
Bibliography	115
About the Author	132

Disclaimer

The opinions and conclusions expressed in this study are those of the author and do not necessarily reflect the position of the Department of Defense or the United States Navy.

List of Acronyms

AFQT	Armed Forces Qualification Test
BCA	Budget Control Act of 2011
BRAC	Base Realignment and Closure
BRS	Blended Retirement System
CBO	Congressional Budget Office
CG	Guided missile cruiser
CIA	Central Intelligence Agency
CNA	Center for Naval Analyses
CNO	Chief of Naval Operations
CO	Commanding Officer
CRS	Congressional Research Service
CSG	Carrier Strike Group
CVN	Nuclear-powered aircraft carrier
CVW	Carrier Air Wing
DDG	Guided missile destroyer
DHS	Department of Homeland Security
DoD	Department of Defense
ECI	Employment cost index
FDNF	Forward Deployed Naval Forces
FY	Fiscal year
FYDP	Future Years Defense Plan
GAO	Government Accountability Office
GDP	Gross domestic product
HADR	Humanitarian assistance and disaster relief
HASC	U.S. House Armed Services Committee
HSDG	High school diploma graduate
IOC	Initial operational capability
JAG	Judge Advocate General
JCS	Joint Chiefs of Staff
NATO	North Atlantic Treaty Organization
NDAA	National Defense Authorization Act
NJP	Non-judicial punishment
NWC	Naval War College
OFRP	Optimized Fleet Response Plan
OPTEMPO	Operational tempo
QDR	Quadrennial Defense Review
SECNAV	Secretary of the Navy
TSP	Thrift Savings Plan
UCMJ	Uniform Code of Military Justice
UNCLOS	United Nations Convention on the Law of the Sea
USMC	United States Marine Corps
USNS	United States Naval Ship
USS	United States Ship
WWII	World War II

List of Tables

Table 1: Ratio of National Debt to Nominal GDP, 2010-2017	26
Table 2: U.S. Navy Recruit Quality, FY2000-FY2017	28
Table 3: Percentage of Retention Goal Achieved, FY2011-FY2014	29
Table 4: Assessment of Readiness Indicators	46
Table 5: Percentage of Deployments Lasting Over Six Months, 1990-2008	60
Table 6: Summary Assessment of Readiness Indicators and Comparison to 2012 CRS Assessment	101

List of Figures

Figure 1: Military Pay Increases vs. ECI, 2000-2018	33
Figure 2: NJPs per 1,000 Active Duty Personnel, FY1977-FY2017	37
Figure 3: Fleet Size and Percentage of Fleet Deployed, 1985-2016	58
Figure 4: OFRP and FDNF Readiness Cycles	64
Figure 5: Historical Annual Mean Sea Level and Projected Sea Level Rise at Naval Station Norfolk, 1960-2100.....	93

Introduction

During the 2010s, the United States Navy was branded as “a global force for good,” “forged by the sea,” and “the Navy the nation needs.” In that same decade, however, an austere fiscal environment, triggered by a ballooning national debt and a global financial crisis, was coupled with the rise of a near-peer military competitor, the People’s Republic of China, for the first time since the fall of the Soviet Union. This led some defense analysts and members of Congress to call the U.S. Navy something else – a “hollow force.” Emerging fears about naval readiness appeared to be validated when, in the course of nine weeks during the summer of 2017, a manifest deterioration in military readiness claimed the lives of as many sailors as did the attack on the USS *Cole*.¹ In the first eight months of 2017, USS *Antietam* ran aground at anchor in Tokyo Bay; USS *Lake Champlain* was hit by a commercial fishing vessel; USS *Fitzgerald* collided with a container ship, killing seven of its crew; and USS *John S. McCain* was struck by an oil tanker, killing ten more servicemembers. All of these mishaps occurred in the Navy’s Japan-based Seventh Fleet, “the most powerful armada in the world and one of the most important commands in the defense of the United States.”²

Navy officials fired at least seven commanders in response to these incidents, including the commanding officers of all four ships, the Commander of Destroyer Squadron Fifteen, and two admirals – the Commander of Carrier Strike Group Five and the Commander of the Seventh Fleet. Two more admirals – the Commander of Naval

¹ Seventeen American sailors were killed on October 12, 2000 when al Qaeda terrorists attacked the USS *Cole* in Yemen’s Aden harbor.

² T. Christian Miller, Megan Rose, and Robert Faturechi, “Death and Valor on an American Warship Doomed by its Own Navy,” *Propublica*, February 6, 2019, <https://features.propublica.org/navy-accidents/uss-fitzgerald-destroyer-crash-crystal/>

Surface Forces and the Commander of the U.S. Pacific Fleet – were forced into early retirement. “Collectively, it was the largest number of senior officers fired or dismissed for mishaps since World War II.”³ Shortly thereafter, Navy officials commissioned multiple inquiries to determine the underlying causes of readiness erosion and to make recommendations to arrest and reverse a slide into force hollowness.

As a bulwark against future readiness-induced disasters, the Navy’s *Strategic Readiness Review* called for fostering “a forward-looking learning culture built upon systemic data analyses focused on leading indicators acquired throughout the Navy.”⁴ This thesis endeavors to contribute to the creation of that learning culture. It also adds a missing volume to the academic literature on military readiness and naval history. While extensive studies address the naval readiness of previous generations, no comprehensive analysis of the more modern Navy yet exists, despite its demonstrable lack of combat preparedness.

The pages that follow examine the military readiness of the United States Navy from 2010 through 2017 through a series of lenses. The evidence presented illustrates how six independent, yet interrelated factors contributed to a generally unready Navy during those years. The aggregation of these challenges will, and should, lead future scholars and analysts to consider that period to be one in which the Navy was a hollow force. Three additional circumstances are rejected as readiness challenges during the

³ T. Christian Miller and Robert Faturechi, “How The Navy’s Top Commander Botched the Highest-Profile Investigation in Years,” *Propublica*, February 7, 2019, <https://features.propublica.org/navy-accidents/us-navy-crashes-japan-cause-mccain/>

⁴ Michael Bayer and Gary Roughead, *Strategic Readiness Review* (Washington D.C.: Department of the Navy, 2017), 76.

2010-2017 scope of inquiry, though one of these three – global climate change – is accepted as a substantial threat to future naval readiness.

Scope and Methodology

The scope of inquiry adopted by this thesis is bounded by the years 2010 through 2017. In June 2010, Admiral Michael Mullen, then-Chairman of the Joint Chiefs of Staff, announced his belief that “our national debt is our biggest national security threat.”⁵ His observation was part of a larger recognition by government officials that economic security challenges had grown increasingly dire relative to other aspects of national security, a concern which was bolstered by the 2008 global financial crisis. A period of government austerity resulted, which included substantial reductions to defense spending. Accordingly, Admiral Mullen’s 2010 statement is selected as the starting point for the research conducted in this thesis. In 2017, four Navy ships were involved in at-sea mishaps, which caused the deaths of 17 sailors. For this reason, the year 2017 is chosen as the logical conclusion to the scope of inquiry, due to its key role in illustrating the consequences of eroded military readiness.

The research presented in this thesis attempts to identify in what ways unreadiness manifested itself in the U.S. Navy during the early- and mid-2010s. Former Secretary of Defense Leon Panetta and scholars at the Bipartisan Policy Center explained that “objective evidence of a readiness shortfall is difficult to find, but that does not mean the shortfall is any less real. For national security reasons, the Defense Department is reluctant to publicly broadcast the precise state of U.S. military preparedness.”⁶ It is for

⁵ Stuart Johnson et al., *A Strategy-Based Framework for Accommodating Reductions in the Defense Budget* (Santa Monica: RAND Defense Research Institute, 2012), 1.

⁶ Leon Panetta et al., *The Building Blocks of a Ready Military: People, Funding, Tempo* (Washington, D.C.: Bipartisan Policy Center, 2017), 8.

this reason that the content of the Defense Readiness Reporting System and the Department of Defense's (DoD) Quarterly Readiness Report to Congress are classified as "Secret."⁷ Secretary Panetta remarked that "even organizations like the Government Accountability Office (GAO) and Congressional Budget Office (CBO) have a difficult time precisely measuring military-readiness levels."⁸ Consequently, this thesis must assess the readiness of the U.S. Navy through examination of publicly available metrics and official statements of military and government officials. This study compiles data obtained from the DoD through Freedom of Information Act requests, open source government reports, academic and professional research, and investigative reporting in an attempt to evaluate the state of naval readiness from 2010 through 2017.

Two assessments of military readiness which were previously conducted by government and private-sector think tanks are leveraged as useful frameworks and are reconsidered in the context of the 2010-2017 Navy. This thesis begins with a brief examination of obstacles which have plagued the service in prior eras, and accepts or rejects each of them individually as a modern threat to naval readiness. New and previously unexplored challenges are then added to the existing frameworks and investigated in substantial depth.

Given the fluid nature of impediments to military readiness over time, this thesis relies upon a hybrid of several research methodologies. Chapter one, which explores the applicability of existing readiness indicators in modern context, adopts a theory-testing methodology. Seven "force-hollowing" indicators, identified by the Center for Naval

⁷ Executive Order 12356 (1982) defines "Secret" information as that which "reasonably could be expected to cause serious damage to the national security" if revealed.

⁸ Panetta et al., 8.

Analyses (CNA), are measured against relevant empirical data and each is then accepted or rejected individually as a challenge to naval readiness in the early- and mid-2010s. Thereafter, chapter two's examination of Navy operational tempo employs a blended historical-evaluative and policy-evaluative methodology in an attempt to both identify and appraise the operational decisions made by Navy leadership and the consequences that resulted from them. Finally, chapter three's study of the relationship between naval readiness and global climate change requires both a theory-testing and literature-assessing approach to research. Three case studies – the role of naval forces in the Arctic region, the increased demand for humanitarian assistance and disaster relief (HADR) missions, and the dangers posed to naval facilities in Hampton Roads, Virginia – are applied to the existing theories and predictive analyses regarding the interaction between climate change and military readiness.

Key Findings

First, seven force-hollowing indicators – enumerated by the Center for Naval Analyses in a 1996 study of post-Vietnam War naval readiness – are reevaluated in order to determine their applicability to the 2010-2017 Navy. The seven criteria considered are: 1) low public support for the military; 2) pressure to cut defense spending; 3) difficulties in maintaining an all-volunteer force; 4) declining military pay; 5) poor morale; 6) delays in fielding modern equipment; and 7) inadequate attention to maintenance of existing equipment.⁹ The CNA's research concluded that each of these criteria contributed to the existence of an unready Navy in the years following the war in Vietnam. Analysts at the Congressional Research Service (CRS) applied this CNA study

⁹ Matthew T. Robinson et al., *Avoiding a Hollow Force: An Examination of Naval Readiness* (Alexandria: Center for Naval Analyses, 1996), 7.

to the whole of the U.S. military in 2012 to assess its continued validity in modern context. CRS determined that five of the seven – all except pressure to cut defense spending and poor morale – were no longer applicable to the U.S. military at that time.¹⁰ Chapter one of this thesis restricts application of the CNA’s seven indicators to the circumstances surrounding the U.S. Navy from 2010 to 2017. Viewed through that lens, this study fundamentally diverges from CRS’s determinations and asserts that five of the seven criteria should be considered obstacles to naval readiness during that time period. Only low public support for the military and difficulties in maintaining an all-volunteer force are rejected as readiness challenges.

The CNA acknowledged that future analyses of military readiness may differ from its own 1996 conclusions when it remarked that “there is no guarantee that the next hollow force will look like the last one.”¹¹ The political, economic, and geostrategic circumstances which the United States faced in the early- and mid-2010s were dissimilar from those posed in previous historical periods, making it almost certain that the naval readiness challenges faced from 2010 to 2017 would likewise differ. With that in mind, chapter two explores an additional readiness indicator not identified by the CNA – an unsustainable operational tempo. The research shows that a statistically-significant increase in the operational tempo of naval forces resulted from a mismatch between the supply of available combatant ships and the demand for those ships to conduct overseas operations. As the size of the Navy’s fleet diminished after the Cold War, a proportionate reduction in overseas naval presence never followed. As a consequence,

¹⁰ Andrew Feickert and Stephen Daggett, *A Historical Perspective on “Hollow Forces”* (Washington D.C.: Congressional Research Service, 2012), 15.

¹¹ Robinson et al., 16.

the Navy was directed to perform the same workload that it managed in the 1980s, but with fewer than half as many ships in the 2010s. The predictable result of this demand was that the remaining ships each had to work harder and longer to meet mission requirements. Non-deployment activities – specifically the “readiness generators” of training and maintenance – were cut to make room for operational tasking. An organizational culture that tolerated such deviations from accepted maintenance and training practices permitted gross violations of readiness standards to emerge.

On June 17, 2017, the growing stress on the fleet manifested itself in the form of an early-morning collision between the USS *Fitzgerald* and a commercial shipping vessel more than three times its size. Seven sailors were killed in what was then the Navy’s worst at-sea mishap in four decades. Then, “barely two months later, it happened again,” when the USS *John S. McCain* collided with an oil tanker in a mishap that claimed ten more lives.¹² Chapter two explains how the Navy’s institutional culture caused decisionmakers to disregard the unreadiness of its fleet and resulted in 2017’s catastrophic mishaps. Relying on the sociological theory of normalization of deviance which stemmed from Diane Vaughan’s exhaustive study of the *Challenger* space shuttle disaster, this thesis determines that similar tendencies characterized Navy leadership in the months and years leading up to the incidents onboard USS *Fitzgerald* and USS *John S. McCain*. Taken in aggregate, the evidence presented in chapter two requires that unsustainable operational tempo be added to the list of problems which deteriorated naval readiness from 2010 to 2017.

¹² Robert Faturechi, Megan Rose, and T. Christian Miller, “Years of Warnings, Then Death and Disaster: How the Navy Failed its Sailors,” *Propublica*, February 7, 2019, <https://features.propublica.org/navy-accidents/us-navy-crashes-japan-cause-mccain/>

Chapter three examines another previously unaddressed readiness indicator – the impact of global climate change – and concludes that, although it did not result in chronic damage to naval readiness in the 2010s, the effects of climate change do pose considerable risk for future readiness. Moreover, it was during the early- and mid-2010s that the severity of these challenges became more widely recognized and understood by military leadership and strategists. The 2010 Quadrennial Defense Review (QDR) acknowledged for the first time that global climate change posed strategic and readiness concerns for military forces “in two broad ways. First, climate change will shape the operating environment, roles, and missions that we undertake. ...Second, DoD will need to adjust to the impacts of climate change on our facilities and military capabilities.”¹³ Accepting DoD’s assessment as valid, chapter three explores global climate change in the context of the problems it poses for naval missions and the threats it creates for naval infrastructure.

Climate change will require the Navy to renew operations in the Arctic for the first time in more than two decades because, as then-Secretary of the Navy (SECNAV) Richard Spencer put it, “the damn thing melted.”¹⁴ Senior military commanders, however, believe that U.S. forces are ill-prepared to deploy above the Arctic Circle with any regularity. In addition to opening new geographic areas of responsibility, climate change will also affect the very types of missions that naval forces are expected to conduct. International demand for humanitarian assistance and disaster relief from the

¹³ Department of Defense, *Quadrennial Defense Review* (Washington D.C.: Department of Defense, 2010), 84-85.

¹⁴ Megan Eckstein, “Navy to Release Arctic Strategy this Summer, Will Include Blue Water Arctic Operations,” *U.S. Naval Institute*, April 19, 2018, <https://news.usni.org/2018/04/19/navy-to-release-arctic-strategy-this-summer-will-include-blue-water-arctic-operations>

United States is expected to spike as climate change increases the frequency and severity of destructive weather events such as typhoons and hurricanes worldwide. Such demands will require policymakers to appropriately prioritize – and perhaps triage – requirements for naval forces to support HADR missions while also meeting their national defense responsibilities. Lastly, climate change poses a significant – and in some cases existential – threat to the military bases from which the U.S. Navy operates. A case study of Naval Station Norfolk, Virginia – the world’s largest naval base – is presented at the end of chapter three as a means by which to illustrate the challenges that climate change poses for the effectiveness and resilience of naval infrastructure. Anticipating future challenges to readiness is admittedly more difficult than assessing the presence or absence of existing force-hollowing indicators. The research that follows, however, presents strong evidence that climate change has the capacity to fundamentally alter both the ways in which naval forces are employed and the bases from which they operate.

With modern obstacles to naval readiness thoroughly examined, the conclusions and recommendations section of this thesis fulfills two roles. It summarizes the principal findings developed during the course of research, and it attempts to explain the complex relationships between the readiness indicators which this thesis studies. For example, as the foremost scholar on military readiness, Richard K. Betts, explained, “intense training exercises increase personnel readiness by testing and honing skills, but they degrade equipment readiness, because they put stress on weapons systems and wear them out. Does that mean that such training should be considered good for readiness, or bad?”¹⁵

¹⁵ Richard K. Betts, *Military Readiness: Concepts, Choices, Consequences* (Washington D.C.: The Brookings Institution, 1995), 4.

Given that this thesis adds new readiness indicators to those existing in prior studies, the relationship between these and previously-examined indicators must be considered.

The *Strategic Readiness Review* determined that “the Navy’s emphasis on readiness as the primary enabler of warfighting capability and capacity must be re-energized, embedded, and continuously monitored in the culture of every community within the Navy.”¹⁶ The conclusion to this study provides concrete recommendations for Navy leadership and policymakers to facilitate both reduction and mitigation of readiness challenges in future years. Though certain of them may be somewhat controversial, these recommendations are designed to begin a crucial conversation about both U.S. grand strategy and the rebalancing of supply and demand of naval forces in an effort to promote readiness restoration in the U.S. Navy.

¹⁶ Bayer and Roughead, 4.

Chapter One

Applicability of Historical Readiness Indicators in Modern Context

Introduction

Following 2017's multiple at-sea collisions, Vice Admiral Joseph Aucoin, Commander of the Seventh Fleet at the time of the mishaps, remarked that "I think the main culprit for these collisions was that we allowed the training of our surface warriors to atrophy. ... Our surface navy is loaded with talent and great people, but they have lacked some of the foundational building blocks of training that have been eroded or simply cut because of budgetary pressure."¹⁷ At the conclusion of any major military operation, reevaluation of national interests often leads policymakers to reduce defense funding in deference to other budgetary priorities. In 2011, the withdrawal of combat troops from Iraq and Afghanistan resulted in a political desire to cut military budgets. This coincided with continued efforts by the Barack Obama Administration to focus political capital on economic revitalization in the wake of the "Great Recession."

Passed by Congress on August 2, 2011, the Budget Control Act of 2011 (BCA; P.L. 112-25) instituted significant cuts to military spending as part of an overarching effort to reduce the federal budget deficit. These proposed reductions prompted questions from both scholars and strategists about whether they risked inducing significant damage to the readiness of the armed forces. Those concerns grew deeper on March 1, 2013, when BCA-mandated budget sequestration went into effect and "the U.S.

¹⁷ Joseph Aucoin, "It's Not Just the Forward Deployed," *U.S. Naval Institute Proceedings*, vol. 44, no. 6 (April 2018): 12-15. Vice Admiral Aucoin was relieved of command as Commander, US SEVENTH FLEET on August 23, 2017, two days after the USS *John S. McCain* collision. His article in the *U.S. Naval Institute Proceedings* magazine was seen by many as a rebuttal to the findings of the *Comprehensive Review of Recent Surface Force Incidents* which was ordered by the Deputy Chief of Naval Operations following the mishaps and was released to the public in October 2017.

Department of Defense lost \$37 billion overnight.”¹⁸ Shortly thereafter, Congressman Howard McKeon (R-CA), then-Chairman of the House Armed Services Committee (HASC), warned that the United States was “on the brink of creating a hollow force.”¹⁹

The following research seeks to first examine how scholars have traditionally viewed the term “hollow force,” and to then identify whether academically-defined indicators of force-hollowing existed in the U.S. Navy from 2010 to 2017. Specifically, this chapter will apply seven causes of 1970s Navy hollowness to the 2010-2017 Navy in an effort to identify whether these readiness indicators remain applicable in modern context. The seven criteria that are considered were originally enumerated in a 1996 study conducted by the Center for Naval Analyses on naval readiness during the years after the Vietnam War. Those criteria are: 1) low public support for the military; 2) pressure to cut defense spending; 3) difficulties in maintaining an all-volunteer force; 4) declining military pay; 5) poor morale; 6) delays in fielding modern equipment; and 7) inadequate attention to maintenance of existing equipment.²⁰ This chapter determines that some, though not all, of these CNA force-hollowing indicators challenged naval readiness from 2010 to 2017.

Andrew Feickert and Stephen Daggett at the Congressional Research Service conducted a brief application of the seven CNA criteria against the whole of the armed forces in 2012. They concluded that “if these seven causes are examined for contemporary relevance, five of the seven causes would be non-applicable.”²¹ This thesis

¹⁸ Cindy Williams, “Accepting Austerity: The Right Way to Cut Defense,” *Foreign Affairs* 92, no. 6 (November/December 2013): 54.

¹⁹ Cindy Williams, “State of the Nation: A Costly Defense,” *Boston Review* vol. 8, no. 5 (May/June 2013): 5.

²⁰ Robinson, et al., 7.

²¹ Feickert and Daggett, 15.

seeks to expand on their existing contribution and to consider whether their determinations remain valid in the context of a Navy-centric examination.

Literature Review

Military Force Hollowness

The concept of a hollow force was first articulated by then-Army Chief of Staff, General Edward C. Meyer, in a May 1981 budget hearing before a HASC subcommittee, where he referenced a “hollow Army.”²² Since then, the term “hollow force” has grown into a political descriptor of a military unable to meet the Constitution’s mandate to “provide for the common defense.” Though General Meyer used the term to highlight deficiencies in manning, one scholar at the U.S. Army War College argued that, by 1994, “the term ‘hollow Army’ had been distorted beyond General Meyer’s meaning.”²³ James L. George summarized the problem in 1999, when he wrote that “‘hollow force’ means different things to different people – which is understandable considering the admittedly subjective nature of readiness itself.”²⁴

Today, a precise definition of what constitutes a hollow force continues to evade academic consensus. In 1994, Air Force Lieutenant Colonel Polly Peyer defined it as “giving the appearance of readiness when in fact, the capability is really not there.”²⁵ Feickert and Daggett used the term 18 years later to “characterize military forces that appear mission-ready, but, upon examination, suffer from shortages of personnel,

²² Frank Jones, *The “Hollow Army” Reappraised: President Carter, Defense Budgets, and the Politics of Military Readiness* (Carlisle: U.S. Army War College Strategic Studies Institute, 2012), 7.

²³ Jones, 42.

²⁴ James L. George, *Is Readiness Overrated: Implications for a Tiered Readiness Force Structure* (Washington D.C.: Cato Institute, April 29, 1999), 9.

²⁵ Polly Peyer, *Hollow Force: Scare or Dare?* (Washington D.C.: Industrial College of the Armed Forces, 1994), 4.

equipment, and maintenance or from deficiencies in training.”²⁶ Researchers at the RAND Corporation used similar language, calling the 1970s hollow force one in which “readiness and sustainability were at a low ebb – when some weapons systems experienced serious shortages of spare parts, munitions, or skilled personnel, for example.”²⁷ More recently, then-Under Secretary of the Navy Thomas Modly described a hollow force as one “that is tired, underequipped, and not sufficiently trained, but that is being asked to do more and more with fewer platforms, less rest, and no relief in the operational tempo.”²⁸ The CNA provided a more focused characterization in 1996 when they surmised “that hollowness is a condition that keeps ships from living up to their design potential. It is the general state that persists whenever maintenance problems dominate a force; when poor quality sailors seem the rule rather than the exception; and when meaningful training is both scarce and questionable.”²⁹ Arthur Herman, a senior fellow at the Hudson Institute, placed the idea of a hollow force into the context of modern U.S. naval strategy when he explained his concern that, if the military should become hollow, “we will resemble Europe in the sense that our ability to project power will be substantially impaired.”³⁰ Hollow forces, in his view, are those which cannot effectively exhibit strength far beyond their own borders for extended periods – a principal role of the U.S. Navy. While agreement on an exact definition of the term “hollow force” remains elusive, sufficient consensus exists to assert that a hollow force is one in which the armed forces lack sufficient military capability to be considered

²⁶ Feickert and Daggett, 1.

²⁷ S. Craig Moore et al., *Measuring Military Readiness and Sustainability* (Santa Monica: RAND Corporation, 1991), 3.

²⁸ Thomas Modly, “Don’t Ever, Ever Give Up the Ship,” *Naval War College Review* vol. 71, no. 2 (Spring 2018): 7.

²⁹ Robinson et al., 7.

³⁰ Arthur Herman, “The Re-Hollowing of the Military,” *Commentary* vol. 130, no. 2 (September 2010): 12.

“ready.” Determining an appropriate means by which to evaluate military capacity first requires a review of the concepts of “capability” and “readiness.”

Military Readiness

Former Secretary of Defense Melvin Laird and former Assistant Secretary of Defense Lawrence Korb collaborated on a paper for the American Enterprise Institute in 1980 in which they explained that “capability and readiness are not the same. Capability is the more inclusive concept. Readiness, on the other hand, is a component of capability.”³¹ A sizable body of literature – including that of Laird and Korb – relies on DoD theory which outlines capability’s four pillars – force structure, modernization, sustainability, and readiness, itself.³² From the hollow force of the 1970s to present, semantic inconsistencies make comparisons of the academic theories on readiness challenging. According to the Congressional Budget Office, for example, DoD “broadly defines ‘readiness’ as the ability of U.S. military forces to fight and meet the demands of the National Military Strategy.”³³ S. Craig Moore, et al., however, referred to readiness as “the ability of forces, units, weapons systems, or equipments [sic] to deliver the outputs for which they were designed.”³⁴ Secretaries Laird and Korb refined the definition further, calling readiness “the ability of the currently configured force structure to perform its assigned missions promptly.”³⁵ For the purposes of this thesis, mindful of the differentiations between the concepts, it is not necessary to distinguish between “readiness” and “capability” broadly. It is sufficient, instead, to adopt the DoD approach,

³¹ Melvin R. Laird and Lawrence J. Korb, *The Problem of Military Readiness* (Washington D.C.: American Enterprise Institute for Public Policy Research, 1980), 2.

³² Laird and Korb, 2.

³³ Congressional Budget Office, *Linking the Readiness of the Armed Forces to DoD’s Operation and Maintenance Spending* (Washington D.C.: Congressional Budget Office, 2011), 1.

³⁴ Moore et al., 1.

³⁵ Laird and Korb, 2.

which seeks to evaluate the ability of the Navy to execute its assigned missions in accordance with national strategy. Some scholars and commentators have referred to this as readiness. Others called it capability. Still more conflated the two concepts into one. This thesis accepts both terms as valid descriptors of the overarching concept it seeks to explore – whether or not the U.S. Navy is able to effectively execute the national security responsibilities assigned to it.

One of the foremost scholars of military readiness, Columbia University professor Richard K. Betts, observed in his seminal book, *Military Readiness: Concepts, Choices, Consequences*, that “readiness is vital, yet hardly anyone really knows what it is.”³⁶ Betts determined that, in order to be of value to decisionmakers in the formulation of foreign policy, security strategy, and budgetary determinations, military readiness “must be seen as a *complex system* composed of numerous variables.”³⁷ The correlation between these variables, moreover, cannot be seen as purely linear, as Betts explained in detail.

A conception of readiness that is relevant to total military capability and strategy over the long haul involves many factors, many of which *conflict with and damage each other*. For example, intense training exercises increase personnel readiness by testing and honing skills, but they degrade equipment readiness, because they put stress on weapons systems and wear them out. Does that mean that such training should be considered good for readiness, or bad?³⁸

³⁶ Betts, 4.

³⁷ Betts, 32. Emphasis in original.

³⁸ Betts, 32. Emphasis in original.

This complicated relationship between traditional measures of readiness requires leadership to answer fundamental questions in the creation of strategy: readiness for when, readiness for what, and readiness of what.³⁹

Throughout decades of the Cold War, answering these questions proved less complicated than it does today. Readiness needed to be constant, since the Soviet Union was believed to stand ready to invade Eastern Europe at any time, and it maintained the ability to launch nuclear attacks without warning (readiness for when). Military planners assumed that the U.S. and its North Atlantic Treaty Organization (NATO) partners must be prepared to repel a massive conventional Soviet invasion force or, worse yet, retaliate against a nuclear first strike (readiness for what). To ensure preparedness for these eventualities, readiness of U.S. and NATO ground forces in Western Europe was critical, as was the uninterrupted readiness of U.S. nuclear forces (readiness of what). The readiness expectations of the period are well-illustrated by the “hyper-ready” image of nuclear bombers maintaining a constant state of airborne alert for years at a time during the 1950s and 1960s.⁴⁰

Modern geopolitics presents a new set of challenges for defense planners. Johns Hopkins University professor Steven R. David argued in 2007 that “there has never been a time in American history when the United States has been safer from external conventional aggression than it is today.”⁴¹ Accordingly, answering questions about readiness for when, readiness for what, and readiness of what proves more complicated. Leslie H. Gelb, former President of the Council on Foreign Relations, wrote for *Foreign*

³⁹ Betts, 33.

⁴⁰ Betts, 59.

⁴¹ Steven R. David, “On Civil War,” *The American Interest* vol. 2, no. 4 (Spring 2007): 23.

Policy in 2010, arguing that “a new way of thinking about U.S. interests and power must aim for a foreign policy fitted to a world in which economic concerns typically – but not always – outweigh traditional military imperatives.”⁴² While avoiding the politically-charged term “hollow force,” Gelb argued that the U.S. should consider accepting exactly that, claiming that “given the receding threat of great-power war, leaders around the world can afford to elevate economic priorities as never before.”⁴³

Gelb called for a new approach to American strategic thinking, saying “the first-tier foreign policy goals of the United States should be a strong economy and the ability to deploy effective counters to threats at the lowest possible cost. Second-tier goals, which are always more controversial, include retaining the military power to remain the world’s power balancer.”⁴⁴ Gross domestic product (GDP), he contended, and not military force structure, commands the respect and fear of strategic competitors and adversaries.⁴⁵ Arthur Herman, however, dissented from Gelb’s view and insisted that “no shrinking defense budget will ever be able to modernize our military or maintain force readiness, let alone fight a war – no matter how prudent and careful the number crunchers may be.”⁴⁶ Herman and others contended that defense austerity in the mid-2010s put the United States on an inevitable path toward force hollowness.

Force Hollowness in Historical Context

Two historical periods are traditionally associated with the concept of a hollow military – the years following the Vietnam War, and those after the fall of the Soviet

⁴² Leslie H. Gelb, “GDP Now Matters More Than Force,” *Foreign Policy* vol. 89, no. 6 (November/December 2010): 36.

⁴³ Gelb, 37.

⁴⁴ Gelb, 42.

⁴⁵ Gelb, 43.

⁴⁶ Herman, 17.

Union. Using these two periods as reference points by which to assess potential hollowness in the Navy of the 2010s requires an understanding of the context surrounding these historical hollow forces. There is widespread consensus in both the academic and policy communities that the years immediately following the Vietnam War constituted a period of force hollowness for not just the Navy, but all of the military's branches of service. What led to the degradation of American military might in those years remains a topic of some debate, but multiple studies have cited common factors including: reductions in defense spending, declining military pay, transition from the draft to the all-volunteer force, demoralized troops, and materiel readiness issues.⁴⁷

As the war in Vietnam drew to a close, the Richard Nixon and Gerald Ford Administrations reduced the defense budget to account for an expected decline in military operational requirements. Expenditure cuts, however, were “horizontal” rather than “vertical,” meaning that substantial decreases in military appropriations were not met with associated alterations to the force structure, leaving less money to fund the same-sized military.⁴⁸ By fiscal year (FY) 1979, the defense budget had reached its lowest point since the force reductions that followed World War Two (WWII).⁴⁹ At the same time, double-digit inflation rates exacerbated the impacts of those funding cuts. That inflation also effectively negated military pay increases of the early 1970s, so much so that, by the end of the decade, “the salaries of very junior enlisted had dropped so low that the income of an E-4 with a small family was below the U.S. government’s official poverty level.”⁵⁰ When compared to those of civilian counterparts, military wages lagged

⁴⁷ George, 10 and Robinson et al., 7.

⁴⁸ George, 11 and Peyer, 14.

⁴⁹ Peyer, 8.

⁵⁰ Feickert and Daggett, 4.

20 percent behind.⁵¹ The all-volunteer force – which emerged from the abandonment of the draft in 1973 – proved unable to gain and retain high quality servicemembers in sufficient numbers during its early years. This challenge was highlighted by declines in education rates and standardized test scores among recruits.⁵² Among the troops that the military was able to recruit, morale reached a low point, in part, because “Vietnam was the only war from which veterans returned to scorn instead of parades.”⁵³ All of these factors compounded so that, by 1979, the Navy was 20,000 petty officers short of desired end-strength.⁵⁴ Robinson et al. summarized the problem, explaining that “because the military of this era was not viewed as an attractive career option, none of the Services had much luck in assessing quality recruits.”⁵⁵ It was in this context – an inability to sufficiently meet the manning requirements of a force structure already inconsistent with funding levels – that General Meyer coined his phrase “hollow Army.”⁵⁶

In 1993, former Senator John McCain (R-AZ) wrote that “we need to be aware of the new risks of going hollow, and that simply attempting to avoid these mistakes of the 1970s will not protect us in the 1990s, or the post-Cold War era.”⁵⁷ Three years later, Robinson, et al. reiterated that warning, observing that “there is no guarantee that the next hollow force will look like the last one.”⁵⁸ While the booming economy of the 1990s caused challenges for military personnel retention and the William Clinton Administration-era “procurement holiday” led some to worry about the state of materiel

⁵¹ Peyer, 8.

⁵² Feickert and Daggett, 2.

⁵³ George, 10.

⁵⁴ Feickert and Daggett, 5.

⁵⁵ Robinson et al., 7.

⁵⁶ Jones, 10.

⁵⁷ Quoted in Peyer, 19.

⁵⁸ Robinson et al., 16.

readiness, a portion of the literature focuses on a new set of causes for post-Cold War force-hollowing. “Profligate commitment of U.S. forces overseas, misallocation of funds by the Pentagon and Congress, and excessive readiness requirements” were identified as new readiness challenges in this period.⁵⁹ Korb claimed in 2002 that “whatever problems the armed forces now face are caused more by poor leadership and mismanagement than by lack of funding.”⁶⁰ Ivan Eland of the Cato Institute concurred, noting that “although the military has experienced shortages of personnel, spare parts, and training, the ‘readiness crisis’ is largely illusory.”⁶¹ Rather than a high degree of personnel and materiel unreadiness, these scholars claimed that it was the excessive and atypical use of the military that contributed to force-hollowing after the fall of the Soviet Union.

Without a major adversary to defend against, “by the late 1990s, the Army was reportedly being mobilized for contingency operations 15 times as frequently as the past decade.”⁶² That amounted to “a record-setting 48 peace enforcement and combat missions” to which the Clinton Administration had committed by 1999.⁶³ Writing for the *National Journal*, James Kitfield illustrated this point by noting that “Air Force planes have flown many more sorties in support of no-fly zones over Iraq, for instance, than were logged during the entire Korean War.”⁶⁴ As a result “many of the pockets of unreadiness in an otherwise dominant military are caused by those furious and far-flung deployments, which rapidly wear out equipment and people and incur significant

⁵⁹ Ivan Eland, *A Hollow Debate on Military Readiness* (Washington D.C.: Cato Institute, 2000), 1.

⁶⁰ Lawrence Korb, “Are U.S. Forces Underprepared and Underfunded?” *Naval War College Review* 55, no. 2 (Spring 2002): 29.

⁶¹ Eland, 2.

⁶² Feickert and Daggett, 13.

⁶³ Eland, 4.

⁶⁴ James Kitfield, “The Hollow Force Myth,” *National Journal* 30, no. 50 (December 12, 1998): 2909. While objectively factual, Kitfield’s assertion does not take into account changes in the role of air power as a principal pillar of military strength in the decades between the Korean War and the 1990s.

costs.”⁶⁵ This led a number of observers to again ask Richard Betts’s fundamental question of military readiness – ready for what?

In 1999, George reiterated Pentagon assessments that the United States saw “no major threats on the horizon until at least 2015.”⁶⁶ Moreover, while post-Cold War military strategy was designed to ensure that the U.S. could fight two “major theater wars” simultaneously, that contingency has never become a reality.⁶⁷ As a result, George and others surmised that existing military readiness requirements exceeded the true necessities presented by geopolitical realities. Put another way, when faced with no strategic competitors, calculated reductions in military readiness do not necessarily mean that the force is hollow, especially in circumstances under which strategic warning of significant future threats could be expected.⁶⁸ As the CNA opined, “a certain amount of hollowness is not necessarily a bad thing.”⁶⁹

Public Support for the Military

Accepting that readiness is the qualitative measure of a military force’s ability to execute its assigned national security responsibilities, this thesis now seeks to assess the degree to which the United States Navy was “ready” from 2010 through 2017. James L. George recalled that “Vietnam was the only war from which veterans returned to scorn instead of parades.”⁷⁰ Not long after the conclusion of that war, as American leaders worried that the armed forces had become hollow, the Gallup Organization measured public approval for the military at a stinging low. Just half of Americans had “a great

⁶⁵ Eland, 4.

⁶⁶ George, 1.

⁶⁷ George, 13.

⁶⁸ Robinson et al., 14 and George, 20.

⁶⁹ Robinson et al., 14.

⁷⁰ George, 10.

deal” or “quite a lot of confidence” in the military in November 1981,⁷¹ supporting the CNA claim that low public support for the armed forces was a contributing factor to the hollowing of the force.⁷² In every year since 1998, however, the military held the top position on Gallup’s list of institutions most trusted by the American public.⁷³

In a 2017 Gallup poll, 72 percent of Americans reported having “a great deal” or “quite a lot of confidence” in the armed forces, up by almost half from the post-Vietnam low of 50 percent.⁷⁴ A similar 2016 Pew Research Center study found that 79 percent of Americans had a “great deal” or a “fair amount” of confidence that the military “acts in the best interests of the public.”⁷⁵ Military leadership was seen by Americans as professional (91 percent), trustworthy (84 percent), and honest and ethical (82 percent).⁷⁶ When evaluated individually, the military’s branches each enjoyed similar approval ratings, with 78 percent of the public having a favorable opinion of the U.S. Navy in 2017.⁷⁷

Though public support for the Navy remained high, an identifiable decrease in the average American’s personal interaction with members of the military also emerged. The Pew Research Center noted that “as the size of the military shrinks, the connections

⁷¹ Frank Newport, “Memorial Day Finds Americans Very Positive About Military,” *Gallup, Inc.*, May 25, 2018, <https://news.gallup.com/opinion/polling-matters/235013/memorial-day-finds-americans-positive-military.aspx>

⁷² Robinson et al., 7.

⁷³ Newport, “Memorial Day Finds Americans Very Positive About Military.”

⁷⁴ Newport, “Memorial Day Finds Americans Very Positive About Military.”

⁷⁵ Brian Kennedy, “Most Americans Trust the Military and Scientists to Act in the Public’s Interest,” *Pew Research Center*, October 18, 2016, <http://www.pewresearch.org/fact-tank/2016/10/18/most-americans-trust-the-military-and-scientists-to-act-in-the-publics-interest/>

⁷⁶ Frank Newport, “U.S. Confidence in Military Reflects Perceived Competency,” *Gallup, Inc.*, June 27, 2017, <https://news.gallup.com/poll/214511/high-confidence-military-reflects-perceived-competency.aspx>. Figures reflect percentages of respondents reporting that these terms described military leaders “very well” or “somewhat” in this May 2017 Gallup Poll.

⁷⁷ Jim Norman, “Americans Give Military Branches Similar High Marks,” *Gallup, Inc.*, May 26, 2017, <https://news.gallup.com/poll/211112/americans-give-military-branches-similar-high-marks.aspx>

between military personnel and the broader civilian population appear to be growing more distant.”⁷⁸ By 2011, older Americans – those who lived through the Vietnam War and whose parents fought WWII – reported having an immediate family member who had served in the military at rates of 76 to 79 percent. Meanwhile, only 33 percent of those aged 18 to 29 reported having a veteran in their immediate family.⁷⁹ This divergence helps to explain the assertion of Georgetown University Law Center professor Rosa Brooks that “most Americans know roughly as much about the U.S. military as they know about the surface of the moon.”⁸⁰ In 2016, she observed that “military service has largely become a hereditary profession in modern America: the children of military veterans join the military at a significantly higher rate than those without a parent who served do.”⁸¹ As a result, the Navy – and the armed forces as a whole – became increasingly built from an emerging “warrior class” in which military service became “the family business.”

Growing emotional distance between the warrior class and the public notwithstanding, American public support for the U.S. Navy remained at near-all-time highs in the early- and mid-2010s. As a result, applicability of the CNA’s “public support for the armed forces” readiness indicator is rejected.

Pressure to Cut Defense Spending

In June 2010, Admiral Michael Mullen, then-Chairman of the Joint Chiefs of Staff, announced his belief that “our national debt is our biggest national security

⁷⁸ Pew Research Center, “The Military-Civilian Gap: Fewer Family Connections,” *Pew Research Center*, November 23, 2011, <http://www.pewsocialtrends.org/2011/11/23/the-military-civilian-gap-fewer-family-connections/>

⁷⁹ Pew Research Center. 79 percent of those aged 50 to 64 reported having an immediate family member that was a veteran. For those aged 65 and older, the percentage was 76.

⁸⁰ Rosa Brooks, “Warriors and Citizens,” *Hoover Digest* Issue 4 (Fall 2016): 73.

⁸¹ Brooks, 74.

threat.”⁸² Adding to that assessment, *The Wall Street Journal* explained in 2015 that “national security and economic strength are inextricably linked.”⁸³ In a 2011 report to Congress, the CRS explained how a shift in geopolitical and financial circumstances had inflated the relative importance of economic strength. “Globalization, the rise of China, the prospect of an unsustainable debt burden, [and] unprecedented federal budget deficits, ... have brought economics more into play in considerations of national security.”⁸⁴ As early as 2012, an editorial in *The Nation* declared that “the United States is an empire in decline, and current outlays are simply unsustainable.”⁸⁵ The next year, for the first time since 1947, the national debt reached the same level as nominal GDP. Thereafter, the debt-to-GDP ratio continued to worsen, as Table 1 demonstrates. By comparison, in the 1970s hollow force period, the ratio of national debt-to-GDP averaged less than 33 percent. That figure grew to an average of just over 60 percent in the 1990s, following the end of the Cold War.⁸⁶ By FY2009 through FY2011, annual federal budget deficits, averaging nine percent of GDP, exacerbated already unmanageable levels of public debt.⁸⁷

In response to these and other economic challenges, Congress passed the Budget Control Act of 2011 as a means by which to rein in federal spending, in order to meet a

⁸² Johnson et al., 1.

⁸³ Michele Flournoy and Richard Fontaine, “Economic Growth is a National Security Issue,” *The Wall Street Journal*, May 27, 2015.

⁸⁴ Dick K. Nanto, *Economics and National Security: Issues and Implications for U.S. Policy* (Washington D.C.: Congressional Research Service, 2011), i.

⁸⁵ “Pentagon Drawdown,” *The Nation* vol. 294, issue 5, editorial, (January 30, 2012), 3.

⁸⁶ Figures are calculated from the average debt to GDP ratio across each decade.

⁸⁷ Grant A. Driessen and Megan S. Lynch, *The Budget Control Act: Frequently Asked Questions* (Washington D.C.: Congressional Research Service, 2018), 1.

Year	National Debt (in trillions)	Nominal GDP (in trillions)	Debt to GDP Ratio
2010	\$13.6	\$15.0	90%
2011	\$14.8	\$15.5	95%
2012	\$16.1	\$16.2	99%
2013	\$16.7	\$16.7	100%
2014	\$17.8	\$17.4	102%
2015	\$18.2	\$18.1	101%
2016	\$19.6	\$18.6	105%
2017	\$20.2	\$19.4	104%

Table 1: Ratio of National Debt to Nominal GDP 2010 – 2017 ⁸⁸

requirement of \$2.1 trillion in savings over the following decade. ⁸⁹ The law established “limits on defense discretionary spending and nondefense discretionary spending, enforced by sequestration (automatic, across-the-board reductions) in effect through FY2021.”⁹⁰ While “sequestration was supposed to be so onerous that it would never come to pass,” failure of the Joint Select Committee on Deficit Reduction to agree on a proposal to reduce the deficit triggered sequestration’s activation on March 1, 2013.⁹¹

The BCA’s financial impact to the DoD was significant. The law required a reduction in spending of \$1 trillion from FY2012 through FY2021, half of which was required to come from defense budgets. On top of those cuts, the *San Diego Business*

⁸⁸ Kimberly Amadeo, “National Debt By Year Compared to GDP and Major Events,” accessed August 15, 2018, <https://www.thebalance.com/national-debt-by-year-compared-to-gdp-and-major-events-3306287>

⁸⁹ Amy Belasco, *Defense Spending and the Budget Control Act Limits* (Washington D.C.: Congressional Research Service, 2015), 1. The BCA was passed by large margins in both houses. The House of Representatives approved the law by a vote of 269 to 161, while the Senate approved it 74 to 26.

⁹⁰ Driessen and Lynch, 1.

⁹¹ Cindy Williams, “State of the Nation: A Costly Defense,” 5.

Journal calculated that sequestration alone would cost the Navy 9.5 percent of funding across every line-item of its budget.⁹² The passage of the BCA, the subsequent budget sequester in 2013, and the underlying economic circumstances that prompted those measures show that the CNA's "pressure to cut defense spending" readiness indicator was applicable to the Navy in the early- and mid-2010s.

Recruiting and Retention

The CNA contended that "difficulties in maintaining an all-volunteer force, i.e., failure to attract and retain high-quality recruits" contributed to the hollowing of the force in the 1970s.⁹³ In 1973, for example, only 58 percent of military recruits scored in the "above average" categories on the Armed Forces Qualification Test (AFQT).⁹⁴ A decade later, in 1983, that figure held stable at 57 percent.⁹⁵ By 2000, however, 64 percent of Navy recruits earned above average scores and 90 percent were high school diploma graduates (HSDG).⁹⁶ Prospective service members with both above average AFQT scores and a high school diploma are considered by the Navy to be "high quality recruits." Proportions of recruits meeting both of these criteria grew steadily throughout the 2000s and early 2010s. Table 2 provides a snapshot of the Navy's trends in AFQT and HSDG from 2000 to 2017. In a January 2010 statement, then-Chief of Naval

⁹² Brad Graves, "Taking A Defensive Posture," *San Diego Business Journal* vol.33, issue 48 (November 26, 2011): 15. The sequester cuts were "horizontal" in nature and gave DoD little autonomy to decide where to apply the reductions. For further discussion of the implications of horizontal cuts, see George, 11 and Peyer, 14.

⁹³ Robinson et al., 7.

⁹⁴ The Navy considers AFQT results in the categories of Level I, II, and IIIA to be "above average" scores.

⁹⁵ Center for Naval Analyses, "NPS Active Component Enlisted Accessions by AFQT Category, FYs 1973-1997," accessed August 15, 2018, <https://www.cna.org/pop-rep/1997/html/d-12.html>. The 1970s figures reflect the U.S. military overall, as data specific to the U.S. Navy is unavailable. Additionally, flaws in a new version of the Armed Services Vocational Aptitude Battery (ASVAB) in 1976 led to inaccurate AFQT ratings for recruits from 1976 through 1982. As a result, data from those years is intentionally excluded from this study.

⁹⁶ Congressional Budget Office, *Recruiting, Retention, and Future Levels of Military Personnel* (Washington D.C.: Congressional Budget Office, 2006), 58.

Personnel, Vice Admiral Mark Ferguson, praised the service’s recruiters for “achieving the highest quality enlisted force in Navy history.”⁹⁷ Thereafter, personnel quality continued to rise until 2012, when both above average AFQT scores and HSDG percentages reached all-time highs of 90 percent and 99 percent respectively.⁹⁸

In their 1996 CNA study, Robinson et al. found the “quality of sailors serving [to be] a key element in avoiding a hollow force.”⁹⁹ Sailor quality, however, is contingent upon sufficient quantity being met. The Navy must meet its annual recruiting goals before it can selectively fill its billets with the best- and fully-qualified candidates. When measured by success in initial recruitment, the 2010-2017 Navy no longer suffered from a shortage of personnel similar to the one experienced after the introduction of the all-

Year	AFQT Level I-III (Above Average Scores)	HSDG
2000	64%	90%
2004	70%	96%
2007	73%	93%
2012	90%	99%
2014	89%	99%
2017	83%	99%

Table 2: U.S. Navy Recruit Quality FY2000 – FY2017 ¹⁰⁰

⁹⁷ United States Navy, “Navy Recruiting Achieves Highest Quality Enlisted Force in Navy History,” *Naval Recruiting Command Public Affairs*, January 29, 2010, http://www.navy.mil/submit/display.asp?story_id=50926

⁹⁸ Kapp, *Recruiting and Retention: FY2011 and FY2012 Results*, 3.

⁹⁹ Robinson et al., 15.

¹⁰⁰ Lawrence Kapp, *Recruiting and Retention: An Overview of FY2011 and FY2012 Results for Active and Reserve Component Enlisted Personnel* (Washington, D.C.: Congressional Research Service, 2013), 3 and Lawrence Kapp, *Recruiting and Retention: An Overview of FY2013 and FY2014 Results for Active and Reserve Component Enlisted Personnel* (Washington, D.C.: Congressional Research Service, 2015), 3.

volunteer force. From 2000 to 2017, the Navy met or exceeded its desired recruitment quotas every year. Retention statistics, however, presented both successes and challenges.

The Navy categorizes personnel into three “zones” for the purposes of setting retention goals. Zone A consists of personnel serving their first enlistment (up to six years of service). Zone B encompasses mid-career personnel (from six to 10 years of service) and Zone C is made up of personnel serving their tenth to fourteenth years.¹⁰¹

Table 3 depicts the percentage of the retention goals achieved in each zone from FY2011 through FY2014, the most recent year for which the CRS has made data publicly available. Shortages in Zones A and B during FY2013 and FY2014 were partially attributable to higher than normal retention goals for those years. The Navy exceeded force reduction targets by almost 5,000 personnel in its most recent drawdown, which triggered an increase in recruiting and retention quotas beginning in FY2012.¹⁰² While better retention numbers in FY2014, mixed with “short-term extensions of additional

	FY2011	FY2012	FY2013	FY2014
Zone A	127.8%	105.2%	83.1%	94.6%
Zone B	115.7%	94.6%	91.4%	93.1%
Zone C	141.5%	147.6%	115.7%	102.6%

Table 3: Percentage of Retention Goal Achieved FY2011 – FY 2014¹⁰³

¹⁰¹ Kapp, *Recruiting and Retention: FY2011 and FY2012 Results*, 12.

¹⁰² Mark Faram, “Sea duty shortages: Why the Navy is offering rare extensions for thousands of first-term sailors,” *Navy Times*, February 5, 2017, <https://www.navytimes.com/news/your-navy/2017/02/05/sea-duty-shortages-why-the-navy-is-offering-rare-extensions-for-thousands-of-first-term-sailors/>

¹⁰³ Kapp, *Recruiting and Retention: FY2011 and FY2012 Results*, 12 and Kapp *Recruiting and Retention: FY2013 and FY2014 Results*, 14.

personnel,” got the Navy back up to desired end strength by FY2014, effects of these manning decisions reverberated years later.¹⁰⁴

In 2017, then-Assistant Commander of Naval Personnel, Rear Admiral John Meier, conceded that as 2012 and 2013 recruits began to rotate to shore duty, the result was “several thousand gaps at sea.”¹⁰⁵ *The Navy Times* reported on the shortage, saying that “as sailors from those unusually large year groups near the end of their first-term enlistment contracts, the Navy is worried it won’t have enough sailors to man the fleet.”¹⁰⁶ Additional concerns arose as a result of Zone C retention rates during the first half of the 2010s. Rates as high as FY2012’s 147 percent of desired retention caused second-order effects over time, including retention problems in lower zones. Since more Zone C sailors remained in their jobs, promotion opportunity for more junior sailors was reduced. Historical trends suggest that this should result in challenges for retention in Zones A and B in subsequent years.

Although isolated personnel management challenges may have existed in the mid-term, the health of the Navy’s manning structure in the early- and mid-2010s appeared particularly strong. Desired end-strength remained met, new recruit quality reached its highest levels in history, and the challenges posed by retention were largely a result of *too many* sailors wanting to stay in the service rather than too few. As a result, applicability of the CNA’s readiness indicator of “difficulties in maintaining an all-volunteer force” is rejected.

¹⁰⁴ Kapp, *Recruiting and Retention: FY2013 and FY2014 Results*, 13.

¹⁰⁵ Faram.

¹⁰⁶ Faram.

Declining Pay

Steep inflation in the 1970s outpaced military pay increases so much that “by 1980, base pay had declined by almost 20 percent in real terms (adjusted for inflation) since the end of FY1972.”¹⁰⁷ Lower compensation, alongside the introduction of the all-volunteer force, left Navy recruiters unable to meet fleet demand signals and, by the end of the 1970s, the Navy was 20,000 petty officers below desired end strength.¹⁰⁸ In response, the government attempted to improve the financial appeal of military service by executing large “catch up” raises in 1980 and 1981, but continued high inflation mitigated the effectiveness of those efforts.¹⁰⁹ Although another “pay gap” between the military and civilian sectors emerged as the result of a strong economy during the 1990s, the 2000s saw that gap shrink. While the CRS cited FY2011 estimates of military compensation lagging behind civilian equivalents by 2.4 percent, other analysts “using a slightly different measurement... contend that the pay gap vanished in 2002 and that there is currently [2011] an 11 percent military pay surplus.”¹¹⁰

In a similar “catch up” effort to the one in 1980 and 1981, the Clinton Administration secured a 4.8 percent increase in basic pay for the military in 2000, followed by congressionally-mandated pay increases of 0.5 percent above the Employment Cost Index (ECI) from 2001 through 2006.¹¹¹ After 2006, the standard set

¹⁰⁷ Feickert and Daggett, 3.

¹⁰⁸ Feickert and Daggett, 5.

¹⁰⁹ Feickert and Daggett, 3.

¹¹⁰ Charles Henning, *Military Pay and Benefits: Key Questions and Answers* (Washington D.C.: Congressional Research Service, 2011) 1.

¹¹¹ James Hosek and Jennifer Sharp, *Keeping Military Pay Competitive: The Outlook for Civilian Wage Growth and Its Consequences* (Santa Monica: RAND Corporation, 2001), 1. As equivalent data regarding real wage growth among the general population is not measurable in the same way that military pay raises are, analysts utilize the ECI as the most reliable indicator of pay increases in the civilian sector.

by federal law resumed effect, requiring military basic pay increases to match the ECI.¹¹² Congress elected to pass separate legislation increasing military pay at a higher rate than ECI through 2010.¹¹³ Beginning in 2011, however, military pay increases began to match or lag civilian wage growth. This was made possible by statutory language that permits the President to “specify an alternative pay adjustment that supersedes the automatic adjustment” required by 37 U.S.C. 1009.¹¹⁴ President Obama elected to exercise this authority as an austerity measure from 2014 through 2016.¹¹⁵ As a result, the military pay increases for those years fell below ECI, as depicted in Figure 1. A consequence of this decision was that service members joining the Navy after October 2010 received smaller pay increases than their civilian counterparts over the course of the early- and mid-2010s. Of additional note, the 2011 pay increase of 1.4 percent was the smallest military pay raise since 1962, a year in which no increase was appropriated at all.¹¹⁶

Compounding the impact of these reduced pay raises, the FY2016 National Defense Authorization Act (NDAA) implemented recommendations from the Military Compensation and Retirement Modernization Commission which instituted the first major overhaul of the military retirement system since 1986.¹¹⁷ Recruits joining the Navy on or after January 1, 2018 are provided with a modernized “Blended Retirement System” (BRS) which reduces the defined benefit portion (pension) of their retirement

¹¹² Henning, 5.

¹¹³ Lawrence Kapp and Barbara Salazar Torreon, *Military Pay: Key Questions and Answers* (Washington, D.C.: Congressional Research Service, 2018), 9.

¹¹⁴ “Adjustments of Monthly Basic Pay.” 37 U.S.C. 1009 (2003) as amended.

¹¹⁵ Kapp and Salazar Torreon, 10.

¹¹⁶ Henning, 6.

¹¹⁷ Kristy N. Kamarck, *Military Retirement: Background and Recent Developments* (Washington, D.C.: Congressional Research Service, 2018), 6.

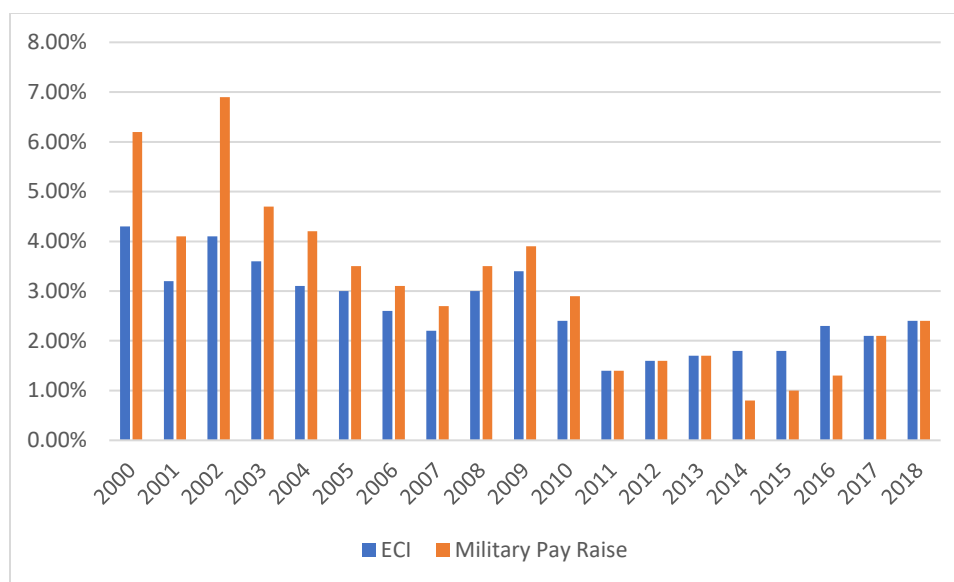


Figure 1: Military Pay Increases vs. ECI 2000 – 2018

package by 20 percent, while adding a matching contribution portion to the package. In order to calculate military pensions, a formula uses the average of a service member’s last three years of basic pay and applies a multiplier to determine the annual pension amount. Under the legacy system, known as “High Three,” retirees qualified for a multiplier equal to 2.5 percent per year of service, meaning that a member retiring after 20 years receives 50 percent of their basic pay as an annual pension. Under the new BRS, that multiplier is reduced to 2.0 percent, leaving that same retiree with a pension totaling only 40 percent of his or her basic pay annually.¹¹⁸ The legacy pension reached its maximum of 75 percent after 30 years of service, while the BRS pension is capped at 60 percent after those same 30 years.

In order to partially offset the multiplier reduction, the 2016 NDAA added a contribution portion to BRS retirement benefits in the form of annual Thrift Savings Plan (TSP) matching contributions of up to five percent of a member’s annual basic pay,

¹¹⁸ Kamarck, 10.

similar to employer 401(K) matching. Government matching contributions vest after two years of active military service, meaning that members who leave the Navy after fewer than 20 years are able to receive some retirement benefit. Under the legacy system, retirement benefits vested only after 20 years of service, leaving those who left the Navy prior to that point with no retirement benefits at all.¹¹⁹ The CRS reported that “the total lifetime benefit was estimated to be slightly higher under the legacy retirement system than under BRS,”¹²⁰ but the government’s calculations assumed and included member TSP contributions in addition to government-provided benefits, and assumed a seven percent annual return on TSP investment. Poor stock market performance or a member’s lack of ability or desire to make voluntary TSP contributions significantly alters the total value of BRS retirements.

The ultimate result of the shift from legacy retirement to BRS is that some retirement benefits are available to a larger portion of the force, but with a measurable reduction in retirement package value for those serving for 20 or more years. Service members leave the Navy at a fairly consistent rate until 10 years of service. After 10 years, they tend to remain in the military until they reach the 20-year mark at which their retirements vest.¹²¹ The impact of the BRS program on retention rates – especially for those with 10 or more years of service – will not be measurable for several years.

To be clear, most members of the U.S. Navy were financially secure from 2010 to 2017. Scholar Cindy Williams noted in 2013 that “today’s military officers take more

¹¹⁹ Kamarck, 7.

¹²⁰ Kamarck, 17.

¹²¹ Carl Forsling, “Here’s Why the Military’s New Retirement System May Not Be So Bad.” *Task and Purpose*. February 28, 2018, <https://taskandpurpose.com/militarys-new-retirement-system-actually-build-smarter-future-force/>

home in their paychecks than eight out of ten college-educated civilians. In terms of their income, enlisted members most resemble the 90th percentile of civilians with comparable levels of education and experience.”¹²² The CNA's force-hollowing criteria, however, considered only whether trends in military compensation were reductive, not from what initial level the decline began. Reduced wage growth compared to the civilian sector since 2011, coupled with less generous retirement benefits for career Navy personnel, therefore, require a determination that the “declining pay” readiness indicator was applicable to the 2010-2017 Navy.

Poor Morale

Navy Captain David Tyler wrote for the *U.S. Naval Institute Proceedings* magazine in November 2016, claiming that “morale has become undervalued and only superficially understood.”¹²³ Feickert and Daggett’s 2012 CRS report determined that “the morale of U.S. troops is declining to some degree, based on surveys conducted in the summer of 2010.”¹²⁴ Feickert and Daggett, however, relied on data that covered all military branches, resulting in morale indicators that were skewed by Army and U.S. Marine Corps (USMC) service members whom, in 2010, were still experiencing high levels of combat stress associated with repeated deployments to Iraq and Afghanistan. Accordingly, a review of Navy-centric data is required to determine if Feickert and Daggett’s findings apply to the Navy in a standalone assessment.

One traditional morale indicator monitored by scholars and analysts is the data regarding courts-martial and non-judicial punishments (NJP). The CNA cited its use of

¹²² Williams, “Accepting Austerity.” 57.

¹²³ David Tyler, “Leadership Forum – Make Morale Our First Priority,” *U.S. Naval Institute Proceedings* vol. 142, no 11 (November 2016): 70.

¹²⁴ Feickert and Daggett, 16.

the number of punitive rank reductions as an indicator of discipline problems and personnel quality in its examination of the 1970s hollow force.¹²⁵ On average from 2010 to 2017, the Navy and USMC¹²⁶ conducted 1,485 courts-martial per annum, charging their uniformed personnel with serious offenses under the Uniform Code of Military Justice (UCMJ). While that figure represents the annual average, each year from 2010 to 2017 saw fewer courts-martial than the previous one, with 2010 having 2,975 courts-marital, and 2017 seeing only 724.¹²⁷ In stark contrast, from 1977 to 1979,¹²⁸ the Navy and USMC conducted an average of 14,434 courts-martial each year, or almost ten times more than they conducted from 2010 to 2017. More mundane UCMJ offenses are adjudicated at non-judicial punishment by unit commanding officers (CO).

Between 2010 and 2017, the Navy and USMC conducted an average of 27 NJPs per 1,000 service members each year. The Navy's Judge Advocate General's Corps began including specific figures on NJP in its *Annual Report of the Judge Advocate General of the Navy* in 1977. From that year until the end of the decade, the Navy and USMC averaged 195 NJPs per 1,000 service members – more than seven times the rate seen from 2010 to 2017. Figure 2 presents a graphical depiction of the reduction in NJP

¹²⁵ Robinson et al., 38.

¹²⁶ The U.S. Navy Judge Advocate General's (JAG) Corps is responsible for handling all criminal cases in the Department of the Navy, which includes the U.S. Marine Corps. As a result, the figures in this thesis include Navy and USMC courts-martial and NJPs for each year. Historical data that separates the two branches' courts-marital and NJP statistics is not published by the JAG Corps. For the purposes of this thesis, the relative courts-martial and NJP rates between the "hollow force" of the 1970s and those of the 2010s is sufficient to draw necessary conclusions regarding morale.

¹²⁷ United States Navy, *Annual Report of the Judge Advocate General of the Navy* (Washington, D.C.: Office of the Judge Advocate General of the Navy, 1970-2017), <http://www.armfor.uscourts.gov/newcaaf/home.htm>

¹²⁸ Changes to the military justice system in 1976 resulted in tens of thousands of fewer courts-martial each year beginning in 1977. Accordingly, courts-martial rates from prior years are not comparable to post-1976 statistics and are excluded from this data set.

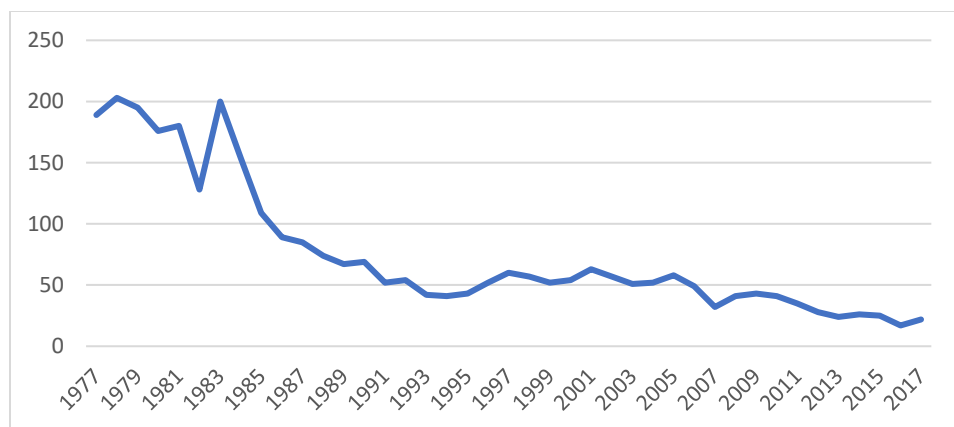


Figure 2: NJPs per 1,000 Active Duty Personnel FY1977 – FY2017¹²⁹

rates from 1977 to present, indicating that far fewer UCMJ offenses were prosecuted in the 2010s than in the 1970s and early 1980s.

Less commonly cited as a morale indicator – perhaps because of the tragedy and taboo associated with the topic – is the rate of military suicides. From 2010 to 2017, 404 active duty Navy personnel committed suicide, equating to an annual suicide rate of 15.5 per 100,000.¹³⁰ While that figure fell above the national average of 12.5 per 100,000 based on 2010 to 2014 data from the Center for Disease Control,¹³¹ adjustment was required to account for Navy demographics, since the Navy was comprised of an 80 percent male population at that time.¹³² The suicide rate among civilian males during the early 2010s averaged 20.2 per 100,000, leaving naval personnel below the national male average. The relative rate of increase in suicides, however, showed serious cause for concern. Among active duty naval personnel, suicide rates per 100,000 increased by 13

¹²⁹ United States Navy, *Annual Report of the Judge Advocate General of the Navy*.

¹³⁰ United States Navy, “Navy Suicide Data,” *Naval Personnel Command*. Accessed August 15, 2018, https://www.public.navy.mil/bupers-npc/support/21st_Century_Sailor/suicide_prevention/Pages/Statistics.aspx

¹³¹ Sally Curtin, Margaret Warner, and Holly Hedegaard, “Increase in Suicide in the United States 1999-2014,” *Center for Disease Control*, April 2016, <https://www.cdc.gov/nchs/products/databriefs/db241.htm>

¹³² United States Navy, “Status of the Navy.” Accessed August 15, 2018, http://www.navy.mil/navydata/nav_legacy.asp?id=146

percent from 2010 to 2014.¹³³ Over the same time period, civilian suicide rates increased only one to two percent, depending on the demographic examined.¹³⁴ This substantial increase must be considered a significant indicator of sailor morale.

A 2014 independent survey of 5,536 active duty naval personnel also portrayed a Navy with major morale problems. In that study, 18 percent of respondents felt that morale was “excellent” or “good,” while more than twice that many – 42 percent – believed morale to be “marginal” or “poor.”¹³⁵ Almost half of the junior personnel surveyed reported that they did not aspire to the rank and responsibility of senior leadership, largely because they viewed the position of commanding officer to be hamstrung by risk-aversion, administratively burdensome, and incongruous with the amount of pay that COs receive.¹³⁶ Moreover, and most tellingly, junior personnel did not trust those in command. “A plurality state they do not trust senior leaders,” according to journalist Kris Osborn’s coverage of the study.¹³⁷ While 2010 force-wide survey data caused the CRS to assess poor morale throughout the entire military, 2014 Navy-centric data left no reason to challenge that assertion.

Although courts-martial and NJP rates from 2010 to 2017 fell below those of the 1970s hollow force by a factor of nine and seven respectively, cause for concern remained. Startling increases in suicide rates among naval personnel, coupled with the results of the 2014 survey on Navy morale, demonstrated that the CNA’s “low morale” readiness indicator was applicable to the 2010-2017 Navy.

¹³³ United States Navy, “Navy Suicide Data.”

¹³⁴ Curtin, Warner, and Hedegaard.

¹³⁵ Kris Osborn, “Navy Survey: Sailors Unhappy, Don’t Trust Brass,” *Military Times*. Accessed August 15, 2018, <https://www.military.com/daily-news/2014/09/04/navy-survey-sailors-unhappy-dont-trust-brass.html>.

¹³⁶ Osborn.

¹³⁷ Osborn.

Delays in Fielding Modern Equipment

The Vietnam War was fought with weapons systems that largely reflected 1950s military technology – weapons systems that were obsolete by the end of that conflict. While a new generation of military hardware had completed development by the end of the 1970s, “budgets fell far short of the levels needed to achieve production rates that would replace aging equipment.” This led to force-hollowing caused by insufficient quantities of modern weapons systems.¹³⁸

Navy records show that from 2010 to 2016, the battle force shrunk in size by 4.5 percent, from 288 to 275 ships.¹³⁹ Though the loss of 13 hulls was a minor fluctuation compared to the 210-ship drawdown during the 1970s hollow force,¹⁴⁰ the Government Accountability Office indicated that shipbuilding plans submitted in the early-to-mid-2010s were insufficient to meet the requirements identified by Navy officials. The GAO’s 2018 assessment indicated that

challenges in meeting shipbuilding cost, schedule, and performance goals have resulted in a less-capable and smaller fleet today than the Navy planned over 10 years ago. While the Navy is continuing to accept delivery of ships, it has received \$24 billion more in funding than originally planned but has 50 fewer ships in its inventory today, as compared to the goals it first established in its 2007 long-range shipbuilding plan.¹⁴¹

¹³⁸ Feickert and Daggett, 6.

¹³⁹ United States Navy, “U.S. Navy Active Force Ship Levels,” *Naval History and Heritage Command*, accessed August 15, 2018, <https://www.history.navy.mil/research/histories/ship-histories/us-ship-force-levels.html#2000>

¹⁴⁰ United States Navy, “U.S. Navy Active Force Ship Levels.”

¹⁴¹ Government Accountability Office, *Navy Shipbuilding: Past Performance Provides Valuable Lessons for Future Investments* (Washington, D.C.: Government Accountability Office, 2018), 1.

Compounding those problems, the same GAO assessment found that the Navy accepted delivery of incomplete ships and ships with known deficiencies, and that the funding and acquisition programs for shipbuilding were not aligned to meet future requirements.¹⁴² The consequence of these circumstances was shortages in the battle force.

The 2016 Brookings Institution *Index of U.S. Military Strength* identified a shortage of 35 small surface combatants – Littoral Combat Ships, mine sweepers, and frigates – in the Navy’s force structure, along with a large surface combatant – cruiser and destroyer – shortfall of four hulls below the Navy’s advertised requirement.¹⁴³ Additionally, as a result of the five-year delay in commissioning the USS *Gerald R. Ford*, from 2012 to 2017 the Navy maintained only ten aircraft carriers (CVN), requiring a congressional waiver to fall below the 11 CVN inventory required by law.¹⁴⁴ As an added consequence, during the first week of January 2017, for the first time since WWII, not a single U.S. aircraft carrier was underway overseas.¹⁴⁵ While the CVN shortage was rectified later that year, a mismatch between funding levels for shipbuilding and desired fleet size resulted in Navy projections showing the battle force will remain short on small surface combatants from FY2016 through FY2027, large surface combatants from FY2036 through FY2045, and attack submarines from FY2025 through FY2036.¹⁴⁶ These shortages were deepened by annual funding requests that fell billions of dollars

¹⁴² Government Accountability Office, *Navy Shipbuilding*, 9, 10, 19.

¹⁴³ Dakota L. Wood, ed., *2016 Index of U.S. Military Strength* (Washington, D.C.: The Brookings Institution, 2016), 236.

¹⁴⁴ Wood, ed., *2016 Index of U.S. Military Strength*, 236.

¹⁴⁵ Dakota L. Wood, ed., *2018 Index of U.S. Military Strength* (Washington, D.C.: The Brookings Institution, 2018), 334.

¹⁴⁶ Wood, ed., *2016 Index of U.S. Military Strength*, 237.

below CBO projections for what was required to establish the 355-ship fleet that the Navy announced in 2017.¹⁴⁷

Faced with some of the same challenges, naval aviation procurement programs were characterized by mixed results in the early- and mid-2010s. The E-2D Advanced Hawkeye – the Navy’s carrier-based advanced surveillance and command and control aircraft – met its desired production levels through FY2016.¹⁴⁸ The EA-18G Growler program – the electronic attack aircraft that replaced the EA-6B Prowler – also proved relatively successful in the 2010s.¹⁴⁹ Significant procurement delays, however, were identified in the fighter/attack procurement programs.

The F-35 Lightning II, commonly referred to as the Joint Strike Fighter, is the largest weapons procurement program in DoD history when measured by total acquisition cost.¹⁵⁰ 2017 Navy plans called for purchasing 273 F-35C variants, capable of carrier flight operations. In 2010, however, budget overruns forced DoD to restructure the F-35 program, resulting in delivery of 122 fewer aircraft than planned for in the FY2010 defense budget.¹⁵¹ Fiscal constraints triggered additional acquisition delays in the FY2013 budget, which delayed production of 179 more F-35s, at a short-term savings of \$15.1 billion.¹⁵² As a result of these and other postponements, the initial operational

¹⁴⁷ U.S. Naval Institute, “Congressional Budget Office Report on 355-Ship Navy Costs,” May 15, 2018, <https://news.usni.org/2018/03/15/congressional-budget-office-report-355-ship-navy-costs>

¹⁴⁸ Dakota L. Wood, ed., *2017 Index of U.S. Military Strength* (Washington, D.C.: The Brookings Institution, 2017), 298.

¹⁴⁹ Wood, ed., *2017 Index of U.S. Military Strength*, 298.

¹⁵⁰ Jeremiah Gertler, *F-35 Joint Strike Fighter (JSF) Program* (Washington, D.C.: Congressional Research Service, 2018), 1.

¹⁵¹ Gertler, 12.

¹⁵² Gertler, 13.

capability (IOC) of the F-35C was pushed back from March 2015 until February 2019.¹⁵³ These shortages in surface and air assets had stinging impacts on the operational fleet.

In 2016, the Navy deactivated Carrier Air Wing (CVW) Nine and the eight aircraft squadrons that comprised it. Traditionally, the Navy maintains one fewer airwing than aircraft carrier on the assumption that at least one carrier will always be unavailable for deployment due to planned maintenance overhauls. With the fleet operating at a reduced capacity of 10 CVNs from 2012 to 2016, the Navy elected to eliminate an airwing, reducing the total to nine.¹⁵⁴ CVW-9's deactivation was also intended to make its aircraft available for assignment to other CVWs that were struggling to maintain sufficient numbers of airframes to meet mission demand in the same way that their surface community counterparts lacked sufficient numbers of ships.¹⁵⁵

Although some new carrier-based aircraft maintained healthy acquisition rates and program successes in the mid-2010s, procurement challenges overshadowed these accomplishments. A four-year delay in IOC of the F-35C, the deactivation of an entire carrier air wing based on a deficient inventory of aircraft carriers and fleet aircraft, and significant shortages of surface combatants relative to advertised requirements plagued the 2010-2017 Navy. As a result, the “delays in fielding modern equipment” readiness indicator is accepted.

Inadequate Maintenance of Existing Equipment

John H. Pendleton, the Director for Defense Capabilities and Management at the GAO, testified to the U.S. Senate Armed Services Committee on September 19, 2017. In

¹⁵³ Gertler, 11.

¹⁵⁴ Wood, ed., *2017 Index of U.S. Military Strength*, 298.

¹⁵⁵ Wood, ed., *2017 Index of U.S. Military Strength*, 299.

his remarks, Pendleton observed that “the United States faces an extremely challenging national security environment at the same time that it is grappling with addressing an unsustainable fiscal situation...DoD is working to both rebuild readiness of its forces and modernize to meet future threats while facing constrained budgets.”¹⁵⁶ Among the consequences of these fiscal constraints, he contended, was a decrease in the material readiness of Navy ships. He informed Senators that casualty reports – messages that ships use to “provide information on equipment or systems that are degraded or out of service, the lack of which will affect a ship’s ability to support required mission areas”¹⁵⁷ – “nearly doubled over the 2009 through 2014 timeframe, and the condition of overseas-homeported ships decreased even faster than that of U.S.-based ships.”¹⁵⁸ This additional wear on Navy ships was largely attributed to the increase in operational requirements placed on them. As a consequence of increased operational tempo and the resulting acceleration in wear and tear to shipboard systems, planned maintenance on surface ships and submarines took significantly longer than originally planned. Due to its specificity and applicability, a portion of Pendleton’s statement is reiterated here in its entirety:

- *Aircraft Carriers:* In FY2011 through FY2016, maintenance overruns on 18 of 21 (86 percent) aircraft carriers resulted in a total of 1,103 lost operational days – days that the ships were not available for operations – the equivalent of losing the use of 0.5 aircraft carriers each year.

¹⁵⁶ John H. Pendleton, *Navy Readiness: Actions Needed to Address Persistent Maintenance, Training, and Other Challenges Affecting the Fleet* (Washington, D.C.: Government Accountability Office, 2017), 1.

¹⁵⁷ Pendleton, *Navy Readiness*, 9.

¹⁵⁸ Pendleton, *Navy Readiness*, 9. The disparity between U.S.-based units and those in the Forward Deployed Naval Forces (FDNF) is important in light of DoD’s decision to double the number of FDNF ships from 2006 to 2017, increasing the portion of the fleet homeported in overseas locations to 14 percent.

- *Surface Combatants (DDGs and CGs)*: In FY2011 through FY2016, maintenance overruns on 107 of 169 (63 percent) surface combatants resulted in a total of 6,603 lost operational days – the equivalent of losing the use of 3.0 surface combatants each year.
- *Submarines*: In FY2011 through FY2016, maintenance overruns on 39 of 47 (83 percent) submarines resulted in a total of 6,220 lost operational days – the equivalent of losing the use of 2.8 submarines each year.¹⁵⁹

These delays reached the point that, by 2017, “some submarines [were] out of service for prolonged periods, as much as four years or more.”¹⁶⁰ According to one admiral, from 2009 to 2017, six submarine maintenance overhauls lasted 50 to 100 percent longer than expected. The resulting backlog “affects 15 submarines and could cost the Navy almost 15 years at sea.”¹⁶¹ The Secretary of the Navy measured the 2017 maintenance backlog at the DoD’s four shipyards at \$4.8 billion.¹⁶² That same year, SECNAV ordered a *Strategic Readiness Review* which identified similar problems in naval aviation units.

The *Strategic Readiness Review* found that delays in conducting planned aircraft overhauls were “most evident in the inability of the Navy’s Aviation Depot Repair facilities to meet the maintenance demand. It has resulted in a backlog of almost 300 F/A-18C/D Hornet aircraft, about half the inventory of these aircraft, awaiting induction

¹⁵⁹ Pendleton, *Navy Readiness*, 14.

¹⁶⁰ Christopher P. Cavas, “Grounded: Nearly two-thirds of U.S. Navy’s strike fighters can’t fly,” *Defense News*, February 6, 2017, <https://www.defensenews.com/naval/2017/02/06/grounded-nearly-two-thirds-of-us-navys-strike-fighters-cant-fly/>.

¹⁶¹ Sydney J. Freedberg, “Submarine Maintenance Backlog Threatens Crisis Response: Admiral,” *Breaking Defense*, November 6, 2017, <https://breakingdefense.com/2017/11/submarine-maintenance-backlog-threatens-crisis-response-admiral/>

¹⁶² Julianne Standford, “Navy Secretary: Resolving Shipyard Backlog is Crucial,” *Kitsap Sun*, October 17, 2017, <https://www.kitsapsun.com/story/news/local/2017/10/17/navy-secretary-resolving-shipyard-backlog-crucial/772440001/>

into repair.”¹⁶³ The F/A-18E/F Super Hornet – the primary fighter/attack aircraft deployed aboard CVNs – also suffered from a maintenance pipeline that was unable to complete the depot-level maintenance required for approximately 60 of those aircraft each year.¹⁶⁴ By 2017, almost two-thirds of F/A-18s – and more than half of all Navy aircraft – were unable to fly “because they’re either undergoing maintenance or simply waiting for parts or their turn in line on the aviation depot backlog.”¹⁶⁵ Shore installations found themselves neglected as well. In April 2018, Undersecretary of Defense for Energy, Installations, and Environment Lucian Niemeyer told a House Armed Services subcommittee that “we currently have an underfunded maintenance backlog exceeding \$116 billion; 23 percent of the department’s facilities are in poor condition, [and] another 9 percent are in failing condition.”¹⁶⁶

CRS determined in 2012 that the military did not meet the “inadequate attention to maintenance of existing equipment” force-hollowing criteria. Examined in the context of the Navy from 2010 to 2017, however, substantial maintenance backlogs justify dissenting from that CRS conclusion and accepting this indicator as valid.

Conclusion

The 1996 CNA examination of Navy readiness identified seven factors that contributed to the emergence of a hollow force after the Vietnam War. They were: 1) low public support for the military; 2) pressure to cut defense spending; 3) difficulties in

¹⁶³ Bayer and Roughead, 54.

¹⁶⁴ Bayer and Roughead, 54. Depot-level maintenance refers to maintenance overhauls and repairs that cannot be conducted at the unit (i.e.: squadron) level. Aircraft in depot-level maintenance are transferred out of the custody of their responsible squadrons until maintenance is complete. Delays at the depot level, therefore, result in insufficient aircraft available to meet fleet demand.

¹⁶⁵ Cavas.

¹⁶⁶ Terri Moon Cronk, “DoD’s Underfunded Maintenance Backlog Exceeds \$116 Billion, Official Says,” *Defense Media Activity*, April 18, 2018, <https://www.defense.gov/News/Article/Article/1497582/dods-underfunded-maintenance-backlog-exceeds-116-billion-official-says/>

maintaining an all-volunteer force; 4) declining military pay; 5) poor morale; 6) delays in fielding modern equipment; and 7) inadequate attention to maintenance of existing equipment.¹⁶⁷ Applying these criteria to the whole of the armed forces in 2012, the CRS found that “if these seven causes are examined for contemporary relevance, five of the seven causes would be non-applicable.”¹⁶⁸ The research outlined in this thesis, however, determined that five of the seven causes were, in fact, applicable when viewed in the context of the U.S. Navy from 2010 to 2017. Only two criteria were not met. Table 4 contrasts the findings of the CRS and those of this thesis.

Readiness Indicator	2012 CRS Assessment ¹⁶⁹	Applicability to U.S. Navy from 2010 to 2017
Low Public Support for the Military	Rejected	Rejected
Pressure to Cut Defense Spending	Accepted	Accepted
Difficulties in maintaining an all-volunteer force	Rejected	Rejected
Declining Pay	Rejected	Accepted
Poor Morale	Accepted	Accepted
Delays in fielding modern equipment	Rejected	Accepted
Inadequate attention to maintenance of existing equipment	Rejected	Accepted

Table 4: Assessment of Readiness Indicators

The emergence of additional positive indicators alone does not necessarily mean that the 2010-2017 Navy was hollow, however. CNA pointed out that “there is no guarantee that the next hollow force will look like the last one,” making a hollowness assessment of the 2010-2017 Navy dependent on more than just the seven criteria that explained 1970s hollowness.¹⁷⁰ Additional factors were evident in the Navy during the 2010s. Among them were a significant divide between the “supply” and “demand” of

¹⁶⁷ Robinson et al., 7.

¹⁶⁸ Feickert and Daggett, 15.

¹⁶⁹ Feickert and Daggett, 15-18.

¹⁷⁰ Robinson et al., 16.

Navy forces worldwide, a “normalization of deviance” culture in Navy leadership, and a rise in mishap rates across the fleet. These characteristics of the 2010-2017 Navy warrant more thorough review to determine whether or not they are additional leading or lagging indicators of force-hollowing.

Chapter Two

Operational Tempo as a Readiness Indicator

Introduction

The previous chapter measured the applicability of seven academically-defined force-hollowing indicators against the readiness of the U.S. Navy from 2010 to 2017. Researching and developing those assessments uncovered a direct link between the degraded material condition of the Navy's ships and its operational tempo (OPTEMPO). Although the CNA's original report was silent on the matter of operational tempo, the CNA did conclude in that study that "there is no guarantee that the next hollow force will look like the last one."¹⁷¹ Accepting that premise as valid, this chapter explores whether operational tempo acted as a force-hollowing agent during the early- and mid-2010s. Examination of available evidence shows that a statistically-significant increase in operational tempo did emerge as a primary challenge to naval readiness during those years. This increase was caused most directly by a reduction in the size of the Navy's combatant force. It was exacerbated, however, by an institutional culture which tolerated deviation from accepted training and maintenance standards, and which ultimately resulted in deteriorating safety trends across the Navy. In short, too few ships being ordered to do too much work resulted in the institutional failures which led to the 2017 mishaps onboard USS *Antietam*, USS *Lake Champlain*, USS *Fitzgerald*, and USS *John S. McCain*. In the latter two cases, the collisions resulted in 17 deaths and \$550 million in damage.¹⁷²

¹⁷¹ Robinson, et al., 16.

¹⁷² Sam LaGrone, "USS Fitzgerald Leaves Mississippi Drydock After More than a Year of Repairs," *U.S. Naval Institute News*, April 16, 2019, <https://news.usni.org/2019/04/16/uss-fitzgerald-leaves-mississippi-drydock-after-more-than-a-year-of-repairs>. See also: Ben Werner, "USS John S. McCain Now In Japan

This chapter begins by exploring the relevant academic and professional literature on the relationship between operational tempo and naval readiness. The literature review then explores Diane Vaughan's sociological theory on normalization of deviance, and its applicability to military forces. Building upon that theoretical foundation, a comparative analysis between the Navy's operational tempo in the 2010s and that of previous decades is conducted. After identifying a statistically-significant increase in operational tempo, an examination of the causes and effects of that increase is undertaken. It is determined that a reduction in the size of the Navy's ship inventory without a proportionate reduction in overseas naval presence requirements was directly responsible for an outsized operational tempo. This study further determines that an institutional culture conducive to normalization of deviance enabled high operational tempo to become both accepted and expected, which resulted in a rise in safety mishaps and the deaths of U.S. sailors.

Literature Review

An examination of the literature addressing the relationship between military readiness and operational tempo showed that properly balancing time spent on deployment, training, and maintenance can improve the readiness of a military force. Damage to readiness, however, results from an operational tempo that burdens the force with deployment requirements without providing sufficient time to conduct the training and maintenance that enables "readiness recovery." During the early- and mid-2010s, the Navy faced an operational tempo so high that it threatened to "break[] the force."¹⁷³ The

For Repairs Following Deadly August Collision," *U.S. Naval Institute News*, December 13, 2017, <https://news.usni.org/2017/12/13/uss-john-s-mccain-now-japan-repairs-following-deadly-august-collision>.

¹⁷³ Bryan Clark and Jesse Sloman, *Deploying Beyond Their Means: America's Navy and Marine Corps at a Tipping Point* (Washington, D.C.: Center for Strategic and Budgetary Assessments, 2015), 1.

Navy's "can-do" culture¹⁷⁴ fostered an environment in which "normalization of deviance" caused an excessive operational tempo to become regarded as "the new normal." The literature further suggests that certain characteristics of military forces make them particularly susceptible to normalization of deviance.

Operational Tempo in a Shrinking Navy

The conventional understanding of operational tempo is that it refers only to the frequency with which military personnel are deployed overseas for operational purposes. In 1999, scholars at the United States Army War College broke with this traditional view and argued that the concept of operational tempo – which they defined as "the rate of military actions or missions" – needed to be expanded. Castro and Adler contended that operational tempo is the sum of three components – deployments, training exercises, and garrison duties, which in naval parlance equates to "inport" time.¹⁷⁵ Collaborating with Jeffrey Thomas at the Walter Reed Army Institute of Research in 2005, Castro and Adler rebranded these criteria and added "role overload" – the perception by servicemembers that they are required to "do more with less" – as a fourth operational tempo component.¹⁷⁶ Naval War College (NWC) researchers agreed that "the tempo and workload of all operations, both pre-deployment training operations and deployments engaged across the full ROMO [range of military operations], should be considered when planners assess OPTEMPO and DEPTempo [deployment tempo]."¹⁷⁷ According to

¹⁷⁴ Philip Davidson, *Comprehensive Review of Recent Surface Force Incidents* (Norfolk: U.S. Fleet Forces Command, 2017), 101.

¹⁷⁵ Carl Castro and Amy Adler, "OPTempo: Effects on Soldier and Unit Readiness," *Parameters* vol. 29, no. 3 (Autumn 1999): 87.

¹⁷⁶ Jeffrey Thomas, Amy Adler, and Carl Andrew Castro, "Measuring Operations Tempo and Relating it to Military Performance," *Military Psychology*, vol. 15, no. 3 (2005): 139.

¹⁷⁷ John Lewis, *Planning for the Effects on Personnel Readiness of Increased OPTempo*. Thesis. (Newport, RI: Naval War College, 2006), 10.

Castro and Adler, “there is a level of operations tempo that *enhances* unit and soldier readiness. Conversely, there is also a level of operations tempo that *decreases* unit and soldier readiness. In other words, there is a level of operations tempo that is related to optimal performance.”¹⁷⁸ This relationship between operational tempo and readiness is such that when operational tempo reaches either extreme highs or lows, unit and personnel readiness suffers.¹⁷⁹

A 2006 NWC study warned that excessive operational tempo can “have a specific negative effect on tactical war fighting capability in that it can literally wear down equipment and personnel to the point of failure, [and] it is also likely to have long term strategic effects.”¹⁸⁰ Nine years later, researchers at the Center for Strategic and Budgetary Assessments found that the inordinately high operational tempo of U.S. naval forces in the early 2010s degraded Navy readiness to such an extent that it risked “breaking the force.”¹⁸¹ Clark and Sloman argued that the Navy’s fleet had grown too small to meet the heavy demands placed on it by military and civilian leadership.¹⁸² Robert Rubel, Dean of the Center for Naval Warfare Studies at NWC, recalled that “for most of the post-World War II history of the U.S. Navy, the issue of warfighting readiness versus presence essentially was moot because fleet size was large enough ... that the two functions were carried out adequately and appropriately by the array of large combatants that constituted the fleet.”¹⁸³ The Clinton-era “procurement holiday” which followed the fall of the Soviet Union led to a decrease in fleet size as a result of reduced

¹⁷⁸ Castro and Adler, 93.

¹⁷⁹ Castro and Adler, 94.

¹⁸⁰ Lewis, 16.

¹⁸¹ Clark and Sloman, 1.

¹⁸² Clark and Sloman, 1.

¹⁸³ Robert Rubel, “Posture Versus Presence: The Relationship between Global Naval Engagement and Naval War-Fighting Posture,” *Naval War College Review* vol. 69, no. 4 (Autumn 2016): 20.

Navy acquisitions. No associated reduction in overseas presence requirements accompanied the cutback in fleet size, however.

Former CIA Director and Secretary of Defense Leon Panetta explained that “the U.S. armed forces are the only military with a global presence and responsibility.”¹⁸⁴ To meet that responsibility, “between 1998 and 2014, the number of ships deployed overseas remained roughly constant at 100. The fleet, however, shrank by about 20 percent. As a result, each ship is working harder to maintain the same level of presence.”¹⁸⁵ This culminated in an 18 percent increase in the time surface combatants spent at sea from 2001 to 2009.¹⁸⁶ This trend continued – and worsened – in the decade that followed. NWC Professor Jamie McGrath observed in 2019 that “today’s fleet of 275 ships is tasked with maintaining the same level of presence as the six-hundred-ship fleet of the late 1980s, and as a result the fleet is operating at a much higher rate than it was designed to support.”¹⁸⁷ Senator Roger Wicker (R-MS), then-Chairman of the Senate Armed Forces Subcommittee on Seapower, wrote for *The National Interest* to explain the effects that increased operational tempo had on the remaining ships in the fleet. “The decline in supply has not been matched by less demand for naval power... The results of this supply-demand mismatch are longer deployments; hundred-hour workweeks; and deferred, delayed and canceled maintenance and training.”¹⁸⁸ Vice Admiral Thomas Rowden, then-Commander of Naval Surface Forces, added in 2018 that “simple math

¹⁸⁴ Panetta et al., 20.

¹⁸⁵ Clark and Sloman, 6.

¹⁸⁶ Clark and Sloman, 7.

¹⁸⁷ Jamie McGrath, “Peacetime Naval Rearmament, 1933-39: Lessons for Today,” *Naval War College Review* vol. 72, no. 2 (Spring 2019): 93.

¹⁸⁸ Roger Wicker and Jerry Hendrix, “The Naval Imperative,” *The National Interest*, no. 155 (May/June 2018): 76, 70.

tells you that when you had 600 ships and were deploying 100, and when you've [now got fewer than] 300 ships and you're deploying 100, there's more stress on the force.”¹⁸⁹

In 2010, the Center for Naval Analyses warned that the pairing of consistently high demand signals with “stagnant, shrinking resources” meant that the Navy’s “current strategies based on combat-credible forward presence are unsustainable.”¹⁹⁰ Within five years, Clark and Sloman called upon “DoD and national leaders [to] decide to either reduce overseas presence or act to build up the fleet; base more of it overseas; or increase its readiness and OPTEMPO” by changing the way it trains.¹⁹¹ Yet, it was not until after the collisions of USS *Fitzgerald* and USS *John S. McCain* that Navy officials conceded that the disparity between naval resource supply and demand meant that “military and civilian leaders must accept less Navy presence worldwide.”¹⁹²

When challenged in 2016 to prioritize either forward presence or increased readiness, the Chief of Naval Operations (CNO) called such a decision a “‘false choice,’ asserting that the Navy must provide both in a balanced manner.”¹⁹³ In an internally-conducted 2017 study, Admiral Philip Davidson explained that Navy crews had been able to meet excessive operational demands with an undersized fleet over the course of the prior decade, in part, due to the service’s “can-do” culture.¹⁹⁴ Bayer and Roughead, however, argued that “can-do,” over time, became “must-do” and that this “unbridled ‘must-do’ attitude compromise[d] established Navy readiness standards and cause[d]

¹⁸⁹ McGrath, 93.

¹⁹⁰ Daniel Whiteneck et al., *The Navy at a Tipping Point: Maritime Dominance at Stake?* (Alexandria: Center for Naval Analyses, 2010), 3.

¹⁹¹ Clark and Sloman, 27.

¹⁹² Bayer and Roughead, 18.

¹⁹³ Rubel, 19.

¹⁹⁴ Davidson, 101.

senior commanders to inadequately appreciate the risks they [were] accepting.”¹⁹⁵ Their *Strategic Readiness Review* further found that efforts to “do more with less” in order to meet combatant commanders’ demand signals “pushed the smaller fleet such that established readiness standards [were] increasingly unachievable...Accepting deficiencies in readiness, rather than a decreased Navy presence worldwide, normalizes a lower standard for our forces on the front lines.”¹⁹⁶ The report called this culture a “normalization of deviation.”¹⁹⁷

Normalization of Deviance Theory

In 1996, Diane Vaughan published her theory on the “normalization of deviance”¹⁹⁸ in a landmark study of the systemic and institutional failures that led to the loss of the *Challenger* space shuttle a decade prior. Her revisionist claim that organizational culture at NASA led to the *Challenger* incident gave rise to a wide-ranging literature on normalization of deviance.¹⁹⁹ According to one professional journal, “the formal definition [of normalization of deviance] is a long-term phenomenon in which a lower standard of safety is accepted until that lower standard becomes accepted as the norm. Another way to look at it is accepting small incremental deviations

¹⁹⁵ Bayer and Roughead, 22.

¹⁹⁶ Bayer and Roughead, 18, 21.

¹⁹⁷ Bayer and Roughead, 22.

¹⁹⁸ Center for Chemical Process Safety, *Recognizing and Responding to Normalization of Deviance* (New York: American Institute of Chemical Engineers, 2018), 5. The American Institute of Chemical Engineers explains that “deviation implies a somewhat more quantitative departure (think standard deviation) than deviance does. It implies that something can be isolated and counted or individually examined... deviance, however, implies a more general quality. The definition [of deviance] is the state of departing from usual or normal behavior.” The methodology used in this chapter makes identification of “quantitative departures” challenging for a variety of reasons, including the classified nature of specific data regarding naval unit readiness. Accordingly, although this thesis will routinely quote sources referring to the “normalization of deviation” which was identified in the 2018 *Strategic Readiness Review*, it subscribes to the “more general quality” of Diane Vaughan’s original theory of “normalization of deviance.”

¹⁹⁹ Phillip Tompkins, Kurt Heppard, and Craig Melville, “Deviance from Normality or the Normalization of Deviance? Making Sense of the *Challenger* Launch Decision,” *Organization* vol. 5, no. 4 (1998): 622.

that seem harmless at the time they occur, but their cumulative effects result in a significant negative outcome.”²⁰⁰ The Center for Chemical Process Safety used the term to refer to “a gradual erosion of standards of performance as a result of increased tolerance of nonconformance.”²⁰¹ Vaughan’s theory bears a heavy resemblance to Ortmann’s understanding of “drift” from established standards in that, like drift, normalization of deviance is “(a) not intended, (b) slow, subtle, and therefore, difficult to perceive, (c) long-lasting and (d) has a certain direction.”²⁰²

Scholars at the University of Colorado at Boulder and the U.S. Air Force Academy likened individual and organizational responses to the normalization of deviance to the idea of a slow boil. “A frog dropped into a pot of cold water will remain there calmly while the water is gradually heated to a boil, but a frog dropped into hot water will leap out instantaneously.”²⁰³ Doctors at the International Anesthesia Research Society placed this analogy into managerial context. They explained that “this incremental process is a gradual erosion of normal procedures that would never be tolerated if proposed in [one] single, abrupt leap.”²⁰⁴ Over time, however, “*the unexpected becomes the expected, which becomes the accepted.*”²⁰⁵ Quoting a 2008 interview with Vaughan, Jeffrey Pinto detailed how “social normalization of deviance means that people within the organization become so much accustomed to a deviant

²⁰⁰ Jeff Caudill, “Combating Normalization of Deviance Within Your Organization,” *Hydrocarbon Processing* vol. 97, no. 3 (March 2018): 47.

²⁰¹ Center for Chemical Process Safety, 5.

²⁰² Günther Ortmann, “On Drifting Rules and Standards,” *Scandinavian Journal of Management* vol. 26, no. 2 (2010): 205.

²⁰³ Tompkins, Heppard, and Melville, 626.

²⁰⁴ Richard Prielipp et al., “The Normalization of Deviance: Do We (Un)Knowingly Accept Doing the Wrong Thing?” *The Open Mind* vol. 110, no. 5 (May 2010): 1499.

²⁰⁵ Jeffrey Pinto, “Project Management, Governance, and the Normalization of Deviance,” *International Journal of Project Management* vol. 32, (2014): 377. Emphasis in original.

behavior that they don't consider it as deviant, despite the fact that they far exceed their own rules for elementary safety."²⁰⁶

Ortmann called his concept of drift "a necessary condition of the functioning of organizations," that also presents dangers.²⁰⁷ Vaughan concurred with this finding and added that, "while the normalization of deviance can be functional for an organization, reducing uncertainty, allowing coherence, and creating continuity between past, present, and future, it also can lead to mistake resulting in mishap and, as in the *Challenger* incident, disaster."²⁰⁸ It is these relationships between normalization of deviance and organizational culture that make the theory applicable to the study of naval readiness. Steve Panger at the U.S. Air Force Air Mobility Command explained that "it can be easy to get drawn into deviations in the military. We operate so often with stress, consequence, time compression, and changing conditions that taking shortcuts to expedite successful outcomes can itself become 'normal.'"²⁰⁹ As deviance normalizes across the generational shifts in military communities, the implications for process and operational safety emerge. Unfortunately, "it is usually only with hindsight that people within an organization can realize that their seemingly 'normal' behavior was, in fact, deviant."²¹⁰ In 2018, Senator Wicker described his view that the U.S. Navy "displayed an institutional pattern of bending the rules to get the mission done."²¹¹ Yet this realization, too, came only in retrospect. Just as normalization of deviance theory was born from the

²⁰⁶ Pinto, 377.

²⁰⁷ Ortmann, 208.

²⁰⁸ Diane Vaughan, *The Challenger Launch Decision* (Chicago: University of Chicago Press, 1996), 410.

²⁰⁹ Steve Panger, "How We Rationalize Shortcuts," *The Mobility Forum* vol. 27, no. 1 (Spring 2018): 8.

²¹⁰ Pinto, 377.

²¹¹ Wicker and Hendrix, 76.

Challenger tragedy, recognition of the Navy’s emerging “normalization of deviation” grew from collisions at sea which cost 17 sailors their lives.

U.S. Navy Operational Tempo, 2010-2017: Doing More With Less

A statistically-significant increase in the operational tempo of naval forces from 2010 to 2017 resulted from a mismatch between the supply of available combatant ships and military leadership’s demand for vessels to conduct overseas operations. Passed in 1996, the Goldwater-Nichols Department of Defense Reorganization Act (Goldwater-Nichols, PL 99-433) fundamentally altered the U.S. military’s command and control structure, ceding operational command of naval forces to geographic combatant commanders, each responsible for different regions around the globe. Responsibility for manning, training, and equipping ready naval forces, however, remains the obligation of the Navy’s administrative command structure led by the Secretary of the Navy and the Chief of Naval Operations.²¹² The result is a separation of the responsibilities for supplying and demanding naval forces between different command structures, each primarily concerned with achieving its own organizational objectives. In the years both before and after Goldwater-Nichols was enacted, competing government priorities and budgetary constraints forced reductions in the size of the Navy’s fleet. This, in turn, restricted the ability of the SECNAV and the CNO to supply ready forces, while combatant commanders simultaneously increased their own demands for units to support combat and non-combat missions. The GAO reported in 2015 that “combatant commander demand for forward presence is at historically high levels and is rising.”²¹³

²¹² “Goldwater-Nichols Department of Defense Reorganization Act,” Public Law 99-433, October 4, 1996.

²¹³ John H. Pendleton, *Navy Force Structure: Sustainable Plan and Comprehensive Assessment Needed to Mitigate Long-Term Risk to Ships Assigned to Overseas Homeports* (Washington, D.C.: Government Accountability Office, 2015), 5.

In short, according to Senator Wicker, “the United States currently has a navy too small for the requirements of a great naval power... Too few ships fulfilling too many missions degraded the combat readiness of ships and sailors alike.”²¹⁴

During the 2000s and early 2010s, the Navy’s operational fleet shrunk by approximately 20 percent²¹⁵ with no appreciable reduction in overseas presence requirements to compensate for the loss of 43 ships.²¹⁶ Navy leadership determined that the force could continue to support the same operational demands with a smaller fleet by increasing the amount of time the remaining ships spent at sea. This led to a statistically-significant increase in the percentage of the fleet deployed on a typical day. Figure 3 depicts the two-fold increase in percentage of the fleet deployed on average from 1985 to 2016, the

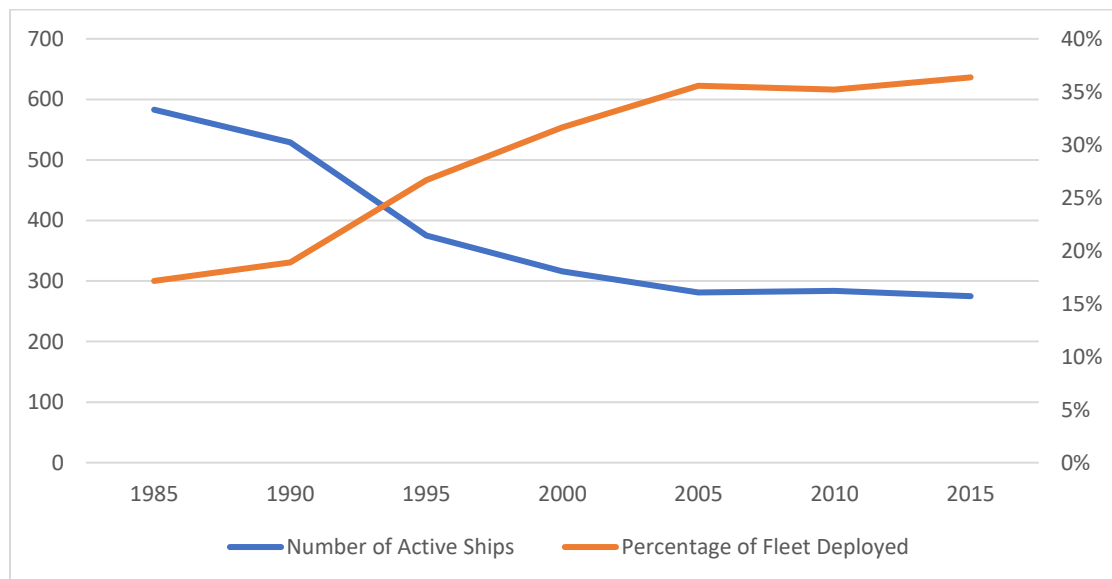


Figure 3: Fleet Size and Percentage of Fleet Deployed, 1985-2016

²¹⁴ Wicker and Hendrix, 76.

²¹⁵ Clark and Sloman, 6.

²¹⁶ United States Navy, “U.S. Navy Active Force Ship Levels.”

result of a consistent forward presence of approximately 100 ships supported by a continuously-shrinking battle force. In testimony before the Senate Armed Services Committee in 2015, then-CNO Admiral Jonathan Greenert, told lawmakers that “since 2013, our ships have deployed beyond the traditional 6-month deployment.”²¹⁷ Even still, “the Navy reports that it met [only] 44 percent of the requests from combatant commanders around the world for Navy forces to support ongoing operations ... for fiscal year 2015. The Navy has reported that it would require over 150 more ships to fully source all combatant commander requests.”²¹⁸

Using the Navy’s target of six-month deployments as its baseline, the Center for Naval Analyses examined deployment length data from 1990 through 2008 and found a statistically-significant increase in the percentage of deployments which exceeded that baseline beginning in 2001. Table 5 details CNA’s findings.²¹⁹ Data subsequent to CNA’s study shows that from 2008 to 2010, carrier strike group (CSG) deployments averaged 6.4 months – about seven percent longer than desired. From 2011 to 2014, however, CSG deployment lengths rose to an average 8.2 months – more than one-third

Year	Percentage of Deployments Lasting Over Six Months
1990-1997	7 %
1998-2000	4 %
2001-2003	32 %
2004-June 2008	23 %

Table 5: Percentage of Deployments Lasting Over Six Months, 1990-2008 ²²⁰

²¹⁷ Jonathan Greenert, “Statement of Admiral Jonathan Greenert, U.S. Navy Chief of Naval Operations, Before the Senate Armed Services Committee on the Impact of Sequestration on National Defense,” January 28, 2015.

²¹⁸ Pendleton, *Navy Force Structure*, 5.

²¹⁹ Whiteneck, et al., 7.

²²⁰ Whiteneck, et al., 7.

higher than baseline assumptions.²²¹ In 2014, three CSGs – those led by the USS *Harry S. Truman*, USS *Carl Vinson*, and USS *George H. W. Bush* – each spent more than nine months deployed.²²² For the USS *Harry S. Truman*, its nine-and-one-half month deployment was one of two back-to-back deployments it had to conduct as a result of the USS *Dwight D. Eisenhower* being unable to deploy due to maintenance delays.²²³

Competing Systems for Creating Ready Forces: Managing Operational Tempo

Optimized Fleet Response Plan

By mid-decade, Navy officials recognized their existing systems for balancing readiness generation (time spent on training and maintenance) and readiness expenditure (overseas deployments) were obsolete. “Excessive OPTEMPO affects naval readiness in a number of ways, but most significantly by reducing the time available for maintenance.”²²⁴ In extreme cases, “destroyers the Navy hoped would last for 40 years were hanging on for just 25.”²²⁵ As discussed briefly in chapter one of this thesis, an operational tempo which required ships to deploy for periods longer than anticipated interrupted planned preventative maintenance cycles, resulting in a degraded material condition of the vessels. This, in turn, caused post-deployment maintenance availabilities²²⁶ to last measurably longer than planned. From 2011 to 2014, 89 percent of aircraft carrier maintenance periods, and 72 percent of availabilities for all other

²²¹ John Pendleton, *Military Readiness: Progress and Challenges in Implementing the Navy’s Optimized Fleet Response Plan* (Washington, D.C.: Government Accountability Office, 2016), 7.

²²² Bill Gortney and Harry Harris, “Applied Readiness,” *U.S. Naval Institute Proceedings* vol. 140, no. 10 (October 2014): 40.

²²³ Pendleton, *Military Readiness*, 16.

²²⁴ Clark and Sloman, 7.

²²⁵ Faturechi, Rose, and Miller.

²²⁶ Pendleton, *Military Readiness*, 9. The Navy refers to depot-level ship maintenance – “major repair, overhaul, or complete rebuilding of weapons systems needed for ships to reach their expected service life” – as “maintenance availabilities.”

surface combatants experienced schedule overruns. These overruns reduced the ability of the ships to conduct training and operations, requiring “ready” ships to meet the remaining demand, thereby establishing a perpetual cycle of harm to readiness.²²⁷ In the case of the USS *Eisenhower*, its 2013 maintenance availability was scheduled to last for 14 months. A 250-percent increase in repair requirements, caused by the ship’s poor material condition, resulted in the maintenance availability extending to more than 23 months. This forced the USS *Harry S. Truman* to complete USS *Eisenhower*’s planned deployment, increasing the *Truman*’s operational tempo.²²⁸

Recognizing the continuous cycle by which maintenance delays and increases in operational tempo spawned one another, Navy leaders abandoned their existing force allocation process in 2014 in favor an Optimized Fleet Response Plan (OFRP). OFRP’s predecessor, the Fleet Response Plan, was rarely executed “as designed due to operational considerations and real-world events,” according to Admirals Bill Gortney and Harry Harris, who headed the Navy’s Fleet Forces Command and Pacific Fleet respectively.²²⁹ In response, the OFRP was intended to “instill predictable operational schedules conducive to ensuring ships are able to adequately address their training and maintenance requirements.”²³⁰ The OFRP aligned the readiness cycles of aircraft carriers and their support ships, extending both to a periodicity of 36 months. By lengthening support ship readiness cycles by nine months, the Navy was able to simultaneously reduce the total proportion of time a ship spends deployed while also increasing the

²²⁷ Pendleton, *Military Readiness*, 13.

²²⁸ Pendleton, *Military Readiness*, 16. Extended maintenance availabilities also result in significant cost overruns. From 2009 to 2017, the actual amount spent out of the Navy’s ship maintenance account exceeded original requests by a total \$4.63 billion. See also: Bayer and Roughead, 60.

²²⁹ Gortney and Harris.

²³⁰ Pendleton, *Navy Force Structure*, 34.

ship's "employability" by 25 percent.²³¹ Leadership planned to introduce the OFRP starting with the USS *Harry S. Truman* CSG in 2014 and continue with remaining strike groups on a rolling basis through 2019.²³²

Forward Deployed Naval Forces

Implementing the OFRP as intended requires an inventory of active warships to execute rotational forward presence. This means that for every ship deployed overseas, four or five additional ships must be executing non-deployment phases of the OFRP to prepare for their own deployment phase.²³³ In an environment characterized by insufficient fleet size, military leadership sought alternative methods to maintain forward presence. To compensate for its shortage of available hulls, from 2006 to 2017, the Navy more than doubled the number of ships that it homeported overseas, from 20 to 41. These so-called "Forward Deployed Naval Forces" (FDNF) comprised 13.9 percent of the total U.S. fleet by 2017 and were intended to maximize forward presence of naval units at minimal operational cost.²³⁴ In 2015, however, the GAO reported that:

Homeporting a ship overseas saves transit time to and from an area of operations and allows it to be in this area longer. However, our analysis shows that the primary reason for the greater number of deployed underway days provided by overseas-homeported ships results from the Navy's decision to truncate training

²³¹ Pendleton, *Military Readiness*, 12. Under the OFRP's predecessor – the Fleet Response Plan (FRP) – aircraft carrier readiness cycles lasted 32 months, while surface combatant cycles were planned for 27 months. "Employability" refers to the amount of time a ship spends in a "deployed" or "sustainment" phase of OFRP and is able to respond rapidly to national tasking.

²³² Gortney and Harris. As discussed previously, USS *Dwight D. Eisenhower*'s maintenance delays resulted in the USS *Harry S. Truman* executing the *Eisenhower*'s operational tasking in 2014. As a result, USS *Harry S. Truman* was unable to transition to OFRP as scheduled, delaying OFRP's rollout, and making USS *Dwight D. Eisenhower* the first strike group to execute the new readiness cycle.

²³³ Bayer and Roughead, 20.

²³⁴ Pendleton, *Navy Force Structure*, 6.

and maintenance periods of these ships in order to maximize their operational availability. ... Since the ships are in permanent deployment status during their time homeported overseas, they do not have designated ramp-up or ramp-down maintenance and training periods built into their operational schedules.²³⁵

In other words, the OFRP structure, which was designed to ensure requisite time is allocated for maintenance and training, does not apply to the Forward Deployed Naval Forces. This creates a scenario in which the Navy's 41 FDNF ships carry an operational workload disproportionate to the rest of the fleet, with less time to recover readiness levels between operations. In fact, the Commander of Fleet Forces recalled in 2017 that FDNF ships, "particularly in Japan, are employed to support operational commitments nearly every day."²³⁶

According to the *Comprehensive Review of Surface Force Incidents*, which examined the 2017 at-sea mishaps, "since 2015, operational requirements for the Western Pacific have increased dramatically."²³⁷ This uptick in support demands from operational commanders, coupled with an interpretation that "every task was a priority," resulted in a nearly 40 percent increase in the time Japan-based cruisers and destroyers spent at sea from 2015 to 2016 alone – a rise from an average 116 days to 162 days.²³⁸ FDNF tasking grew so severe that one ballistic missile defense ship spent 235 days at sea in 2016 and at least another 231 underway in 2017.²³⁹ Predictably, this level of operational tempo had adverse consequences for the readiness of FDNF ships.

²³⁵ Pendleton, *Navy Force Structure*, 14.

²³⁶ Davidson, 68.

²³⁷ Davidson, 69.

²³⁸ Davidson, 68.

²³⁹ Bayer and Roughead, 22.

While OFRP called for U.S.-based ships to spend seven of every 36 months in a deployed status,²⁴⁰ their FDNF counterparts were expected to spend up to two-thirds of every year at sea.²⁴¹ The “bruising tempo of operations in the Japan-based 7th Fleet”²⁴² led to the percentage of its ships’ expired training certifications more than quadrupling, from six percent to nearly 40 percent, between 2015 and 2017.²⁴³ A 2015 GAO investigation found that, of those expired certifications, more than 75 percent had been expired for more than five months.²⁴⁴ Former CNO, Admiral Gary Roughead, explained how, “in an environment where this ‘normalization-of-deviation’ has taken hold, ships and their crews perceive the certification process as merely a burden to their success, rather than the key to achieving individual, ship, and fleet readiness.”²⁴⁵ This

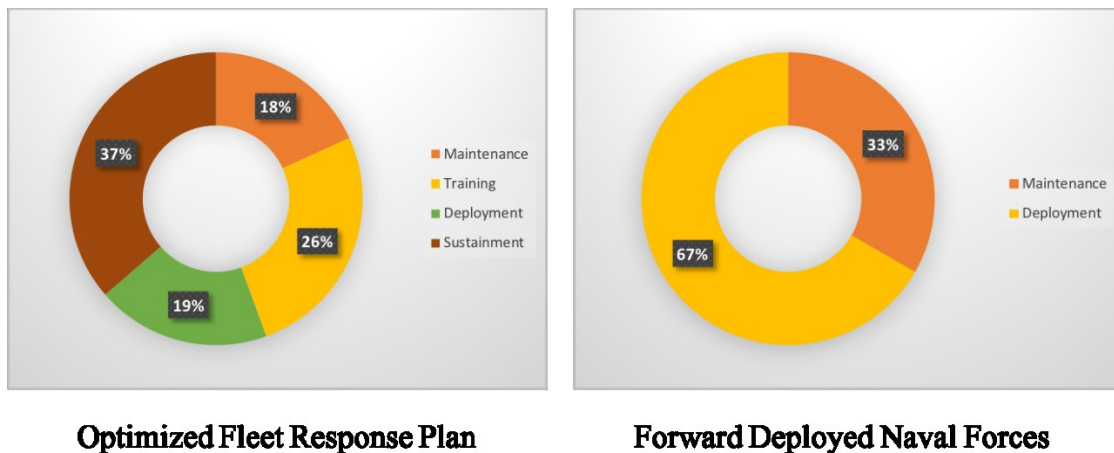


Figure 4: OFRP and FDNF Readiness Cycles

²⁴⁰ Pendleton, *Military Readiness*, 12.

²⁴¹ Pendleton, *Navy Force Structure*, 16.

²⁴² Geoff Ziezulewicz, “Worse Than You Thought: Inside the Secret Fitzgerald Probe the Navy Doesn’t Want You to Read,” *Navy Times*, January 13, 2019, <https://www.navytimes.com/news/your-navy/2019/01/14/worse-than-you-thought-inside-the-secret-fitzgerald-probe-the-navy-doesnt-want-you-to-read/>

²⁴³ Bayer and Roughead, 22.

²⁴⁴ Pendleton, *Navy Force Structure*, 25.

²⁴⁵ Bayer and Roughead, 23.

normalization of deviance – knowingly dispatching unready forces to execute operational tasking – ultimately resulted in Vaughan’s “mistake resulting in mishap and ... disaster.”²⁴⁶

The Consequences of Unsustainable Operational Tempo

According to congressional leaders, “it has become life-threatening to keep the necessary ships at sea without compromising maintenance, training and readiness certifications.”²⁴⁷ Empirical evidence suggested that these claims were more than mere political rhetoric or hyperbole. Shortly after 1:30 a.m. on June 17, 2017, an Arleigh Burke-class guided missile destroyer, the USS *Fitzgerald*, collided with a commercial shipping vessel more than three-times its own size. Seven sailors were unable to escape from rapidly flooding areas of the ship. All seven drowned. It was the Navy’s worst at-sea mishap in forty years.²⁴⁸ Following the accident, multiple investigations were initiated to identify the causes of the tragedy. The results of those investigations depicted an exhausted Navy, crippled by excessive operational tempo, unable to complete required maintenance and training, and ignored by senior leadership who continued to demand that the fleet “do more with less.”

Extensive investigative reporting by *Propublica* uncovered the USS *Fitzgerald*’s challenging state of readiness at the time of its crash. Calling the crew “exhausted and undertrained,” their published findings showed that the ship was undermanned, with only about 270 of the 303 required personnel onboard. As a result, those sailors the ship did have were overworked and routinely facing 100-hour work weeks. At the time of the

²⁴⁶ Vaughan, *The Challenger Launch Decision*, 410.

²⁴⁷ Wicker and Hendrix, 76.

²⁴⁸ Miller, Rose, and Faturechi.

collision, the officer of the deck – the person in charge of directing all the ship’s activity – had been working for nearly 22 hours with only one hour of rest prior to taking over the bridge. Her deputy, the junior officer of the deck, had also slept for only one hour that day. The conning officer – the individual responsible for steering the nearly nine-thousand ton warship – had been working for 19 hours straight.²⁴⁹ Crew members were so fatigued that the official U.S. Navy report on the collision noted that, after sleeping through the violent initial impact of the crash, “at least one Sailor had to be pulled from his [bed] and into the water before he woke up.”²⁵⁰

With a schedule as grueling as USS *Fitzgerald*’s, operational requirements often precluded completion of planned training, leaving the ship’s crew unprepared to meet the demands of its tasking. Of the 22 certifications required for destroyers to demonstrate mission readiness prior to deploying, USS *Fitzgerald* had passed only seven.²⁵¹ The ship was not even certified in its primary warfare area, ballistic missile defense.²⁵² Commander Bryce Benson – USS *Fitzgerald*’s commanding officer at the time of the crash – explained in a letter to SECNAV that “all of our training and certification exercises for the foreseeable future had been postponed for operational tasks... This was no anomaly. Other ships were, if not as extreme as our case, facing the same situation.”²⁵³

²⁴⁹ Miller, Rose, and Faturechi.

²⁵⁰ United States Navy, *Report on the Collision between USS FITZGERALD (DDG 62) and Motor Vehicle ACX CRYSTAL* (Washington, D.C.: Office of the Chief of Naval Operations, 2017), 14.

²⁵¹ Bryce Benson, Letter in Rebuttal to Secretarial Letter of Censure, April 26, 2019, 13. Available from the U.S. Naval Institute at <https://news.usni.org/2019/04/26/former-uss-fitzgerald-co-outlines-defense-in-rebuttal-to-secnav>

²⁵² Miller, Rose, and Faturechi.

²⁵³ Benson, 15.

Although demonstrably unprepared to sail, “Seventh Fleet commanders deployed the Fitzgerald like a pinch hitter, repeatedly assigning it new missions to complete.”²⁵⁴ The overworked crew had little at-sea experience to compensate for its lack of training. In the eight months leading up to the crash, just under 40 percent of the crew had been reassigned – the highest turnover rate of any destroyer in the Navy at that time.²⁵⁵ The ship itself had also been worked into a state of material fatigue. Although USS *Fitzgerald* had recently finished an eight-month period of maintenance in its homeport of Yokosuka, Japan, “hundreds of repairs, major and minor, remained to be done.”²⁵⁶ USS *Fitzgerald* “skipped or shortened four planned maintenance periods during the spring of 2017, due to the Navy constantly issuing orders for new missions.”²⁵⁷

According to Benson, “our pace of operations on 16 June was arduous: this was the expectation of a SEVENTH Fleet destroyer.”²⁵⁸ Multiple government investigations concluded that the readiness challenges faced by the USS *Fitzgerald* and its crew permeated the bulk of the Japan-based FDNF fleet. While on June 17, the USS *Fitzgerald* mishap became the Navy’s worst in four decades, “barely two months later, it happened again.”²⁵⁹ On August 21, 2017, facing similar operational tempo, training, and maintenance challenges, the USS *John S. McCain* – also homeported in Japan – collided with an oil tanker in the Straits of Singapore. The crash killed ten more sailors and

²⁵⁴ Miller, Rose, and Faturechi.

²⁵⁵ Miller, Rose, and Faturechi. See also: Benson, 14.

²⁵⁶ Miller, Rose, and Faturechi.

²⁵⁷ Miller, Rose, and Faturechi.

²⁵⁸ Benson, 9.

²⁵⁹ Faturechi, Rose, and Miller.

provided further evidence that Vaughn’s normalization of deviance carries a heavy cost.²⁶⁰

Normalization of Deviance in the U.S. Navy

The Navy’s 2017 *Strategic Readiness Review* determined that “four recent accidents involving U.S. Navy warships are the direct consequences of eroded readiness and are a leading indicator of unsustainable operations.”²⁶¹ That these findings concluded the mishaps were leading, rather than lagging, indicators of unsustainable operations is itself indicative of a deeply-rooted normalization of deviance among Navy leadership. The report went on to explain that “accepting deficiencies in readiness, rather than a decreased Navy presence worldwide, normalizes a lower standard for our forces on the front lines. Indeed, provisions exist to purposefully and thoughtfully waive certifications and accept shortcomings in training and maintenance to respond to emergent demands when the supply is inadequate.”²⁶² The Navy established a Readiness Reform and Oversight Council in January 2018. The group’s charter said the following about the Navy’s readiness challenges: “budgetary pressures, decreasing combatant inventories, and a rising operational tempo over decades led to a gradual acceptance of lower readiness standards, until they became the *new normal*.”²⁶³ Bayer and Roughead further alleged that “the Navy has a culture that currently prioritizes immediate mission accomplishment over long-term sustainable readiness.”²⁶⁴

²⁶⁰ United States Navy, *Report on the Collision between USS JOHN S. MCCAIN (DDG 56) and Motor Vessel ALNIC MC* (Washington, D.C.: Office of the Chief of Naval Operations, 2017), 43.

²⁶¹ Bayer and Roughead, 16.

²⁶² Bayer and Roughead, 21.

²⁶³ Thomas Modly, *Charter for the Readiness Reform and Oversight Council* (Washington, D.C.: Department of the Navy, 2018), 1. Emphasis added.

²⁶⁴ Bayer and Roughead, 73.

Recalling the theory advocated by Diane Vaughan in response to the *Challenger* space shuttle disaster, normalization of deviance is a “long-term phenomenon in which a lower standard of safety is accepted until that lower standard becomes accepted as the norm.”²⁶⁵ Prielipp, et al., added that “normalization of deviance breaks the safety culture ... accepting more and more risk, always in the interest of efficiency and on-time schedules.”²⁶⁶ A multitude of government reports and investigations concurred that meeting forward presence demands of combatant commanders – i.e.: “on-time schedules” – underpinned Navy leadership’s perceived need to deploy unready ships overseas. “By routinely employing forces that do not meet full readiness standards, leadership marginalized the standard, and in turn degraded the training and certification process, resulting in increased risk to the FDNF-Japan surface force.”²⁶⁷ Although the DoD told the GAO that it was “‘well aware of the risks’ and accepted them as the cost of increasing its presence in the region,”²⁶⁸ some senior military officials disagreed. Former Under Secretary of the Navy Janine Davidson painted a different picture – one of leadership “sleepwalking into a level of risk you don’t realize you have.”²⁶⁹

Even after the Seventh Fleet collisions, former SECNAV Ray Mabus claimed of the mishaps that “both of them were failures on those ships” and called their close timing “a coincidence.”²⁷⁰ His clouded view of the mishaps validated Ortmann’s belief that normalization of deviance is “difficult to perceive.”²⁷¹ The evidence presented in this thesis refutes Mabus’s claims. While official reports on the crashes identify certain

²⁶⁵ Caudill, 47.

²⁶⁶ Prielipp, et al., 1499.

²⁶⁷ Davidson, 102.

²⁶⁸ Faturechi, Rose, and Miller.

²⁶⁹ Faturechi, Rose, and Miller.

²⁷⁰ Faturechi, Rose, and Miller.

²⁷¹ Ortmann, 205.

mistakes and failures on the part of the ships' crews, further investigation shows that the ships' readiness deficiencies had been repeatedly communicated to the Navy's most senior decision makers – in some cases communicated by the Commander of the Seventh Fleet, himself – and were ignored.²⁷² The ships were knowingly sent to sea unready.

The academic literature emphasizes that a lack of adverse consequences reinforces the belief that deviation from standards can be accepted.²⁷³ In the Seventh Fleet, “up to the point of the mishaps, the ships had been performing operationally with good outcomes, which ultimately reinforced the rightness of trusting past decisions.”²⁷⁴ Among the decisions trusted was the one to knowingly exclude FDNF ships from the OFRP process, marginalizing the effectiveness of the very system designed to ensure force readiness. As noted by the American Institute of Chemical Engineers, “management systems are only effective when they are followed. Strict adherence should be expected and required.”²⁷⁵ In his 2019 letter to SECNAV, Commander Benson specifically complained of “the absence of an Optimized Fleet Response Plan with risk-mitigated readiness schedules for overseas-homeported ships, such as the one the Government Accountability Office called for in 2015 with U.S. Pacific Fleet concurrence.”²⁷⁶ Yet, at the same time that the GAO and other agencies were highlighting the risk associated with excluding FDNF from the OFRP process, the Navy, failing to perceive the increasing risk to its forces, continued to grow the size of its FDNF fleet. This decision, coupled with Secretary Mabus's claims that “both of [the deadly

²⁷² Miller, Rose, and Faturechi

²⁷³ Panger, 8.

²⁷⁴ Davidson, 8.

²⁷⁵ Center for Chemical Process Safety, 35.

²⁷⁶ Benson, 17.

collisions involving USS *Fitzgerald* and USS *John S. McCain*] were failures on those ships” and that their close timing was “a coincidence,”²⁷⁷ indicates that even catastrophic incidents may be insufficient to fully “de-normalize” deviance.

Conclusion

Based upon the 1996 determination by the Center for Naval Analyses that “there is no guarantee that the next hollow force will look like the last one,”²⁷⁸ the research presented here sought to identify whether operational tempo functioned as a force-hollowing actor during the early- and mid-2010s. An examination of available data showed that the military readiness of the U.S. Navy was measurably damaged by an excessive operational tempo during those years.²⁷⁹ This tempo grew unsustainable as a result of a shrinking supply of combatant ships continuing to maintain the same forward presence sustained in prior decades by a fleet twice as large. The belief that a smaller naval force could continue to do more with less resulted from a normalization of deviance culture which permeated Navy leadership until four at-sea mishaps brought the problematic culture to light in 2017. Recalling Richard Betts’s theory that “a conception of readiness that is relevant to total military capability and strategy over the long haul involves many factors, many of which *conflict with and damage each other*,”²⁸⁰ predicting whether a specific operational tempo will improve readiness – or lead to mistake, mishap, and disaster²⁸¹ – may not be possible. With that said, the cautionary signs of deteriorating readiness were clear. Ship maintenance was routinely delayed or

²⁷⁷ Faturechi, Rose, and Miller.

²⁷⁸ Robinson et al., 16.

²⁷⁹ While this paper does not allege that excessive operational tempo was absent from the post-Vietnam “hollow force,” it does observe that such a criterion is absent from the CNA’s assessment of that historical period.

²⁸⁰ Betts, 32. Emphasis in original.

²⁸¹ Vaughan, *The Challenger Launch Decision*, 410.

canceled, training certifications expired in droves, and ships were undermanned.

Moreover, some senior military and civilian officials provided unambiguous warning that the demands placed on the Navy had grown untenable – especially in the Forward Deployed Naval Forces. That these warnings were ignored validates accusations of normalized deviance in Navy culture and requires decisive action in order to restore naval readiness in the interest of the national defense.

Chapter Three

The Effects of Global Climate Change on Naval Readiness

Introduction

The naval readiness challenges caused by global climate change received considerable attention and study in the early- and mid-2010s. The effects of climate change not only threaten environmental catastrophes, they induce and exacerbate the myriad security challenges facing states in areas including economic policy, public health, infrastructure, and national and international security, making climate change “the mother of all security problems.”²⁸² Though climate change did create episodic readiness difficulties during the 2010-2017 timeframe, it did not have a chronic “hollowing” effect on the Navy in the same ways as did the indicators accepted in chapters one and two of this thesis. The research suggests, however, that more significant and enduring threats to readiness will be caused by climate change in future years.

Every four years the Department of Defense publishes the government’s national defense policy in the Quadrennial Defense Review.²⁸³ In 2010, the QDR acknowledged for the first time that global climate change posed strategic and readiness concerns for U.S. military forces “in two broad ways. First, climate change will shape the operating environment, roles, and missions that we undertake. ... Second, DoD will need to adjust to the impacts of climate change on our facilities and military capabilities.”²⁸⁴ Using the 2010 QDR categories of infrastructure and missions, this study explores the impact that

²⁸² Oli Brown, Anne Hammill, and Robert McLeman, “Climate Change as the ‘New’ Security Threat: Implications for Africa,” *International Affairs* vol. 83, no. 6 (2007): 1142.

²⁸³ The Quadrennial Defense Review was replaced by a new document, the National Defense Strategy, in 2018.

²⁸⁴ Department of Defense, *Quadrennial Defense Review* (Washington D.C.: Department of Defense, 2010), 84-85.

climate change has on naval readiness with a focus on shifts in operational requirements and threats to naval installations and infrastructure. First, the Navy's ability to operate in unfamiliar geographic theaters, specifically the Arctic, is examined. Then, the competition between traditional military operations and humanitarian assistance and disaster relief missions is considered in naval context. Finally, the impacts on naval infrastructure are illustrated through careful consideration of climate change's projected effects at the world's largest naval base – Naval Station Norfolk, Virginia.

Literature Review

The Science of Climate Change

Prior to placing global climate change into a national security and military readiness context, a modest, but sufficient, understanding of the basic scientific concepts underlying this research is required. Assuming no near-term shifts in global carbon emissions, average annual temperature increases in the United States of 4-6°F are expected by 2050, growing to 7-11°F by 2090.²⁸⁵ The Union of Concerned Scientists explained that “as global temperatures increase, land-based ice melts into the oceans, and seawater expands as it absorbs more heat from the warming atmosphere. [As a result,] global sea level has risen about eight inches since 1880.”²⁸⁶ The CNA's Military Advisory Board – a collection of 16 retired military admirals and generals²⁸⁷ – emphasized that “most of that rise [has] occur[ed] since 1980,” creating considerable

²⁸⁵ T.C. Gallaudet and C.C. St. John, “The U.S. Navy's Approach to Climate Change and Sea Level Rise,” in *Climate: Global Change and Local Adaptation*, edited by I. Linkov and T.S. Bridges (New York: Springer, 2011), 298.

²⁸⁶ Union of Concerned Scientists, “The U.S. Military on the Front Lines of Rising Seas: Growing Exposure to Coastal Flooding and East and Gulf Coast Military Bases,” *Union of Concerned Scientists*, July 27, 2016, <https://www.ucsusa.org/resources/us-military-front-lines-rising-seas>

²⁸⁷ The Board consisted of 11 members at the time of its original 2007 report. Its membership expanded to 16 when it issued its follow-on report in 2014.

implications for storm surge and other effects of extreme weather.²⁸⁸ As a result, Espach, Zvijac, and Riladelfo explained that “in future decades, climate change will reduce freshwater, dry soils, melt glaciers and ice shelves, and intensify flooding, droughts, and storms in many regions of the world.”²⁸⁹ Britain’s chief government scientist, Sir David King, claimed that the impacts of climate change on physical geography could grow so severe that “the maps of the world will have to be redrawn.”²⁹⁰ For the purpose of this thesis, climate change will be understood in the context of a 2016 White House definition which referred to “changes in average temperature of the atmosphere or ocean; changes in regional precipitation, winds, and cloudiness, and changes in the severity and duration of extreme weather, including droughts, floods, and storms” over multiple decades.²⁹¹

Climate Change and National Security

In a 2016 *Memorandum on Climate Change and National Security* addressed to senior government officials, then-President Barack Obama assessed that climate change and associated impacts on U.S. military and other national security-related missions and operations could adversely affect readiness, negatively affect military facilities and training, increase demands for Federal support to non-federal civil-authorities, and increase response requirements to support international stability and humanitarian assistance needs.²⁹²

²⁸⁸ Military Advisory Board, *National Security and the Accelerating Risks of Climate Change* (Alexandria: Center for Naval Analyses, 2014), 9.

²⁸⁹ Ralph Espach, David Zvijac, and Ronald Filadelfo, “Impact of Climate Change on U.S. Military Operations in the Western Pacific,” *Marine Corps University Journal* vol. 7 (2016): 89.

²⁹⁰ Tiffany Duong, “When Islands Drown: The Plight of Climate Change Refugees and Recourse to International Human Rights Law,” *University of Pennsylvania Journal of International Law* vol. 31, no. 1239 (2010): 1242.

²⁹¹ Barack Obama, *Memorandum of Climate Change and National Security* (Washington, D.C.: The White House, 2016), 6.

²⁹² Obama, 1.

The President's determination is supported by a voluminous academic and professional literature which identified wide-ranging impacts of global climate change on national security and military readiness. In 2007, the CNA's Military Advisory Board delivered the first major report which definitively stated that "projected climate change poses a serious threat to America's national security."²⁹³ They assessed that climate change "has the potential to create sustained natural and humanitarian disasters on a scale far beyond what we see today," making climate change a "threat multiplier" which exacerbates existing security challenges and has the potential to create new tensions, "even in stable regions of the world."²⁹⁴

The Harvard Business Review put the CNA's research into a naval context in 2017 with an incisive summary of the relationship between climate change and Navy readiness.

The United States Navy operates on the front lines of climate change. It manages tens of billions of dollars of assets on every continent and on every ocean. Those assets – ships, submarines, aircraft, naval bases, and the technology that links everything together – take many years to design and build and then have decades of useful life. This means that the Navy needs to understand now what sorts of missions it may be required to perform in 10, 20, or 30 years and what assets and infrastructure it will need to carry out those missions. Put another way, it needs to plan for the world that will exist at that time.²⁹⁵

²⁹³ Military Advisory Board, *National Security and the Threat of Climate Change* (Alexandria: Center for Naval Analyses, 2007), 44.

²⁹⁴ Military Advisory Board, *National Security and the Threat of Climate Change*, 6-7.

²⁹⁵ Forest Reinhardt and Michael Toffel, "Managing Climate Change: Lessons from the U.S. Navy," *Harvard Business Review* vol. 95, no. 4 (July/August 2017): 104.

Reinhardt and Toffel added that “as the world’s climate changes, the navy must address both an increased demand for its military and humanitarian services and an impaired capacity to deliver those services as risk of damage to ports and bases increases.”²⁹⁶ This assessment mirrored that of the 2010 QDR, in that it determined that climate change’s effects on naval readiness generally fit into the two major categories of impacts to naval missions and impacts to naval installations.

Impact of Climate Change on Naval Missions

Scholars have suggested that climate change impacts naval missions in two key ways. First, it requires the Navy to execute more frequent operations in response to natural disasters both domestically and internationally. Second, it opens new areas of strategic competition where the Navy will be required to protect U.S. interests, most demonstrably in the Arctic. Joshua Busby at the Council on Foreign Relations explained that “a tenth of the world’s population – 634 million people – live in coastal areas that lie between zero and ten meters above sea level.”²⁹⁷ Of those 634 million, 160 million of them live less than 1 meter above sea level.²⁹⁸ The dangers posed to this population by the effects of climate change will increase the frequency of foreign requests for humanitarian assistance and disaster relief efforts, adding further strain on available naval forces. Larissa Forster observed that the Navy’s 2007 strategy document added HADR to the service’s list of core mission sets. “While in prior years, these tasks were treated as

²⁹⁶ Reinhardt and Toffel, 104.

²⁹⁷ Joshua Busby, *Climate Change and National Security: An Agenda for Action* (Washington, D.C.: Council on Foreign Relations, 2007): 8.

²⁹⁸ Gallaudet and St. John, 301.

an ‘extra,’ they now have been promoted to being equally as important as the four traditional naval missions of sea control, presence, deterrence, and power projection.”²⁹⁹

Due to the destruction of local infrastructure, lack of accessibility, and loss of life, local governments and nongovernmental organizations often struggle to effectively respond to disasters in their immediate aftermath. Forster claimed that “no other organization can deliver large-scale logistical capabilities and relief assets so rapidly” as can the U.S. Navy.³⁰⁰ Apte and Yoho added that the Navy “is only one of the major relief providers responding to disasters around the world... However, it brings specialized capabilities in response to disasters that few other organizations can provide.”³⁰¹ Based upon its historic willingness to dispatch military forces for disaster relief, “after a large natural disaster or war, the global community expects US support and aid.”³⁰² As a result, from 1979 to 2000 the U.S. Navy diverted its ships from operational tasking 366 times to conduct HADR missions.³⁰³ Busby predicted that “the United States will be pressured to deploy military forces or at least provide lift and logistic support for large-scale humanitarian emergencies” as they become more common in the future.³⁰⁴ While they likely offer “soft power” strategic opportunities in the long term, HADR missions are equally likely to present readiness challenges for naval forces in the near term. Readiness challenges will also arise from emerging requirements to conduct HADR and other operations in unfamiliar and unforgiving geographic areas.

²⁹⁹ Larissa Forster, “The Soft Power Currencies of US Navy Hospital Ship Missions,” *International Studies Perspectives* vol. 16 (2013): 367.

³⁰⁰ Forster, 371.

³⁰¹ Aruna Apte and Keenan Yoho, “Reacting to Crisis: The Costs of First Response by the United States Navy,” *Journal of Homeland Security and Emergency Management* vol. 14, no. 1 (2017): 11.

³⁰² Forster, 375.

³⁰³ Aruna Apte and Keena Yoho, *United States Navy Humanitarian Assistance and Disaster Relief (HADR) Costs: A Preliminary Study* (Monterey: Naval Postgraduate School, 2015), 1.

³⁰⁴ Busby, 9.

Reinhardt and Toffel remarked that “just as climate change alters the mix of services needed to meet evolving demands, it modifies the geography and distance over which those services will have to be delivered.”³⁰⁵ Briggs concurred that “environmental changes can also shift where operations are likely to occur.”³⁰⁶ The 2010 QDR placed this challenge into focus and determined that “the effect of changing climate on the Department’s operating environment is evident in the maritime commons of the Arctic.”³⁰⁷ Margaret Blunden claimed that “climate change, proceeding at a much higher rate in the Arctic than in the rest of the world, and the retreating ice cap, are giving [the Arctic] a new strategic importance.”³⁰⁸ Former DoD official Jeffrey Marqusee noted in a 2016 interview that when “the Navy began to see the rapid decrease of ice coverage in the summer; senior people began to understand that they will have a new ocean, the Arctic, to defend.”³⁰⁹

Given Gallaudet and St. John’s claim that “the Arctic is warming twice as fast as the rest of the globe,”³¹⁰ the Military Advisory Board warned of an “essentially ice-free Arctic summer occurring for the first time, between 2021 and 2043.”³¹¹ Busby explained that this condition will “open up the Northern Sea Route (north of Russia) and the Northwest Passage (through the Canadian archipelago) to shipping, at least for parts of the year.”³¹² According to Admiral Frank Bowman, however, “the United States, in

³⁰⁵ Reinhardt and Toffel, 107.

³⁰⁶ Chad M. Briggs, “Environmental Change, Strategic Foresight, and Impacts on Military Power,” *Parameters* vol. 40, no. 3 (Autumn 2010): 7.

³⁰⁷ Department of Defense, *Quadrennial Defense Review*, 86.

³⁰⁸ Margaret Blunden, “The New Problem of Arctic Stability,” *Survival* vol. 51, no. 5 (October/November 2009): 122.

³⁰⁹ Jeffrey Marqusee, “Department of Climate Defense,” *Dissent* vol. 63, no. 2 (Spring 2016): 58.

³¹⁰ Gallaudet and St. John, 294.

³¹¹ Military Advisory Board, *National Security and the Accelerating Risks of Climate Change*, 9.

³¹² Busby, 7.

particular the Navy and Coast Guard, is woefully ill prepared to execute anticipated plethora of mission requirements in the Arctic.”³¹³ Patricia Kime similarly assessed that the Navy’s warfighting capacity – both in terms of useful naval installations and ships capable of operating safely and effectively in the Arctic – is insufficient to meet the expected operational requirements of the coming decades.³¹⁴ This lack of readiness resulted from the Navy’s strategic shift away from Arctic operations following the collapse of the Soviet Union. This shift allowed the Navy’s Arctic capability to degrade “to the point that there is no infrastructure to support it.”³¹⁵ Such infrastructure-related challenges also extend beyond the Arctic.

Impact of Climate Change on Naval Infrastructure

The second key means by which climate change impacts naval readiness is through its effects on naval infrastructure. A January 2018 report from the DoD reminded decisionmakers that “our warfighters require bases from which to deploy, on which to train, or to live when they are not deployed. If extreme weather makes our critical facilities unusable or necessitate costly or manpower-intensive work-arounds, that is an unacceptable impact” of climate change.³¹⁶ Scott and Khan surmised that “perhaps the most direct and obvious significance of climate change for the military is its impact on military infrastructure.”³¹⁷ The Environmental and Energy Study Institute reported that the DoD maintains an expansive real estate portfolio encompassing more than

³¹³ Military Advisory Board, *National Security and the Accelerating Risks of Climate Change*, 18.

³¹⁴ Patricia Kime, “The Climate Challenge,” *Seapower* vol. 53, no. 5 (May 2010): 58.

³¹⁵ National Research Council, *National Security Implications of Climate Change for U.S. Naval Forces* (Washington, D.C.: The National Academies Press, 2011), 110.

³¹⁶ Department of Defense, *Climate-Related Risk to DoD Infrastructure Initial Vulnerability Assessment Survey Report* (Washington, D.C.: Department of Defense, 2018), 7.

³¹⁷ Shirley Scott and Shahedul Khan, “The Implications of Climate Change for the Military and for Conflict Prevention, Including through Peace Missions,” *ASPJ Africa & Francophonie* vol. 7, no. 3 (Third Quarter 2016): 83.

560,000 buildings on 4,800 bases and installations worldwide³¹⁸ and valued at approximately \$1.2 trillion.³¹⁹ Gallaudet and St. John pointed out that “the Navy in particular locates the majority of its installations along coasts that will be increasingly vulnerable to the impacts of extreme events and sea level rise.”³²⁰ The National Research Council explained in 2011 that “these installations are enduring facilities, predominately in the coastal zone, that have been built to last for decades. All were constructed before climate change was recognized as a factor in their design and construction.”³²¹ Briggs warned that “even marginal rises in sea levels combined with storm surges and coastal erosion can put areas several meters above normal sea level at risk.”³²² Another study remarked that “given their central role in national security, such installations have historically been well protected. But sea level rise, increased tidal flooding, and heightened storm surges do not stop for checkpoints.”³²³ Reinhardt and Toffel valued the replacement cost of the Navy’s 111,000 buildings – situated on 2.2 million acres – at \$220 billion.³²⁴

Beyond just the potential economic damage, major readiness challenges are posed when destructive weather events and rising sea levels preclude military installations from fulfilling their roles as support entities for the Navy’s operational units – ships, submarines, aviation squadrons, etc. The 2010 QDR warned that “DoD’s operational

³¹⁸ Environmental and Energy Study Institute, *The National Security Impacts of Climate Change* (Washington, D.C.: Environmental and Energy Study Institute, 2017), 2.

³¹⁹ Eric Roston, “Major Military Bases Unprepared for Climate Change, U.S. Watchdog Finds,” *Bloomberg*, June 13, 2019, <https://www.bloomberg.com/news/articles/2019-06-13/major-military-bases-unprepared-for-climate-change-u-s-watchdog-finds>

³²⁰ Gallaudet and St. John, 300.

³²¹ National Research Council, 73.

³²² Briggs, 8.

³²³ Union of Concerned Scientists.

³²⁴ Reinhardt and Toffel, 108.

readiness hinges on continued access to land, air, and sea training and test space.”³²⁵ The Military Advisory Board added that “the impacts of climate change may undermine the capacity of our domestic installations to support training activities.”³²⁶ Arija Flowers assessed in 2011 that “more hurricanes of higher intensity means military equipment and personnel must be moved out of harm’s way, adding expense and wear and tear, reducing general readiness, and interrupting training operations.”³²⁷ Severe storms can make bases unusable for extended periods and, in extreme cases, entire installations can be lost. “In 1992, Hurricane Andrew did such damage to Homestead Air Force Base in Miami that it never reopened. In 2004, damage from Hurricane Ivan kept Pensacola Naval Air Station closed for almost a year.”³²⁸ With threats demonstrably capable of reaching existential levels for some installations, the damage caused to military bases by more frequent and more severe storms “can cripple the military’s ability to respond to a crisis.”³²⁹

Methodology

Anticipating future threats to naval readiness is more difficult than assessing the presence or absence of existing force-hollowing indicators. Accordingly, the research discussed in this chapter relies upon projections and predictive modeling conducted by the scientific, engineering, governmental, and military communities and explores the relationship between climate change and naval readiness through examination of certain case studies. The case studies utilized are chosen not because they represent the only readiness challenges caused by climate change, but rather because they are assessed as its

³²⁵ Department of Defense, *Quadrennial Defense Review*, 85.

³²⁶ Military Advisory Board, *National Security and the Accelerating Risks of Climate Change*, 23.

³²⁷ Arija Flowers, “National Security in the 21st Century: How the National Security Council Can Solve the President’s Climate Change Problem,” *Sustainable Development Law & Policy* vol. 11, no. 2 (Winter 2011): 51.

³²⁸ Busby, 6.

³²⁹ Environmental and Energy Study Institute, 6.

most significant and likely effects. Specifically, Arctic naval operations and humanitarian assistance missions are examined because these are assessed as the most likely areas in which naval missions will be directly impacted by climate change. Pertaining to infrastructure, Naval Station Norfolk, Virginia is examined because it is both the world's largest naval base and also one of the Navy's most at-risk installations relative to climate change impacts. With that said, myriad additional readiness challenges are posed by climate change, some of which are alluded to periodically throughout this chapter and others of which warrant additional future research.

Climate Change Impacts on Naval Missions

Return of Naval Operations in the Arctic

Joane Nagel at the University of Kansas believes that “it turns out climate change as a security problem is good news for the continued relevance of the U.S. military.”³³⁰ While perhaps somewhat cynical, her assessment is accurate, especially in light of the Arctic's reemergence as a strategic area of operations after more than 20 years of receiving little attention.³³¹ In 2009, the Navy published its *Arctic Roadmap*. Though the document laid out the Navy's anticipated Arctic strategy through 2030, it had to be updated a mere five years later in 2014. When asked by reporters about what prompted the revision, Secretary of the Navy Richard Spencer said, referring to the Arctic, “the damn thing melted.”³³² Empirical data suggests that Arctic temperatures are rising at double the rate of the rest of the globe.³³³ Already, minimum sea ice levels have been

³³⁰ Joane Nagel, “Climate Change, Public Opinion, and the Military Security Complex,” *The Sociological Quarterly* vol. 52 (2011): 206.

³³¹ Mika Raunu and Rory Berke, “Preparing for Arctic Naval Operations,” *U.S. Naval Institute Proceedings* vol. 144, no. 12 (December 2018): 70.

³³² Eckstein.

³³³ Gallaudet and St. John, 294.

decreasing at a rate of 13.5 percent each decade since 1979.³³⁴ By as soon as 2030, multiple scientific models point to an ice-free Arctic in most summers.³³⁵ As one consequence of this, the CNA's Military Advisory Board identified a hundredfold increase in scheduled Arctic Ocean transits between 2012 and 2014 alone.³³⁶ Such an increase was driven largely by the wealth of natural resources and trade routes made available by reduced ice coverage.

Shrinking icecaps and declining sea ice opens the Arctic region to both states and corporations seeking to exploit the abundant hydrocarbon and rare earth minerals believed to be there.³³⁷ By some estimates, almost one-third of the globe's undiscovered natural gas and 13 percent of undiscovered oil may be found in the Arctic.³³⁸ Added to that are vast quantities of zinc, iron ore, graphite, palladium, nickel, coal, and other valuable mineral deposits that geologists expect to find.³³⁹ In addition to the abundant natural resources which may become recoverable as polar ice melts, shorter and faster routes by which to transport those and other goods will also emerge. The Northwest Passage, for example, reduces the sea transit distance between Asia and Europe by 4,000 nautical miles compared to the traditional Panama Canal route.³⁴⁰ The economic impacts

³³⁴ Environmental and Energy Study Institute, 5.

³³⁵ Ronald O'Rourke, *Changes in the Arctic: Background and Issues for Congress* (Washington, D.C.: Congressional Research Service, 2015), 16.

³³⁶ Military Advisory Board, *National Security and the Accelerating Risks of Climate Change*, 19. Most of these scheduled transits were never actually completed. That permit requests for such transits increased by such a substantial level in only two years, however, is considered indicative of a significant shift in the economic and geostrategic role of the Arctic.

³³⁷ Jonathan Greenert, *The United States Navy Arctic Roadmap for 2014 to 2030* (Washington, D.C.: Department of the Navy, 2014), 3.

³³⁸ Environmental and Energy Study Institute, 5.

³³⁹ Greenert, *The United States Navy Arctic Roadmap*, 7.

³⁴⁰ Busby, 7.

associated with these resources and trade routes – along, surely, with strategic military considerations – create a political environment ripe for territorial disputes.

At the time the CRS submitted its report on *Changes in the Arctic* to Congress in 2015, at least five international territorial disputes remained unresolved. Canada, for example, claimed much of the emerging Northwest Passage as internal waters, while the United States, the European Union, and other governments asserted that the waterway should be treated as an international strait outside of Canada’s exclusive jurisdiction.³⁴¹ Russia, meanwhile, continued attempts at claiming Lomonosov Ridge as an extension of its continental shelf. This claim – which was also asserted by Canada – would grant Russia control over half of the Arctic region. As a signal of its resolve, the Russian government planted its flag on the seabed at the North Pole in 2007 in a symbolic, though legally inconsequential, act.³⁴² While disputes such as these were assessed by security experts as unlikely to result in direct military conflict in the Arctic, “as one of only eight nations with territory north of the Arctic Circle, the United States holds a tangible security interest in the region’s future.”³⁴³ This security interest, coupled with increases in commercial, diplomatic, and perhaps military activity in the Arctic, creates new strategic requirements for naval presence in the region.

For the Navy, however, “the Arctic region remains a challenging operating environment with a harsh climate, vast distances, and little infrastructure. These issues, coupled with limited operational experience, are just a few of the substantial challenges the Navy will have to overcome.”³⁴⁴ Specifically, surface fleet operations in Arctic

³⁴¹ O’Rourke, 20.

³⁴² O’Rourke, 20.

³⁴³ Military Advisory Board, *National Security and the Accelerating Risks of Climate Change*, 17.

³⁴⁴ Greenert, *The United States Navy Arctic Roadmap*, 3.

waters require a sufficient inventory of icebreaking ships capable of creating a safe navigating environment for combatant vessels. The Congressional Research Service, however, reported that the United States has only two serviceable icebreakers, a mere one-third of the capacity deemed necessary by the Department of Homeland Security (DHS).³⁴⁵ Only one icebreaker has been added to the U.S. fleet since the early 1980s.³⁴⁶ In contrast, the Russian Federation maintains 27 icebreakers in its fleet.³⁴⁷ Additionally, although the Navy's submarine fleet has experience operating under the polar icecaps, its surface and air forces have not conducted missions there with any regularity for more than two decades. Major training and readiness considerations must be taken into account, including matters as seemingly-mundane as the fact that the Navy does not have sufficient quantities of cold weather uniform gear to outfit most of its sailors.³⁴⁸ Reduced periods of daylight at high latitudes affect planning for flight operations. And cold temperatures and compacted ice have discernable impacts on the effectiveness of electronic warfare and radar systems respectively.³⁴⁹ Changes in the salinity and density of Arctic waters, induced by global warming and melting icecaps, also impact the sensitivity and reliability of acoustic systems used to detect and track submarines and other vessels.³⁵⁰ The Navy also has insufficient intelligence and "temperature ocean atlases" to plan for active combat operations in that environment.³⁵¹

³⁴⁵ O'Rourke, 44. The United States Coast Guard – a component of DHS – maintains the U.S. icebreaker fleet.

³⁴⁶ Blunden, 128.

³⁴⁷ Environmental and Energy Study Institute, 5.

³⁴⁸ Raunu and Berke, 70.

³⁴⁹ Raunu and Berke, 71.

³⁵⁰ National Academy of Sciences, 107.

³⁵¹ National Academy of Sciences, 109.

At present, naval forces undertake little or no training for the novel implications of Arctic operations. Worsening this problem, most of the servicemembers who had relevant experience in the region have retired.³⁵² Even in strategic planning, “war games today use only notional weather or do not even consider environmental impact.”³⁵³ As a result of these challenges, Admiral Frank Bowman suggested that recent DoD strategies and plans “may paint too rosy a picture of our Arctic capability or the ease of achieving that necessary capability.”³⁵⁴ That is to say, naval forces in the Arctic are not as “ready” as they are believed to be. They are, as General Meyer would have described them, hollow. Moreover, many of the currently fielded strategies reflect only traditional mission sets for naval forces. Climate change, however, will also redefine the types of missions that the Navy is expected to conduct.

Humanitarian Assistance and Disaster Relief

The impacts of climate change are likely to demand increased participation in non-military missions such as humanitarian assistance and disaster relief. HADR became so prominent in the early 2010s that, from 2010 to 2013, more than 40 academic theses at the Naval Postgraduate School explored different aspects of HADR operations.³⁵⁵ It was added alongside sea control, presence, deterrence, and power projection as a core mission set in the Navy’s 2007 global strategy.³⁵⁶ Citing HADR as one of its principal justifications in 2014, however, the Military Advisory Board expressed concern about the

³⁵² National Academy of Sciences, 112.

³⁵³ Russell Smith et al., “Environmental Prediction is a Weapon System,” *U.S. Naval Institute Proceedings* vol. 144, no. 12 (December 2018): 72.

³⁵⁴ Military Advisory Board, *National Security and the Accelerating Risks of Climate Change*, 18.

³⁵⁵ Kenneth Stewart and Dale Kuska, “Operation HA/DR – NPS Efforts to Improve Humanitarian Assistance and Disaster Relief Operations,” *Naval Postgraduate School*, March 28, 2014, <https://web.nps.edu/About/News/Operation-HA/DR-NPS-Efforts-to-Improve-Humanitarian-Assistance-and-Disaster-Relief-Operations.html>.

³⁵⁶ Forster, 267.

relationship between climate change and military readiness.³⁵⁷ In the Asia-Pacific region alone, the Navy reported that, already, an average two disasters per year require HADR response.³⁵⁸ Admiral Samuel Locklear, Commander of U.S. Pacific Command from 2012 to 2015, used to tell his subordinate commanders that “while you’re here you may not have a conflict with another military, but you will have a natural disaster that you have to either assist in or be prepared to manage the consequences [of.]”³⁵⁹ Locklear’s warning is supported by historical data.

From 1970 to 2003, more than two-thirds of unplanned contingency operations in the Pacific Command’s area of responsibility involved HADR.³⁶⁰ As climate change results in more frequent and more severe destructive weather events, a wealth of scholarly writing anticipates an even further increase in the frequency of HADR support requests.³⁶¹ This led Commander Timothy McGeehan to warn in 2017 that HADR requirements could “spread thin” the Navy’s forces as they manage competing priorities, and thereby threaten force readiness.³⁶² The Council on Foreign Relations likewise noted that responding to natural disasters at home and abroad requires the United States to “divert its attention and military resources” away from their traditional national security responsibilities.³⁶³ While humanitarian missions are essential to preserving life, reducing human suffering, and even act as a “soft power” tool of U.S. foreign policy, they also

³⁵⁷ Military Advisory Board, *National Security and the Accelerating Risks of Climate Change*, 23.

³⁵⁸ Micah Blechner, “Experts Come Together to Discuss HA/DR Readiness during PP18,” *Pacific Partnership 2018 Public Affairs*, May 29, 2018, https://www.navy.mil/submit/display.asp?story_id=105757

³⁵⁹ Timothy McGeehan, “A War Plan Orange for Climate Change,” *U.S. Naval Institute Proceedings* vol. 143, no. 10 (October 2017).

³⁶⁰ Espach, Zvijac, and Filadelfo, 96.

³⁶¹ Espach, Zvijac, and Filadelfo, 109. See also: Kime, 58; Military Advisory Board, *National Security and the Accelerating Risks of Climate Change*, 23; Scott and Khan, 85.

³⁶² McGeehan.

³⁶³ Busby, 1.

reduce the time available for training, maintenance, and deployment operations, with corresponding impacts to naval readiness. By their sudden and emergent nature, HADR missions also have the potential to increase operational tempo for the Navy in particular. While the Navy does not consider HADR in its force size and structure decisions,³⁶⁴ its amphibious landing ships, deployable aviation lift assets, freshwater production plants, two purpose-built hospital ships – USNS *Mercy* and USNS *Comfort* – and other unique capabilities make it a key player in HADR.³⁶⁵ Moreover, “since it is forward deployed at all times, the [Navy] can and does provide a broad range of relief on short notice.”³⁶⁶ As Forster noted, the Navy enjoys “greater mobility and flexibility compared to the other services.”³⁶⁷ This results in naval forces being recalled from assigned tasking – including training, deployment operations, and other missions – to support immediate HADR needs. In November 2013, for example, the entire USS *George Washington* carrier strike group was diverted from operations in the Western Pacific to support Operation Damayan, the HADR response following Super Typhoon Haiyan in the Philippines.³⁶⁸

Beyond its impacts on operational schedules, HADR has direct budgetary effects as well. In 2013 – the year that Operation Damayan was launched – a record \$22 billion was spent on HADR missions worldwide.³⁶⁹ Since neither the Navy nor the DoD plan for HADR in their budget requests, HADR funding can impact money available for other missions and priorities. Given the Navy’s historic “send everything and we will figure

³⁶⁴ Espach, Zvijac, and Filadelfo, 100.

³⁶⁵ Apte and Yoho, *HADR Costs: A Preliminary Study*, 1. See also: Forster, 371.

³⁶⁶ Apte and Yoho, “Reacting to Crisis,” 2.

³⁶⁷ Forster, 369.

³⁶⁸ Stewart and Kuska. A total of 57 countries contributed the HADR operations in the Philippines following Super Typhoon Haiyan. The term “Operation Damayan” refers only to the U.S. military response. Aruna Apte, *Metrics for the Naval Humanitarian Assistance and Disaster Relief (HADR) Operations* (Monterey: Naval Postgraduate School, 2017), 30.

³⁶⁹ Apte and Yoho, “Reacting to Crisis,” 1.

out how to pay for it [later]”³⁷⁰ approach to HADR, the effects on the service’s finances can be significant. In fact, Navy HADR missions have routinely come at costs of \$100-130 million in recent years.³⁷¹ In one extreme case – Operation Tomodachi, the response to the 2011 Tohoku earthquake in Japan – the total cost of the Navy’s efforts was approximately \$2.89 billion.³⁷² While the DoD operates as an agent of the State Department for overseas HADR operations, and therefore receives funding from State’s Overseas Humanitarian Disaster and Civic Aid budget, much of the incurred cost still comes from DoD coffers.³⁷³ Hefty price tags in addition to time removed from readiness-generating activities such as training and maintenance, caused some key scholars and one former CNO, Admiral Gary Roughead, to question whether HADR can continue to remain central to naval strategy in the future.³⁷⁴ Additional challenges for effective HADR missions – and naval operations in general – also stem from the reality that, in addition to major population centers overseas, many U.S. Navy bases themselves are at serious risk because of climate change.

Climate Change Impacts on Naval Installations

Of the DoD installations identified by the U.S. Government as being at “high risk” or “very high risk” to climate change, many of them are naval bases.³⁷⁵ Just a three-foot rise in sea levels could threaten 128 domestic military installations, 56 of which – valued at \$100 billion – belong to the Navy.³⁷⁶ Many facilities overseas are also

³⁷⁰ Apte and Yoho, “Reacting to Crisis,” 1.

³⁷¹ Apte and Yoho, “Reacting to Crisis,” 7-10. See also: Apte and Yoho, *HADR Costs: A Preliminary Study*, 6-11.

³⁷² Apte and Yoho, “Reacting to Crisis,” 10.

³⁷³ Apte, 11.

³⁷⁴ Apte and Yoho, “Reacting to Crisis,” 2. See also: Gary Roughead et al., *U.S. Navy Humanitarian Assistance in an Era of Austerity* (Washington, D.C.: Center for Strategic and International Studies, 2013).

³⁷⁵ National Research Council, 74.

³⁷⁶ Union of Concerned Scientists.

considered at risk, including Naval Fleet Activities Yokosuka, home to the Japan-based Forward Deployed Naval Forces and the U.S. Seventh Fleet.³⁷⁷ Though perhaps the most substantial for the Navy, sea level rise is only one effect of climate change that poses problems for military bases. In January 2019, the DoD released a report identifying the dangers posed to 79 “mission assurance priority installations” by additional effects of climate change. Of those 79 mission-critical bases, 18 belong to the Navy and all 18 were impacted by at least one of the five enumerated climate-related challenges, namely recurrent flooding, drought, desertification, wildfires, and thawing permafrost. Appendix 1 indicates the specific threats posed to each facility, including those in the fleet-concentration area of Hampton Roads, Virginia.

Hampton Roads, Virginia: “The Greatest Concentration of Military Might in the World”

The Center for Climate and Security called the Hampton Roads area of Virginia “the greatest concentration of military might in the world,”³⁷⁸ and the CNA noted that more than 20 percent of the U.S. Navy’s fleet is homeported there.³⁷⁹ The DoD, however, has acknowledged that Hampton Roads is one of the most vulnerable areas in the United States with regard to climate change impacts on military facilities.³⁸⁰ The conditions in Hampton Roads are so critical that at least one area base – Naval Air Station Oceana, Dam Neck – is at risk of losing between 75 and 95 percent of its land to

³⁷⁷ Reinhardt and Toffel, 108.

³⁷⁸ Matt Connolly, “5 Things to Know about Hurricanes, Hampton Roads and National Security,” *The Center for Climate and Security*, October 2, 2015, <https://climateandsecurity.org/2015/10/02/5-things-to-know-about-hurricanes-hampton-roads-and-national-security/>

³⁷⁹ Military Advisory Board, , *National Security and the Accelerating Risks of Climate Change*, 25.

³⁸⁰ Department of Defense, *Report on Effects of Changing Climate to the Department of Defense* (Washington, D.C.: Department of Defense, 2019), 6.

sea level rise by the end of the century.³⁸¹ Of perhaps even greater concern, Hampton Roads is also home to Naval Station Norfolk – the world’s largest naval base.

Naval Station Norfolk is homeport for 75 ships on its 13 piers, and 134 aircraft spread across 11 aviation hangars. The base covers just under 3,800 acres and houses 6,700 Navy personnel.³⁸² Ten times that many, however – 67,000 military and civilian employees – work on the base each day.³⁸³ Given current meteorological conditions, the base already floods ten times per year, making parts of the installation impassable and causing damage to electrical systems and other infrastructure. According to *National Geographic*, “all it takes to cause such disarray these days is a full moon, which triggers exceptionally high tides.”³⁸⁴ Future projections only paint a more chronic and challenging picture. Sea levels in Norfolk rose 1.5 feet in the last century – twice the global average³⁸⁵ – and future sea level rise at the base is projected to reach 4.5 to 6.9 feet by 2100.³⁸⁶ Only a three-foot rise was the threshold identified by experts as dangerous. The National Oceanic and Atmospheric Administration says that only New Orleans faces a greater threat from sea level rise. The Army Corps of Engineers explained that “at some point between a 1.5-foot and three-foot rise of the sea, [Naval Station Norfolk], and much of Hampton Roads, would be underwater for hours, or even days, following a large

³⁸¹ Union of Concerned Scientists. Two other military bases face a similar threat. One of them, Naval Air Station Key West, is also owned by the Navy.

³⁸² Union of Concerned Scientists.

³⁸³ Connolly.

³⁸⁴ Laura Parker, “Who’s Still Fighting Climate Change? The U.S. Military,” *National Geographic*, February 7, 2017, <https://www.nationalgeographic.com/news/2017/02/pentagon-fights-climate-change-sea-level-rise-defense-department-military/>

³⁸⁵ Nicholas Kusnetz, “Rising Seas Threaten Norfolk Naval Shipyard, Raising Fears of ‘Catastrophic Damage,’” *NBC News*, November 19, 2018, <https://www.nbcnews.com/news/us-news/rising-seas-threaten-norfolk-naval-shipyard-raising-fears-catastrophic-damage-n937396>

³⁸⁶ Union of Concerned Scientists. See also: Connolly.

storm.”³⁸⁷ When asked in November 2015 by then-Secretary of State John Kerry how long the base could continue to function in light of these projections, the commanding officer of Naval Facilities Engineering Command Mid-Atlantic told him that the world’s largest naval base had a life expectancy of only 20 to 50 years.³⁸⁸ Media reports on their meeting claimed that “yes, they could shore up the sea walls for a while. Yes, they could raise roads. But without the massive influx of billions of dollars to fortify and elevate the

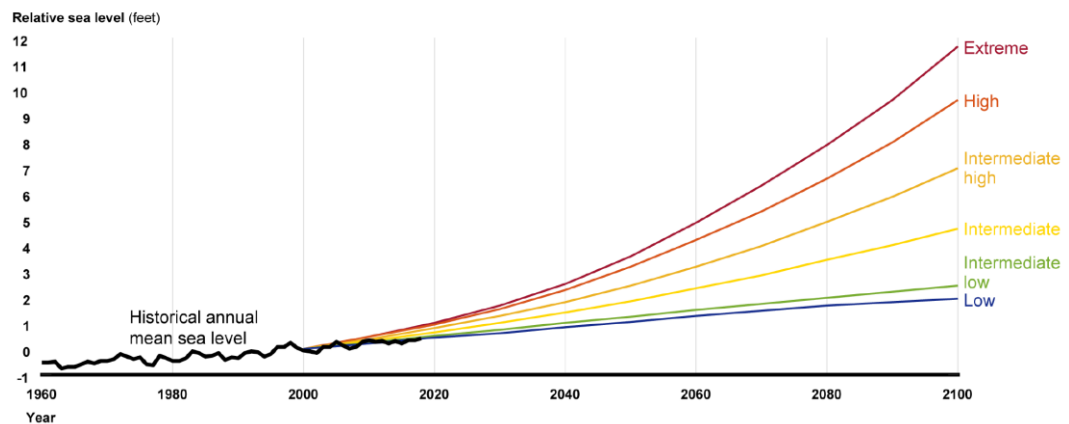


Figure 5: Historical Annual Mean Sea Level and Projected Sea Level Rise at Naval Station Norfolk, 1960-2100³⁸⁹

city of Norfolk, as well as the roads and railroads that connect it to the surrounding region, the base was doomed.”³⁹⁰ By the end of the century, some models predict that the base will flood 280 times per year – 28 times as frequently as it does today.³⁹¹ These risks, faced by the home of the Navy’s Atlantic Fleet, are likewise faced by the facilities that build and maintain that fleet.

³⁸⁷ Connolly.

³⁸⁸ Jeff Goodell, “The Fight of Our Time,” *Rolling Stone* Issue 1250/1251 (December 2015): 40.

³⁸⁹ Government Accountability Office, *Climate Resilience: DoD Needs to Assess Risk and Provide Guidance on Use of Climate Projections in Installation Master Plans and Facilities Designs* (Washington, D.C.: Government Accountability Office, 2019), 8.

³⁹⁰ Goodell, 40.

³⁹¹ Parker.

Norfolk Naval Shipyard is one of only three facilities worldwide capable of conducting dry-dock maintenance on nuclear-powered aircraft carriers. In the ten years between 2008 and 2018, it flooded nine times.³⁹² According to former Navy Secretary Ray Mabus, storm surge caused by a major hurricane could cause “serious, if not catastrophic damage, and it would certainly put the shipyard out of business for some amount of time.”³⁹³ After the Federal Emergency Management Agency ran simulations of a category four hurricane driving directly through Hampton Roads, the Navy refused to publicly disclose the predicted damage to the shipyard. News reports indicated that “a storm of that magnitude would likely submerge the entire facility,” and called the threat to the shipyard “existential.”³⁹⁴ A second of the three nuclear aircraft carrier-capable shipyards – operated by Huntington Ingalls Industries – is also located in Hampton Roads and, as a result, faces similar climate change-induced challenges as those at Norfolk Naval Shipyard.³⁹⁵ Operationally, more frequent maintenance delays caused by flooding at these shipyards can create what Secretary Mabus called “a very, very serious readiness issue”³⁹⁶ by disrupting planned OFRP cycles and affecting ship availability. Such

³⁹² Kusnetz.

³⁹³ Kusnetz.

³⁹⁴ Kusnetz. See also: Union of Concerned Scientists. “Well-prepared bases will remain vulnerable if surrounded by unprepared communities.” Even if the foregoing projections are excessive and the risks to the Naval Station Norfolk and Norfolk Naval Shipyard are overstated, rising sea levels can still threaten both installations’ readiness due to the inability of military and civilian personnel to get to and from work. Of the 130,000 personnel that work on the Navy’s six Hampton Roads bases, most live off base and commute to and from work. A Joint Land Use Study conducted by the cities of Norfolk and Virginia Beach suggested that in 2017 about 35 miles of local area roads were impacted by flooding. A 1.5-foot rise in sea levels increases the affected roadways to 104 miles and with a 3-foot sea level rise, 269 miles of roads will routinely flood. See also: Peter Coutu, “Study Details Steps Norfolk, Virginia Beach Should Take to Protect Navy Bases as Sea Levels Rise,” *The Virginian-Pilot*, May 29, 2019, https://www.pilotonline.com/government/local/article_3984b93a-8182-11e9-aad6-5f172ed188a0.html

³⁹⁵ Association of Defense Communities, “Hampton Roads Businesses Look to Adapt to Climate Change,” *Association of Defense Communities*, July 1, 2015, <https://www.defensecommunities.org/blog/headlines/hampton-roads-businesses-look-to-adapt-to-climate-change/>

³⁹⁶ Kusnetz.

disruptions will create yet an additional intersection between climate change and naval readiness, making climate change central to the tangled and complicated web of military capability in the years to come.

Conclusion

For the United States Navy, it became increasingly clear from 2010 to 2017 that myriad security challenges posed by global climate change will influence naval readiness both directly and indirectly. First, climate change affects where the Navy will be required to operate. As the warming of the planet continues to alter the physical geography of the Arctic, increased commercial, political, and military activity in the region will require a proportionate upsurge in Navy presence and Arctic operations. Second, more frequent and more severe destructive weather events like typhoons, hurricanes, and droughts will result in increased demand for Navy participation in humanitarian assistance and disaster relief operations as part of U.S. foreign policy. Third, rising sea levels will threaten the suitability and continued utility of key naval installations worldwide. Among them are the world's largest naval base and two of only three maintenance facilities capable of conducting major repairs to U.S. nuclear-powered aircraft carriers. According to at least one key expert, Naval Station Norfolk may survive for only a few more decades as a viable home for the Navy's Atlantic Fleet.

It must be acknowledged that the scientific data and climate projections that underlie these assessments, while overwhelmingly accepted by the scientific community, still remain challenged by some scholars. Retired Navy Captain Larry DeVries, for example, pointed to studies from the University of Alabama at Huntsville in his determination that "the jury is still out on 'climate change' as a euphemism for

‘catastrophic man-made global warming requiring intervention.’”³⁹⁷ In the context of naval readiness, however, the validity of DeVries proposed euphemism is unimportant. As explained by the Military Advisory Board, “falling short of 100 percent agreement [on climate change] is not a justifiable reason for inaction.”³⁹⁸ Unlike the scientific community which makes its determinations based on empirical evidence and experimentation in accordance with the scientific method, military planners and strategists rely on assessments of risk, probability, and severity.

A military leader’s perspective of risk often differs from those of scientists, policymakers, or the media...As military leaders, we evaluate the probability and possible consequences of events in determining overall risk. Even for those outcomes or projected scenarios that have low probabilities of occurrence, if the consequence is high enough, the resulting risk demands action.³⁹⁹

Viewed through this lens, the naval readiness consequences – and those to national security more generally – of the widely-studied climate change scenarios explored in this thesis demand action.

³⁹⁷ Larry DeVries, “The Climate is Changing, the Navy is on Course,” *U.S. Naval Institute Proceedings* vol. 136, no. 7 (July 2010).

³⁹⁸ Military Advisory Board, *National Security and the Accelerating Risks of Climate Change*, 7.

³⁹⁹ Military Advisory Board, *National Security and the Accelerating Risks of Climate Change*, 9.

Conclusions and Recommendations

Evaluation of Readiness Indicators

From 2010 through 2017, the military readiness of the United States Navy eroded to such an extent that defense analysts and government officials publicly questioned whether it had become a hollow force. Scholars in future years will, and should, find the answer to that question to be “yes.” The research presented in the preceding pages demonstrated that no fewer than six factors detracted from the military readiness of the United States Navy from 2010 to 2017. Three additional elements were rejected as readiness challenges. Seven indicators of force hollowness were proposed by the Center for Naval Analyses in a 1996 study of post-Vietnam War naval readiness and subsequently reexamined by the Congressional Research Service in 2012. Of those seven, this thesis accepted five as applicable to the U.S. Navy during the 2010-2017 scope of inquiry. Recognizing that “there is no guarantee that the next hollow force will look like the last one,”⁴⁰⁰ this study then presented evidence that two further indicators – excessive operational tempo and the effects of global climate change – must be added to any holistic examination of naval readiness during this period. In the case of the former, operational tempo directly damaged naval readiness from 2010 to 2017 and resulted in the loss of 17 lives – as many as were lost in the attack on the USS *Cole*. In the case of the latter, while it is among the Navy’s most severe future readiness challenges, climate change did not sufficiently impact naval capabilities to warrant acceptance as an indicator of unreadiness during the early- and mid-2010s.

⁴⁰⁰ Robinson et al., 16.

Concurrence with Congressional Research Service Findings

As detailed in chapter one, CRS research sought to reconsider the findings of the CNA in the context of general military readiness in 2012. In a more restrictive context, which focuses only on the Navy during the years 2010 to 2017, this thesis certified only four of the seven CRS assessments as valid. In rejecting both levels of public support and difficulty recruiting and retaining personnel as indicators of unreadiness in the Navy during those years, this thesis concurred with the determinations reached by the CRS. With the Navy's favorability ratings measured by Gallup at between 70 and 80 percent, assessing public support as detrimental to naval readiness during the 2010s is unwarranted.⁴⁰¹ Similarly, with recruiters "achieving the highest quality enlisted force in Navy history,"⁴⁰² and meeting or exceeding desired retention quotas every year from 2010 to 2017, the Navy demonstrated a strong ability to maintain its all-volunteer force.

This thesis also joined CRS in determining that both pressure to cut defense spending and poor force morale acted as hollowing agents for the Navy in the early- and mid-2010s. As military leaders warned that "our national debt [had become] our biggest national security threat,"⁴⁰³ Congress determined a critical need to reduce federal spending. The Budget Control Act of 2011 and sequestration budget cuts in March 2013 caused the Navy to lose 9.5 percent of funding across every line-item in its budget.⁴⁰⁴ The DoD as a whole "lost \$37 billion overnight."⁴⁰⁵ During those same years, a

⁴⁰¹ Norman, *Americans Give Military Branches Similar High Marks*.

⁴⁰² Ferguson, *Navy Recruiting Achieves Highest Quality*.

⁴⁰³ Johnson et al., 1.

⁴⁰⁴ Graves, 15.

⁴⁰⁵ Williams, *Accepting Austerity*, 54.

measurable spike in suicide rates among naval personnel – a 13-percent increase from 2010 to 2014 alone⁴⁰⁶ – demonstrated cause for serious concern about force morale.

Those concerns were validated by a 2014 independent survey in which more than twice as many active-duty respondents called Navy morale “marginal” or “poor” as called it “excellent” or “good.”⁴⁰⁷

Dissent from Congressional Research Service Findings

Divergences between the determinations reached in this thesis and those of the CRS occurred in three cases – declining pay, delays in fielding modern equipment, and inadequate attention to the maintenance of existing equipment. In each case, the CRS assessed these factors to be generally inapplicable to modern military readiness.

Considered solely in the context of naval readiness, however, this thesis accepted them as relevant. First, although most members of the U.S. Navy remained financially secure relative to peers of equal education and experience, austerity measures instituted by the Obama Administration from 2014 to 2016 resulted in reduced military wage growth compared to the civilian sector from 2011 to 2017. Less generous retirement benefits for career Navy personnel as a result of the 2016 restructuring of the military retirement system, added to the financial impact on servicemembers. Accordingly, while the CRS likely based its determination on the general health of sailors’ finances, the CNA criterion specifically concerned itself with whether trends in military pay were reductive. From 2010 to 2017, they were.

Similar dissent was required following analysis of equipment procurement and maintenance trends during the early- and mid-2010s. In 2016, analysis from the Heritage

⁴⁰⁶ United States Navy, “Navy Suicide Data.”

⁴⁰⁷ Osborn.

Foundation identified a shortage of 39 combatant ships in the Navy’s surface fleet.⁴⁰⁸ Those assessments were validated by reporting from the Government Accountability Office claiming that the Navy had 50 fewer ships in inventory in 2017 than it called for in its shipbuilding plans ten years earlier.⁴⁰⁹ The first-in-its-class aircraft carrier, USS *Gerald R. Ford*, for example, commissioned five years behind schedule in 2017, forcing the Navy to seek a congressional waiver to fall below its statutorily-required aircraft carrier inventory of 11.⁴¹⁰ Likewise, a four-year postponement in reaching initial operational capability for the F-35C Joint Strike Fighter left the Navy’s air forces without a strategically-vital fifth-generation fighter capability.⁴¹¹ These procurement delays exacerbated already existing backlogs in the maintenance of the Navy’s fielded platforms.

According to the GAO, from FY2011-FY2016 the Navy lost the use of 0.5 aircraft carriers, 3.0 cruisers and destroyers, and 2.8 submarines each year due to maintenance availabilities running beyond their allotted lengths, creating massive backlogs.⁴¹² The Secretary of the Navy measured the backlog at the DoD’s four shipyards at \$4.8 billion in 2017.⁴¹³ The Navy’s aviation maintenance facilities were likewise unable to keep up with heavy demand. By 2017, almost two-thirds of F/A-18 fighter jets – and more than half of all other Navy aircraft – were not able to fly.⁴¹⁴ Ashore, 23 percent of Navy facilities were rated in “poor” condition, with another nine

⁴⁰⁸ Wood, ed., *2016 Index of U.S. Military Strength*, 236.

⁴⁰⁹ Government Accountability Office, *Navy Shipbuilding*, 1.

⁴¹⁰ Wood, ed., *2016 Index of U.S. Military Strength*, 236.

⁴¹¹ Gertler.

⁴¹² Government Accountability Office, *Navy Readiness*, 14.

⁴¹³ Stanford.

⁴¹⁴ Government Accountability Office, *Navy Readiness*, 9.

percent deemed to be in “failing” condition.⁴¹⁵ Accordingly, thorough consideration of available procurement and maintenance data mandated dissent from the 2012 CRS assessments. Both delays in procurement of new equipment and problems associated with maintenance of existing equipment challenged Navy readiness in the early- and mid-2010s. Table 6 offers a summary comparison of the conclusions reached by this thesis and those of the CRS.

Readiness Indicator	2012 CRS Assessment ⁴¹⁶	Concurrence with CRS Assessment	Applicability to U.S. Navy from 2010 to 2017
Low Public Support for the Military	Rejected	Concur	Rejected
Pressure to Cut Defense Spending	Accepted	Concur	Accepted
Difficulties in maintaining an all-volunteer force	Rejected	Concur	Rejected
Declining Pay	Rejected	Dissent	Accepted
Poor Morale	Accepted	Concur	Accepted
Delays in fielding modern equipment	Rejected	Dissent	Accepted
Inadequate attention to maintenance of existing equipment	Rejected	Dissent	Accepted
Unsustainable Operational Tempo	N/A	N/A	Accepted
Impact of Global Climate Change	N/A	N/A	Rejected (Future Impact Accepted)

Table 6: Summary Assessment of Readiness Indicators and Comparison to 2012 CRS Assessment

Added Readiness Indicators

Chapters two and three of this thesis moved beyond the framework established by the CRS and identified two additional readiness indicators which were found to be crucial

⁴¹⁵ Moon Cronk.

⁴¹⁶ Feickert and Daggett, 15-18.

to any holistic study of naval readiness from 2010 to 2017. Specifically, chapter two determined that an unsustainable operational tempo resulted in chronic damage to readiness during those years. Chapter three's research showed that global climate change did not present immediate readiness challenges during the 2010s, but that it will create serious threats to readiness in future years.

This thesis showed that damage to readiness results from an operational tempo that burdens the force with deployment requirements without also providing sufficient time to conduct the training and maintenance that enables “readiness recovery.” As the size of the Navy's combatant fleet shrank, military leadership failed to proportionately reduce the operational requirements placed on its smaller force. Senator Wicker explained how “too few ships fulfilling too many missions degraded the combat readiness” of the U.S. Navy.⁴¹⁷ This degradation occurred as a result of operational requirements being prioritized over maintenance and training. The outcome was demonstrably unready ships being sent to sea. On June 17, 2017, the consequences of those decisions became clear. USS *Fitzgerald* collided with a commercial shipping vessel in a mishap which cost seven of its sailors their lives. Prior to being dispatched for its assigned tasking, the ship had attained less than one-third of its required training certifications⁴¹⁸ and “hundreds of repairs, major and minor, remained to be done” onboard.⁴¹⁹ USS *Fitzgerald* was deployed in spite of its unreadiness as a result of a deeply-rooted organizational culture of normalization of deviance.

⁴¹⁷ Wicker and Hendrix, 76.

⁴¹⁸ Benson, 13.

⁴¹⁹ Miller, Rose, and Faturechi.

“Accepting deficiencies in readiness, rather than a decreased Navy presence worldwide” became the Navy’s “new normal,” especially in its Forward Deployed Naval Forces based overseas.⁴²⁰ The “bruising tempo of operations in the Japan-based 7th Fleet”⁴²¹ left its ships accepting more and more risk in the interest of “getting the job done.” Measured against the CRS definition of a “hollow force,” – “military forces that appear mission-ready, but, upon examination, suffer from shortages of personnel, equipment, and maintenance or from deficiencies in training”⁴²² – it is clear that a normalization of deviance had a hollowing effect on the Navy.

With different cause, but similar effect, the impacts of global climate change on Navy operations will damage the force’s readiness in future years. While this thesis concluded that climate change-induced readiness degradation was not chronic in the 2010-2017 scope of inquiry, evidence of future readiness threats grew both abundant and clear during those years. In its 2010 Quadrennial Defense Review, the DoD for the first time acknowledged that climate change posed readiness concerns for military forces by shifting mission requirements and threatening the very bases from which those missions are planned and staged.⁴²³

As Arctic temperatures rise at double the rate of the rest of the globe, states and multinational corporations are scrambling to lay their claims to new natural resources and shipping routes which have emerged. This demands an increased Navy presence in the region – something for which the service is decidedly unprepared. With insufficient Arctic infrastructure and little operational experience in the region during the last 20

⁴²⁰ Bayer and Roughead, 21.

⁴²¹ Ziezulewicz.

⁴²² Feickert and Daggett, 1.

⁴²³ Department of Defense, *Quadrennial Defense Review*, 84

years, the Navy’s strategies “paint too rosy a picture of our Arctic capability.”⁴²⁴ While improving its readiness for Arctic operations, the Navy must also prepare for an increased demand for its services in humanitarian assistance and disaster relief operations. As destructive weather events grow more frequent and more severe, “no other organization can deliver large-scale logistical capabilities and relief assets so rapidly” as can the U.S. Navy.⁴²⁵ Naval leadership must balance requests for HADR support against the service’s national defense obligations as these requests grow more common.

Climate change also poses direct threats to naval installations both at home and abroad. Sea level rise and predicted storm surge could cause Naval Station Norfolk, Virginia – the world’s largest naval base – to reach the end of its serviceable life as early as 2035 according to one senior officer responsible for the Navy’s facilities engineering.⁴²⁶ Naval Station Norfolk is not alone. Of the 79 mission-critical installations identified by DoD as most at-risk to the effects of climate change, 18 belong to the Navy and all 18 exhibit both current and future climate change-based vulnerabilities.⁴²⁷

Relationships Between Readiness Indicators

Considered as standalone challenges, the six obstacles identified by this thesis as applicable resulted in varying degrees of damage to naval readiness from 2010 to 2017. An understanding of the ways in which these factors influence and interact with each other, however, is required to understand the aggregate risk posed to the fleet. Richard Betts explained in 1995 that, in order to be of value to decisionmakers in the formulation

⁴²⁴ Military Advisory Board, *National Security and the Accelerating Risks of Climate Change*, 18.

⁴²⁵ Forster, 371.

⁴²⁶ Goodell, 40.

⁴²⁷ Department of Defense, *Report on Effects of a Changing Climate*, Appendix.

of policy, military readiness “must be seen as a *complex system* composed of numerous variables.”⁴²⁸ Further convoluting the validity of readiness assessments, those variables in many cases “conflict with and damage each other.”⁴²⁹

It is unsurprising that pressure to cut defense spending has direct correlation to many of the other readiness indicators examined in this thesis. Reductions in naval budgets impacted Navy readiness during the early- and mid-2010s in two key ways. First, the post-Cold War “procurement holiday” resulted in a major downsizing of the Navy’s combatant fleet. From 1987 to 2015, the Navy lost 323 ships – a reduction of 54 percent from 594 to 271.⁴³⁰ Since this force reduction was not met with an equivalent decrease in operational tasking, during those same 28 years, the average percentage of the fleet deployed increased by 218 percent.⁴³¹ As the Navy’s smaller fleet worked harder and longer, the increased pace resulted in more wear and tear on its ships. This extra wear caused maintenance periods to run beyond their allotted time which in turn mandated that other ships remain at sea longer to cover the resulting gaps. Those deployment extensions caused similarly excessive wear on more ships, perpetuating the cycle of damage to readiness.

A second round of funding cuts, mandated by the Budget Control Act of 2011 and the 2013 sequester, further deteriorated readiness by adding to maintenance backlogs at government-owned repair facilities and by deferring and delaying the acquisition of additional ships and aircraft. Delays in delivery of new platforms resulted in the fleet remaining smaller for longer and required extensions to the service-life of existing ships

⁴²⁸ Betts, 32. Emphasis in original.

⁴²⁹ Betts, 32.

⁴³⁰ United States Navy, “U.S. Navy Active Force Ship Levels.”

⁴³¹ Assumes the Navy’s reported average of 100 ships normally deployed.

in order to fill a constant operational need. Budget considerations also resulted in austerity measures which cut military pay increases from 2014 to 2016. This decrease in relative compensation coupled with an ever-growing operational tempo contributed to a drop in force morale, adding additional layers to the interrelation between readiness indicators during the 2010s.

The web connecting readiness indicators to each other will grow only more vast in years to come. As demonstrated in chapter three, the effects of global climate change will constitute a significant standalone challenge to naval readiness. That said, the aggregation of climate change with additional readiness factors compounds the challenge. The following scenario is quite plausible in upcoming decades. An increase in HADR missions resulting from more frequent and more severe storms at home and abroad will place further strain on the Navy's undersized fleet. The opening of the Arctic to growing naval presence requirements will likewise increase the force's operational tempo or require Navy leadership to reduce presence in other theaters in order to compensate. These heightened demands for forces will be matched with shrinking ship availability due to maintenance delays and infrastructure-induced challenges caused by rising sea levels at critical naval bases and shipyards. The adaptation efforts required to extend the useful life of those threatened installations, or to construct new ones to replace those deemed unsalvageable, will place additional financial pressure on an already strained military budget. These requirements will compete for priority with, among other things, the Navy's shipbuilding budget which will further exacerbate increases to operational tempo. While this particular hypothetical is by no means a certainty, it sufficiently illustrates the interrelation of both the present and future factors affecting naval readiness.

Policy Recommendations for the Department of Defense

Understanding the complexity of the interactions between readiness inputs and outputs, this thesis now seeks to provide concrete policy recommendations designed to balance these factors and promote readiness recovery in the United States Navy.

Accordingly, the Department of Defense should:

1. *Reassess the Composition of the Fleet.* To provide the overseas presence demanded by combatant commanders, the Navy should reassess not only the size of its battle force, but its composition as well. Modern guided-missile destroyers cost \$1.8 billion. Ford-class nuclear aircraft carriers carry a price tag of \$12.8 billion. Reallocating the Navy's shipbuilding budget to field larger numbers of smaller, cheaper, purpose-built vessels in lieu of some portion of its large surface combatants would increase fleet size. This, in turn, would enable a sufficient naval presence overseas, while simultaneously reducing operational tempo and adding limited or no financial cost to the federal budget. In addition, future operational demands in the Arctic region mandate that DoD and DHS consider further investing in additional hulls for the U.S. icebreaker fleet, as two operable ships is insufficient to meet mission requirements. Lastly, DoD should maintain its fleet of two hospital ships to meet the requirements of an expected rise in HADR requests resulting from more frequent and more severe destructive weather events in the future.

2. *Reexamine Naval Strategy in the Context of Emerging Challenges.* Traditional U.S. Navy strategy contends that forward presence by naval forces reassures allies, deters adversaries, and secures American defense and economic interests abroad. These presence requirements are, in part, the source of the Navy's decision to increase the size

of its Forward Deployed Naval Forces. In light of the emergence of peer and near-peer adversaries – China and Russia specifically – the Naval War College should conduct classified analyses which weigh the effectiveness of two opposing strategies: First, the existing presence strategy which calls for a continuous, but dispersed, overseas presence. Second, a strategy reliant on a more robust, “surge-ready” fleet which can bring concentrated force to bear against major threats, but conducts routine overseas presence operations less frequently.

3. *Include Normalization of Deviance in Training Curriculum for Senior Leaders.* Instruction on Vaughan’s normalization of deviance theory – and case studies on the USS *Fitzgerald* and USS *John S. McCain* mishaps – should be added to the curriculum for senior Navy commanders during the Major Command Leadership Course and the Naval Flag and Executive Course. This requirement contributes to the *Strategic Readiness Review*’s call for fostering an institutional culture which studies past performance and assesses lessons learned. Senior commanders are required to attend these courses prior to assuming command in the ranks of captain and admiral, respectively. As a result, addition of this training to the existing curriculum provides a revenue-neutral means by which to ensure Navy leaders understand the readiness and safety implications of their decisions affecting operational tempo. This revenue-neutrality prevents unnecessary expenditure of limited financial resources.

4. *Include climate change vulnerability as a primary consideration during all future Base Realignment and Closure rounds.* The CNA's Military Advisory Board determined in 2014 that “future basing decisions, as well as future Base Realignment and

Closure (BRAC) rounds, will have to make climate change a crucial consideration.”⁴³²

Following considerable research and analysis, this thesis concurs with that assessment. A core tenet of economic policy is that one should never “throw good money after bad,” and some naval installations may be at such risk to rising sea levels and other climate change-induced dangers that they warrant closure. The last BRAC round occurred in 2005 and, for six of the last seven years, the DoD has requested that Congress authorize a new BRAC round.⁴³³ In addition to identifying bases which face substantial climate change-induced problems, a BRAC round would offer an opportunity to optimize alignment between naval infrastructure and the National Defense Strategy. Specifically, unrealized savings of an estimated \$2 billion⁴³⁴ could be reprogramed to support construction of key infrastructure in the Arctic area of operations, reducing the gap between existing and required capabilities in that region.

5. *Incentivize graduate education on climate science and climate change adaptation.* The Navy currently provides its officers with a number of purpose-driven programs for graduate education. The Politico-Military Masters Program, for example, is designed to ensure the Navy maintains a cadre of officers trained in strategy and foreign relations to staff its strategic development and policymaking departments. A similar program aimed at building a community of experts educated on climate science and climate change adaptation would position the Navy to meet future readiness challenges posed by climate change. Navy policy now requires officers to complete in-residence graduate education prior to assuming major command in the rank of captain. This

⁴³² Military Advisory Board, *National Security and the Accelerating Risks of Climate Change*, 24.

⁴³³ Frederico Bartels, *Making the Case for a New Round of BRAC* (Washington D.C.: The Heritage Foundation, 2019), 2.

⁴³⁴ Bartels, 4.

requirement creates revenue-neutral avenues by which to build such a cadre of specialists.

Policy Recommendations for the President and the National Security Council

1. *Deliberately balance U.S. military and economic strength in the formation of grand strategy.* Richard Betts observed that “throughout American history the lack of readiness for combat on preferred terms made for inefficiency, and sometimes made for the tragic waste of lives. But it also saved a lot of money. After all, wars are intense but infrequent events.”⁴³⁵ The CNA put it somewhat differently when it said that “a certain amount of hollowness is not necessarily a bad thing.”⁴³⁶ That is particularly true when accepting such hollowness allows for achieving alternate strategic objectives such as a reduced national debt. Given the acknowledged rise in the relative importance of economic security, the President and the National Security Council need to make hard decisions about the size and readiness requirements for the Navy and the armed forces as a whole. Their basic choice should be between a large navy that requires more time to properly prepare for major combat operations, or a smaller navy which is maintained in a higher state of readiness and is therefore more ready to respond to emerging events quickly. Without major reconsideration of the Navy’s budget, choosing one type of reduced readiness over another is a decision between the lesser of two evils. That choice must be made in the context of overarching U.S. grand strategy. To best inform this decision, the DoD should provide the President with the classified analyses from the Naval War College war games called for in the recommendation found above.

⁴³⁵ Betts, 14.

⁴³⁶ Robinson et al., 14.

Policy Recommendations for the United States Congress

1. Ratify the United Nations Convention on the Law of the Sea (UNCLOS).

Ratification of UNCLOS would advantageously position the United States to influence international agreements regarding accepted behaviors and resolution of territorial disputes in the Arctic. Moreover, it would do so with no requirement for additional financial or operational investment on the part of the United States. Both the DoD and the White House have advocated for UNCLOS ratification since 1994.⁴³⁷ In March 2012, then-SECNAV Ray Mabus told the Senate Armed Services Committee that

The convention has been approved by nearly every maritime power and all the permanent members of the UN Security Council, except the United States. Our notable absence as a signatory weakens our position with other nations, allowing the introduction of expansive definitions of sovereignty on the high seas that undermine our ability to defend our mineral rights along our own continental shelf and in the Arctic.⁴³⁸

The Senate should review the DoD and Navy recommendations on UNCLOS and vote on ratification.

Conclusion

This thesis determined that eroded naval readiness can be attributed to six factors: pressure to cut defense spending, declining military pay, poor force morale, delays in fielding modern equipment, inadequate maintenance of existing equipment, and an excessive operational tempo. An organizational culture that tolerated deviation from

⁴³⁷ United States Navy, “The Convention on the Law of the Sea,” *U.S. Navy Judge Advocate General’s Corps*, Accessed October 10, 2019, https://www.jag.navy.mil/organization/code_10_law_of_the_sea.htm.

⁴³⁸ United States Navy, “The Convention on the Law of the Sea.”

accepted norms and standards compounded the challenges created by these problems, much like the impacts of global climate change will compound them in future years. In 2018, following publication of the *Strategic Readiness Review* and the *Comprehensive Review of Surface Force Incidents*, the CNO appeared before the Senate Armed Services Committee and outlined the Navy's plan to restore its readiness by 2022.⁴³⁹ Echoing military readiness scholar Richard Betts, Admiral Richardson told the committee that "the big question when you talk about readiness, is ready for what?"⁴⁴⁰ In order to achieve its goal of readiness recovery by 2022, the Navy needs to answer that question for itself. For that reason, this thesis recommends, among other things, that both the Navy and its civilian leadership in Congress and the White House, assess readiness requirements in the context of the nation's grand strategy. This will require either increasing the Navy's funding or accepting less overseas presence by naval forces on a day-to-day basis. Given the increasing importance of economic considerations in national security, strategists should accept that the latter condition is the more likely of the two to be adopted.

The Harvard Business Review explained that "the Navy needs to understand now what sorts of missions it may be required to perform in 10, 20, or 30 years and what assets and infrastructure it will need to carry out those missions. Put another way, it needs to plan for the world that will exist at that time."⁴⁴¹ Today, the Navy needs to plan for a world in which it faces smaller budgets, fewer large combatant ships and an

⁴³⁹ Megan Eckstein, "CNO: Navy to Restore Readiness Levels By 2022 After Years of Insufficient Funding," *U.S. Naval Institute Press*, April 19, 2018, <https://news.usni.org/2018/04/19/cno-navy-restore-readiness-levels-2022-years-insufficient-funding>.

⁴⁴⁰ Eckstein.

⁴⁴¹ Forest Reinhardt and Michael Toffel, "Managing Climate Change: Lessons from the U.S. Navy," *Harvard Business Review* vol. 95, no. 4 (July/August 2017), 104.

insufficient maintenance capacity. Added to these historic challenges will be increased operational requirements and threats to its own bases as a result of climate change. If the Navy – and the DoD as a whole – plans and budgets for a world bounded by these realities, its effort to arrest and reverse the force’s readiness erosion will find its best chances for success.

Appendix

Climate Impacts to U.S. Navy Mission Assurance Priority Installations as Determined by DoD⁴⁴²

DEPARTMENT OF NAVY		Recurrent Flooding		Drought		Desertification		Wildfires		Thawing Permafrost	
Installation	State	Current	Potential	Current	Potential	Current	Potential	Current	Potential	Current	Potential
Naval Base (NB) Coronado	CA	Yes	Yes	Yes	Yes	No	No	No	No	No	No
Naval Base (NB) San Diego	CA	Yes	Yes	Yes	Yes	No	No	No	No	No	No
Joint Base (JB) Anacostia Bolling	DC	Yes	Yes	Yes	Yes	No	No	No	No	No	No
U.S. Naval Observatory / Naval Support Facility (NSF) Naval Observatory	DC	No	No	Yes	Yes	No	No	No	No	No	No
Washington Navy Yard	DC	Yes	Yes	Yes	Yes	No	No	No	No	No	No
Naval Air Station (NAS) Key West	FL	Yes	Yes	Yes	Yes	No	No	No	Yes	No	No
Naval Submarine Base (NSB) Kings Bay	GA	Yes	Yes	Yes	Yes	No	No	No	Yes	No	No
Joint Base (JB) Pearl Harbor Hickam	HI	Yes	Yes	Yes	Yes	No	No	No	Yes	No	No
Wahiawa Annex	HI	Yes	Yes	Yes	Yes	No	No	No	Yes	No	No
Naval Support Facility (NSF) Indian Head	MD	Yes	Yes	Yes	Yes	No	No	No	No	No	No
Naval Air Station (NAS) Oceana	VA	Yes	Yes	Yes	Yes	No	No	No	No	No	No
Naval Support Activity (NSA) Hampton Roads - Northwest / (former) Naval Security Group Activity (NSGA) Chesapeake	VA	Yes	Yes	Yes	Yes	No	No	No	No	No	No
Naval Station (NS) Norfolk	VA	Yes	Yes	Yes	Yes	No	No	No	No	No	No
Naval Support Activity (NSA) Hampton Roads	VA	Yes	Yes	Yes	Yes	No	No	No	No	No	No
Naval Magazine Indian Island	WA	Yes	Yes	Yes	Yes	No	No	No	Yes	No	No
Naval Base (NB) Kitsap Bangor (Naval Submarine Base (NSB) Bangor)	WA	No	No	Yes	Yes	No	No	No	Yes	No	No
U.S. Territory - Naval Base Guam	Guam	Yes	Yes	Yes	Yes	No	No	No	Yes	No	No
U.S. Territory - Andersen AFB	Guam	Yes	Yes	Yes	Yes	No	No	No	No	No	No

⁴⁴² Department of Defense, *Report on Effects of a Changing Climate*, Appendix.

Bibliography

Adams, Gordon and Matthew Leatherman. "A Leaner and Meaner Defense: How to Cut the Pentagon's Budget While Improving its Performance." *Foreign Affairs* vol.90, no. 1 (January/February 2011): 139-152.

Adde, Nick. "Readiness Pillars: Surface Warfare Enterprise aims to foster better cooperation among fleet organizations." *Seapower* vol. 56, no. 12 (December 2013): 14-16.

"Adjustments of Monthly Basic Pay." 37 U.S.C. 1009 (2003) as amended.

Amadeo, Kimberly. "National Debt By Year Compared to GDP and Major Events." Accessed August 15, 2018. <https://www.thebalance.com/national-debt-by-year-compared-to-gdp-and-major-events-3306287>.

American Enterprise Institute. *State of the U.S. Military: A Defense Primer*. Washington, D.C.: American Enterprise Institute, 2015.

Apte, Aruna. *Metrics for the Naval Humanitarian Assistance and Disaster Relief (HADR) Operations*. Monterey: Naval Postgraduate School, 2017.

Apte, Aruna and Keenan Yoho. "Reacting to Crisis: The Costs of First Response by the United States Navy." *Journal of Homeland Security and Emergency Management* vol. 14, no. 1 (2017): 1-13

Apte, Aruna and Keenan Yoho. *United States Navy Humanitarian Assistance and Disaster Relief (HADR) Costs: A Preliminary Study*. Monterey: Naval Postgraduate School, 2015.

Association of Defense Communities. "Hampton Roads Businesses Look to Adapt to Climate Change." *Association of Defense Communities*, July 1, 2015. <https://www.defensecommunities.org/blog/headlines/hampton-roads-businesses-look-to-adapt-to-climate-change/>

Aucoin, Joseph. "It's Not Just the Forward Deployed." *U.S. Naval Institute Proceedings* vol. 144, no. 6 (April 2018): 12-15.

Baker, Thomas R. "Learning the New Language of Readiness." *Naval Aviation News* vol. 93, no. 4 (Fall 2011): 12-13.

Barnett, Jon and W. Neil Adger. "Climate Change, Human Security and Violent Conflict." *Political Geography* vol. 26 (2007): 639-655.

Barno, David, Nora Bensahel, and Travis Sharp. *Hard Choices: Responsible Defense in an Age of Austerity*. Washington, D.C.: Center for New American Security, 2011.

Barterls, Frederico. *Making the Case for a New Round of BRAC*. Washington D.C.: The Heritage Foundation, 2019.

Bayer, Michael and Gary Roughead. *Strategic Readiness Review*. Washington D.C.: Department of the Navy, 2017.

Beasley, Jr., William M. "Answering Mayday." *U.S. Naval Institute Proceedings* vol. 140, no. 7 (July 2014): 66-71.

Belasco, Amy. *Defense Spending and the Budget Control Act Limits*. Washington, D.C.: Congressional Research Service, 2015.

Benson, Bryce. Rebuttal to Secretarial Letter of Censure. April 26, 2019. Available from the U.S. Naval Institute at <https://news.usni.org/2019/04/26/former-uss-fitzgerald-co-outlines-defense-in-rebuttal-to-secnav>

Betts, Richard K. *Military Readiness: Concepts, Choices, Consequences*. Washington, D.C.: The Brookings Institution, 1995.

Blechner, Micah. "Experts Come Together to Discuss HA/DR Readiness during PP18." *Pacific Partnership 2018 Public Affairs*, May 29, 2018.
https://www.navy.mil/submit/display.asp?story_id=105757

Blunden, Margaret. "The New Problem of Arctic Stability." *Survival* vol. 51, no. 5 (October/November 2009): 121-142.

Bogard, Kevin, Timothy Ludwig, Chris Staats, and Danielle Kretschmer. "An Industry's Call to Understand the Contingencies Involved in Process Safety: Normalization of Deviance." *Journal of Organizational Behavior Management* vol. 35, no. 1/2 (January-June 2015) 70-80.

Briggs, Chad M. "Environmental Change, Strategic Foresight, and Impacts on Military Power." *Parameters* vol. 40, no. 3 (Autumn 2010): 1-15.

Brooks, Rosa, and Elizabeth A. Stanley, eds. *Creating Military Power the Sources of Military Effectiveness*. Stanford: Stanford University Press, 2007.

Brooks, Rosa. "Warriors and Citizens." *Hoover Digest* Issue 4 (Fall 2016): 73-82.

Brown, Oli, Anne Hammill, and Robert McLeman. "Climate Change as the 'New' Security Threat: Implications for Africa." *International Affairs* vol. 83, no. 6 (2007): 1141-1154.

Brzoska, Michael. "Climate Change and the Military in China, Russia, the United Kingdom, and the United States." *Bulletin of the Atomic Scientists* vol. 68, no. 2 (2012): 43-54.

Busby, Joshua W. *Climate Change and National Security: An Agenda for Action* (New York: Council on Foreign Relations, 2007).

Busch, Patricia. "Environment, Governance, and Conflict in Northern Nigeria and Darfur," *LOGOS: A Journal of Undergraduate Research* vol. 11 (Fall 2018): 152-171.

Canyon, Deon, Benjamin Ryan, and Frederick Burkle. "Military Provision of Humanitarian Assistance and Disaster Relief in Non-Conflict Crises." *Journal of Homeland Security and Emergency Management* vol. 14, no. 3 (2017): 1-5.

Castro, Carl and Amy Adler. "OPTEMPO: Effects on Soldier and Unit Readiness." *Parameters* vol. 29, no. 3 (Autumn 1999): 86-95.

Caudill, Jeff. "Combating Normalization of Deviance Within Your Organization." *Hydrocarbon Processing* vol. 97, no. 3 (March 2018): 47-49.

Causevic, Amar. "Facing an Unpredictable Threat: Is NATO Ideally Placed to Manage Climate Change as a Non-Traditional Threat Multiplier?" *Connections: The Quarterly Journal* vol. 16, no. 2 (2017): 59-80.

Cavas, Christopher P. "Grounded: Nearly two-thirds of U.S. Navy's strike fighters can't fly." *Defense News*, February 6, 2017.
<https://www.defensenews.com/naval/2017/02/06/grounded-nearly-two-thirds-of-us-navys-strike-fighters-cant-fly/>.

Center for Chemical Process Safety. *Recognizing and Responding to Normalization of Deviance*. New York: American Institute of Chemical Engineers, 2018.

Center for Naval Analyses. "NPS Active Component Enlisted Accessions by AFQT Category, FYs 1973-1997." Accessed August 15, 2018. <https://www.cna.org/pop-rep/1997/html/d-12.html>.

Clark, Bryan and Jesse Sloman. *Deploying Beyond Their Means: America's Navy and Marine Corps at a Tipping Point*. Washington, D.C.: Center for Strategic and Budgetary Assessments, 2015.

Colgan, Jeff. "Climate Change and the Politics of Military Bases." *Global Environmental Politics* vol. 18, no. 1 (February 2018): 33-51.

Congressional Budget Office. *Linking the Readiness of the Armed Forces to DoD's Operation and Maintenance Spending*. Washington D.C.: Congressional Budget Office, 2011.

Congressional Budget Office. *Recruiting, Retention, and Future Levels of Military Personnel*. Washington D.C.: Congressional Budget Office, 2006.

Congressional Research Service. *The Budget Control Act: Frequently Asked Questions*. Washington, D.C.: Congressional Research Service, 2018.

Congressional Research Service. *Economics and National Security: Issues and Implications for U.S. Policy*. Washington, D.C.: Congressional Research Service, 2011.

Connolly, Matt. “5 Things to Know about Hurricanes, Hampton Roads and National Security.” *The Center for Climate and Security*, October 2, 2015.
<https://climateandsecurity.org/2015/10/02/5-things-to-know-about-hurricanes-hampton-roads-and-national-security/>

Cooper, Helene. “Navy Leaders Admit Fleet Is Pulled Thin.” *The New York Times*. September 20, 2017.

Cordle, John. “Institutionalize the ‘Comprehensive Review’ Process.” *U.S. Naval Institute Proceedings* vol. 144, no. 12 (December 2018): 14-18.

Coutu, Peter. “Study Details Steps Norfolk, Virginia Beach Should Take to Protect Navy Bases as Sea Levels Rise.” *The Virginian-Pilot*, May 29, 2019.
https://www.pilotonline.com/government/local/article_3984b93a-8182-11e9-aad6-5f172ed188a0.html

Curtin, Sally, Margaret Warner, and Holly Hedegaard. “Increase in Suicide in the United States 1999-2014.” *Center for Disease Control*, April 2016.
<https://www.cdc.gov/nchs/products/databriefs/db241.htm>

Dabbieri, Ron. “Readiness: It’s Everybody’s Business.” *Engineer* vol. 21, no. 2 (April 1991): 28-32.

David, Steven R. “On Civil War.” *The American Interest* vol. 2, no. 4 (Spring 2007): 23-32.

Davidson, Philip. *Comprehensive Review of Recent Surface Force Incidents*. Norfolk: U.S. Fleet Forces Command, 2017.

Department of Defense. *Climate-Related Risk to DoD Infrastructure: Initial Vulnerability Assessment Survey (SLVAS) Report*. Washington, D.C.: Department of Defense, 2018.

Department of Defense. *Quadrennial Defense Review*. Washington, D.C.: Department of Defense, 2010.

Department of Defense. *Report on Effects of a Changing Climate to the Department of Defense*. Washington, D.C.: Department of Defense, 2019.

DeVries, Larry. "The Climate is Changing, the Navy is on Course." *U.S. Naval Institute Proceedings* vol. 136, no. 7 (July 2010): 6-8.

Driessen, Grant A. and Megan S. Lynch. *The Budget Control Act: Frequently Asked Questions*. Washington D.C.: Congressional Research Service, 2018.

Duong, Tiffany. "When Islands Drown: The Plight of Climate Change Refugees and Recourse to International Human Rights Law." *University of Pennsylvania Journal of International Law* vol. 31, no. 4 (2010): 1239-1266.

Easterbrook, Gregg. "Apocryphal Now: The myth of the hollow military." *The New Republic* (September 11, 2000): 22-27.

Eckstein, Megan. "CNO: Navy to Restore Readiness Levels By 2022 After Years of Insufficient Funding." *U.S. Naval Institute Press*, April 19, 2018.
<https://news.usni.org/2018/04/19/cno-navy-restore-readiness-levels-2022-years-insufficient-funding>.

Eckstein, Megan. "Navy to Release Arctic Strategy this Summer, Will Include Blue Water Arctic Operations." *U.S. Naval Institute*, April 19, 2018.
<https://news.usni.org/2018/04/19/navy-to-release-arctic-strategy-this-summer-will-include-blue-water-arctic-operations>

Eland, Ivan. *A Hollow Debate on Military Readiness*. Washington D.C.: Cato Institute, 2000.

Ellis, James. "Rightsizing the Navy." *Hoover Digest* vol. 3 (Summer 2018) 48-54.

Environmental and Energy Study Institute. *The National Security Impacts of Climate Change*. Washington, D.C.: Environmental and Energy Study Institute, 2017.

Espach, Ralph, David Zvijac, and Ronald Filadelfo. "Impact of Climate Change on U.S. Military Operations in the Western Pacific." *Marine Corps University Journal*, Special Issue: Climate Change and Policy (2016): 89-113.

Etzold, Thomas H. *Defense of Delusion?: America's Military in the 1980s*. New York: Harper & Row, 1982.

Faram, Mark. "Sea duty shortages: Why the Navy is offering rare extensions for thousands of first-term sailors." *Navy Times*, February 5, 2017.
<https://www.navytimes.com/news/your-navy/2017/02/05/sea-duty-shortages-why-the-navy-is-offering-rare-extensions-for-thousands-of-first-term-sailors/>.

Faturechi, Robert, Megan Rose, and T. Christian Miller. "Years of Warnings, Then Death and Disaster: How the Navy Failed its Sailors." *Propublica*, February 7, 2019. <https://features.propublica.org/navy-accidents/us-navy-crashes-japan-cause-mccain/>.

Feickert, Andrew and Stephen Daggett. *A Historical Perspective on "Hollow Forces."* Washington, D.C.: Congressional Research Service, 2012.

Flournoy, Michele and Richard Fontaine. "Economic Growth is a National Security Issue." *Wall Street Journal*, May 27, 2015. Accessed August 15, 2018, <https://www.wsj.com/articles/economic-growth-is-a-national-security-issue-1432683397>.

Flowers, Arija. "National Security in the 21st Century: How the National Security Council Can Solve the President's Climate Change Problem." *Sustainable Development Law & Policy* vol. 11, no. 2 (Winter 2011): 50-55.

Forsling, Carl. "Here's Why the Military's New Retirement System May Not Be So Bad." *Task and Purpose*, February 28, 2018. <https://taskandpurpose.com/militarys-new-retirement-system-actually-build-smarter-future-force/>.

Forster, Larissa. "The Soft Power Currencies of U.S. Navy Hospital Ship Missions." *International Studies Perspectives* vol. 16 (2015): 367-387.

Freedberg, Sydney J. "Submarine Maintenance Backlog Threatens Crisis Response: Admiral." *Breaking Defense*, November 6, 2017. <https://breakingdefense.com/2017/11/submarine-maintenance-backlog-threatens-crisis-response-admiral/>

Fuentes, Gidget. "Rising Sea Levels." *Seapower* vol. 58, no. 6 (July/August 2015): 42-45.

Gallaudet, T.C. and C.C. St. John. "The U.S. Navy's Approach to Climate Change and Sea Level Rise." In *Climate: Global Change and Local Adaptation*, edited by I. Linkov and T.S. Bridges, 293-309. New York: Springer, 2011.

Gansler, Jacques S. *Affording Defense*. Cambridge: Massachusetts Institute of Technology, 1989.

Gelb, Leslie H. "GDP Now Matters More Than Force: A U.S. Foreign Policy for the Age of Economic Power." *Foreign Affairs* vol. 89, no. 6 (November/December 2010): 35-43.

George, James L. *Is Readiness Overrated?: Implications for a Tiered Readiness Force Structure*. Washington D.C.: Cato Institute, April 29, 1999.

Gertler, Jeremiah. *F-35 Joint Strike Fighter (JSF) Program*. Washington, D.C.: Congressional Research Service, 2018.

Gibson, Jenny and Andrew Schulman. “Recovering Military Installation Readiness for the 21st Century Mission.” *Journal of the American Society of Military Comptrollers* vol. 63, no. 2 (Spring 2018): 30-33.

Glavinov, Aleksandar and Goran Kamchev. “The Impact of Climate Change on Military Activities.” *Contemporary Macedonian Defense* vol. 16, no. 31 (2016): 67-78.

Goldwater-Nichols Department of Defense Reorganization Act. Public Law 99-433, October 4, 1996.

Goodell, Jeff. *The Fight of Our Time*. Rolling Stone, issue 1250/1251 (December 2015): 39-43.

Gortney, William and Harry Harris. “Applied Readiness.” *U.S. Naval Institute Proceedings* vol. 140, no. 10 (October 2014): 40-45.

Government Accountability Office. *Climate Change Adaptation: DoD Can Improve Infrastructure Planning and Processes to Better Account for Potential Impacts*. Washington, D.C.: Government Accountability Office, 2014.

Government Accountability Office. *Climate Change Adaptation: DoD Needs to Better Incorporate Adaptation into Planning and Collaboration at Overseas Installations*. Washington, D.C.: Government Accountability Office, 2017.

Government Accountability Office. *Climate Resilience: DoD Needs to Assess Risk and Provide Guidance on Use of Climate Projections in Installation Master Plans and Facilities Designs*. Washington, D.C.: Government Accountability Office, 2019.

Government Accountability Office. *Navy Shipbuilding: Past Performance Provides Valuable Lessons for Future Investments*. Washington, D.C.: Government Accountability Office, 2018.

Government Accountability Office. *Naval Shipyards: Action Needed to Improve Poor Conditions that Affect Operations*. Washington, D.C.: Government Accountability Office, 2017.

Graves, Brad. “Taking A Defensive Posture.” *San Diego Business Journal* vol.33, issue 48 (November 26, 2011): 15-21.

Greenert, Jonathan. *Navy Climate Change Roadmap*. Washington, D.C.: Department of the Navy, 2010.

Greenert, Jonathan. “Statement of Admiral Jonathan Greenert, U.S. Navy Chief of Naval Operations, Before the Senate Armed Services Committee on the Impact of Sequestration on National Defense,” January 28, 2015.

Harris, Sinclair. "The Navy's Role in Confronting Irregular Challenges." *U.S. Naval Institute Proceedings* vol. 139, no. 4 (April 2013): 79-81.

Harrison, Todd. "Rethinking Readiness." *Strategic Studies Quarterly* vol. 8, no. 3 (Fall 2014): 38-68.

Haskin, Grace. "Climate Change and Security." *Global Security Studies* vol. 7, no. 2 (Spring 2016): 1-13.

Hayden, F. Gregory. "Military Planning in a Context of Complex Systems and Climate Change." *Journal of Economic Issues* vol. 52, no. 2 (June 2018): 349-357.

Henning, Charles. *Military Pay and Benefits: Key Questions and Answers*. Report for Congress. Washington D.C.: Congressional Research Service, 2011.

Herman, Arthur. "The Re-Hollowing of the Military." *Commentary* vol. 130, no. 2 (September 2010): 11-17.

Hosek, James and Jennifer Sharp. *Keeping Military Pay Competitive: The Outlook for Civilian Wage Growth and Its Consequences*. Santa Monica: RAND Corporation, 2001.

Jones, Frank L. *A "Hollow Army" Reappraised: President Carter, Defense Budgets, and the Politics of Military Readiness*. Carlisle: U.S. Army War College Strategic Studies Institute, 2012.

Johnson, Stewart, et al. *A Strategy-Based Framework for Accommodating Reductions in the Defense Budget*. Santa Monica: RAND Defense Research Institute, 2012.

Jones, Jeffrey M. "More Americans Say U.S. Has Top Military Than Top Economy." *Gallup, Inc.*, February 22, 2017. <https://news.gallup.com/poll/204233/americans-say-top-military-top-economy.aspx>.

Kamarck, Kristy N. *Military Retirement: Background and Recent Developments*. Washington, D.C.: Congressional Research Service, 2018.

Kapp, Lawrence and Barbara Salazar Torreon. *Military Pay: Key Questions and Answers*. Washington D.C.: Congressional Research Institute, 2018.

Kapp, Lawrence. *Recruiting and Retention: An Overview of FY2011 and FY2012 Results for Active and Reserve Component Enlisted Personnel*. Washington D.C.: Congressional Research Institute, 2013.

Kapp, Lawrence. *Recruiting and Retention: An Overview of FY2013 and FY2014 Results for Active and Reserve Component Enlisted Personnel*. Washington D.C.: Congressional Research Institute, 2015.

Kaufman, William. "Hollow Forces?" *Brookings Review* vol. 12, no. 4 (Fall 1994): 24-30.

Kennedy, Brian. "Most Americans Trust the Military and Scientists to Act in the Public's Interest." *Pew Research Center*, October 18, 2016.
<http://www.pewresearch.org/fact-tank/2016/10/18/most-americans-trust-the-military-and-scientists-to-act-in-the-publics-interest/>.

Kime, Patricia. "The Climate Challenge: Sea Services Wrestle with the Implications of Dramatic Change." *Seapower* vol. 53, no. 5 (May 2010): 56-60.

Kitfield, James. "The Hollow Force Myth." *National Journal* 30, no. 50 (December 12, 1998): 2906-2912.

Kohn, Richard H. "Beyond Sequester: Improving National Defense in an Age of Austerity." *Joint Force Quarterly*, no. 70 (Third Quarter, 2013): 47-54.

Konigsberg, Charles. *America's Priorities: How the U.S. Government Raises and Spends \$3,000,000,000 (Trillion) Per Year*. Bloomington: Author House, 2007.

Korb, Lawrence J. "Are U.S. Forces Unprepared and Underfunded?" *Naval War College Review* 55, no. 2 (Spring 2002): 29-40.

Kraska, James, ed. *Arctic Security in an Age of Climate Change*. Cambridge: Cambridge University Press, 2011.

Kusnetz, Nicholas. "Rising Seas Threaten Norfolk Naval Shipyard, Raising Fears of 'Catastrophic Damage.'" *NBC News*, November 19, 2018.
<https://www.nbcnews.com/news/us-news/rising-seas-threaten-norfolk-naval-shipyard-raising-fears-catastrophic-damage-n937396>

LaGrone, Sam. "USS Fitzgerald Leaves Mississippi Drydock After More than a Year of Repairs." *U.S. Naval Institute News*, April 16, 2019.
<https://news.usni.org/2019/04/16/uss-fitzgerald-leaves-mississippi-drydock-after-more-than-a-year-of-repairs>

Laird, Melvin R. and Lawrence J. Korb. *The Problem of Military Readiness*. Washington D.C.: American Enterprise Institute for Public Policy Research, 1980.

Leggett, Jane. *President Obama's Climate Action Plan*. Washington, D.C.: Congressional Research Service, 2013.

Lewis, John. *Planning for the Effects on Personnel Readiness of Increased OPTEMPO*. Thesis. Newport, RI: Naval War College, 2006.

Lorenzo Hall, Joseph. “*Columbia and Challenger: Organizational Failure at NASA*” *Space Policy* vol. 37, no. 3 (2016): 127-133.

Marqusee, Jeffrey. “Department of Climate Defense.” *Dissent* vol. 63, no. 2 (Spring 2016): 56-62.

Matthew, Richard A. “Is Climate Change a National Security Issue?” *Issues in Science and Technology* (Spring 2011): 49-60.

Mazo, Jeffrey. *Climate Conflict: How Global Warming Threatens Security and What to Do About It*. London: International Institute for Strategic Studies, 2010.

McAllister Linn, Brian. “The U.S. Army's Postwar Recoveries.” *Parameters* vol. 46, no. 3 (Autumn 2016): 13-22.

McDevitt, Michael. “Shrinking the Status-Quo Navy.” *U.S. Naval Institute Proceedings* vol. 137, no. 2 (February 2011): 22.

McGeehan, Timothy. “A War Plan Orange for Climate Change.” *U.S. Naval Institute Proceedings* vol. 143, no. 10 (October 2017): 48-53.

McGrath, Jamie. “Peacetime Naval Rearmament, 1933-39: Lessons for Today.” *Naval War College Review* vol. 72, no. 2 (Spring 2019): 89-109.

Military Advisory Board. *National Security and the Accelerating Risks of Climate Change*. Alexandria: Center for Naval Analyses, 2014.

Military Advisory Board. *National Security and the Threat of Climate Change*. Alexandria: Center for Naval Analyses, 2007.

Miller, Richard M. “This Time, It’s Different.” *U.S. Naval Institute Proceedings* vol. 139, no. 1 (January 2013): 52-56.

Miller, T. Christian, Megan Rose, and Robert Faturechi. “Death and Valor on an American Warship Doomed by its Own Navy.” *Propublica*, February 6, 2019. <https://features.propublica.org/navy-accidents/uss-fitzgerald-destroyer-crash-crystal/>.

Miller, T. Christian and Robert Faturechi. “How The Navy’s Top Commander Botched the Highest-Profile Investigation in Years.” *Propublica*, February 7, 2019. <https://features.propublica.org/navy-accidents/us-navy-crashes-japan-cause-mccain/>.

Modly, Thomas. *Charter for the Readiness Reform and Oversight Council*. Washington, D.C.: Department of the Navy, 2018.

Modly, Thomas. “Don’t Ever, Ever Give Up the Ship.” *Naval War College Review* vol. 71, no. 2 (Spring 2018): 5-11.

Moon Cronk, Terri. "DoD's Underfunded Maintenance Backlog Exceeds \$116 Billion, Official Says." *Defense Media Activity*, April 18, 2018.
<https://www.defense.gov/News/Article/Article/1497582/dods-underfunded-maintenance-backlog-exceeds-116-billion-official-says/>

Moore, S. Craig, J.A. Stockfish, Matthew S. Goldberg, Suzanne M. Holroyd, and Gregory G. Hildebrandt. *Measuring Military Readiness and Sustainability*. Santa Monica: RAND Corporation, 1991.

Morales, Emilio. "Global Climate Change as a Threat to U.S. National Security." *Journal of Strategic Security* vol. 8, no. 5 (Fall 2015): 134-148.

Murdock, Clark and Kevin Kallmyer. "Applied Grand Strategy: Making Tough Choices in an Era of Limits and Constraint." *Orbis* (Fall 2011): 541-557.

Nagel, Joane. "Climate Change, Public Opinion, and the Military Security Complex." *The Sociological Quarterly* vol. 52 (2011): 203-211.

Nanto, Dick K. *Economics and National Security: Issues and Implications for U.S. Policy*. Washington D.C.: Congressional Research Service, 2011.

The Nation Editorial Staff. "Pentagon Drawdown." *The Nation* vol. 294, no. 5 (January 30, 2012): 3-4.

National Research Council. *National Security Implications of Climate Change for U.S. Naval Forces: Letter Report*. Washington, D.C.: Naval Studies Board, 2010.

National Research Council. *National Security Implications of Climate Change for U.S. Naval Forces*. Washington, D.C.: Naval Studies Board, 2011.

Newport, Frank. "Americans' Confidence in Institutions Edges Up." *Gallup, Inc.*, June 26, 2017. <https://news.gallup.com/poll/212840/americans-confidence-institutions-edges.aspx>.

Newport, Frank. "Americans Not Convinced U.S. Needs to Spend More on Defense." *Gallup, Inc.*, February 21, 2018. <https://news.gallup.com/poll/228137/americans-not-convinced-needs-spend-defense.aspx>.

Newport, Frank. "Memorial Day Finds Americans Very Positive About Military." *Gallup, Inc.*, May 25, 2018. <https://news.gallup.com/opinion/polling-matters/235013/memorial-day-finds-americans-positive-military.aspx>.

Newport, Frank. "U.S. Confidence in Military Reflects Perceived Competency." *Gallup, Inc.*, June 27, 2017. <https://news.gallup.com/poll/214511/high-confidence-military-reflects-perceived-competency.aspx>.

Norman, Jim. "Americans Give Military Branches Similar High Marks." *Gallup, Inc.*, May 26, 2017. <https://news.gallup.com/poll/211112/americans-give-military-branches-similar-high-marks.aspx>.

Obama, Barack. *Memorandum of Climate Change and National Security*. Washington, D.C.: The White House, 2016.

O'Hanlon, Michael. *Budgeting for Hard Power: Defense and Security Spending under Barack Obama*. Washington, D.C.: Brookings Institution Press, 2009.

O'Hanlon, Michael. *A Moderate Plan for Additional Defense Budget Cuts*. Washington, D.C.: Brookings Institution Press, 2013.

O'Hanlon, Michael. *Is the Pentagon headed for a military readiness crisis?* Washington, D.C.: Brookings Institution Press, 2017.

O'Rourke, Ronald. *Changes in the Arctic: Background and Issues for Congress*. Washington, D.C.: Congressional Research Service, 2015.

Ortmann, Günther. "On Drifting Rules and Standards." *Scandinavian Journal of Management* vol. 26, no. 2 (2010): 204-214.

Osborn, Kris. "Navy Survey: Sailors Unhappy, Don't Trust Brass." *Military Times*. Accessed August 15, 2018, <https://www.military.com/daily-news/2014/09/04/navy-survey-sailors-unhappy-dont-trust-brass.html>.

Pandolfe, Frank. "The Evolution of Modern U.S. Naval Strategy." *Naval War College Review* vol. 69, no. 4 (Autumn 2016): 7-13.

Panetta, Leon et al.. *The Building Blocks of a Ready Military: People, Funding, Tempo*. Washington, D.C.: Bipartisan Policy Center, 2017.

Panger, Steve. "How We Rationalize Shortcuts." *The Mobility Forum* vol. 27, no. 1 (Spring 2018): 8-9.

Parker, Laura. "Who's Still Fighting Climate Change? The U.S. Military." *National Geographic*, February 7, 2017. <https://www.nationalgeographic.com/news/2017/02/pentagon-fights-climate-change-sea-level-rise-defense-department-military/>

Patel, Ronak B. and David P. Palotty IV, "Climate Change and Urbanization: Challenges to Global Security and Stability," *Joint Force Quarterly* vol. 89 (Second Quarter 2018): 93-98.

Pendleton, John H. *Military Readiness: Progress and Challenges in Implementing the Navy's Optimized Fleet Response Plan*. Washington, D.C.: Government Accountability Office, 2016.

Pendleton, John H. *Navy Force Structure: Sustainable Plan and Comprehensive Assessment Needed to Mitigate Long-Term Risk to Ships Assigned to Overseas Homeports*. Washington, D.C.: Government Accountability Office, 2015.

Pendleton, John H. *Navy Readiness: Actions Needed to Address Persistent Maintenance, Training, and Other Challenges Affecting the Fleet*. Washington, D.C.: Government Accountability Office, 2017.

Perneger, Thomas. "The Swiss Cheese Model of Safety Incidents: Are there Holes in the Metaphor?" *BMC Health Services Research* vol. 5, no. 71 (2005): 1-7.

Pew Research Center. "The Military-Civilian Gap: Fewer Family Connections." *Pew Research Center*, November 23, 2011. <http://www.pewsocialtrends.org/2011/11/23/the-military-civilian-gap-fewer-family-connections/>.

Peyer, Polly. *Hollow Force: Scare or Dare?* Executive Research Project. Washington D.C.: Industrial College of the Armed Forces, 1994.

Philipps, Dave and Eric Schmitt. "Strains on Crews and Vessels Set the Stage for Navy Crashes." *The New York Times*. August 28, 2017.

Pickup, Sharon. *Military Readiness: Navy's Report to Congress on the Impact of Training and Crew Size on Surface Force Material Readiness*. Washington, D.C.: Government Accountability Office, 2011.

Pinto, Jeffrey. "Project Management, Governance, and the Normalization of Deviance." *International Journal of Project Management* vol. 32, no. 3 (2014): 376-387.

Prielipp, Richard, Maria Magro, Robert Morell, and Sorin Brull. "The Normalization of Deviance: Do We (Un)Knowingly Accept Doing the Wrong Thing?" *American Association of Nurse Anesthetists Journal* vol. 78, no. 4 (August 2010): 284-287.

Proulx, Guylene. "Reponses to Fire Alarms: The Way People Respond to a Fire Alarm Depends on a Number of Factors." *Fire Protection Engineering* vol. 33, no. 8 (Winter 2007): 8-14.

Pumphrey, Carolyn, ed. *Global Climate Change: National Security Implications*. Carlisle, U.S. Army War College, 2008.

RAND Corporation. *Have Improved Resources Increased Military Recruiting and Retention?* Santa Monica: RAND Corporation, 2004.

Rasmussen Reports. "New High: 43 Say U.S. Doesn't Spend Enough on National Security." *Rasmussen Reports*, August 19, 2014.
http://www.rasmussenreports.com/public_content/politics/general_politics/august_2014/new_high_43_say_u_s_doesn_t_spend_enough_on_national_security.

Rasmussen Reports. "Voters Still Hold Military In High Esteem." *Rasmussen Reports*, March 16, 2015.
http://www.rasmussenreports.com/public_content/politics/general_politics/march_2015/voters_still_hold_military_in_high_esteem.

Rasmussen, Scott. "Ready to Cut Military Spending." *Reason* vol. 44, no. 5 (October 2012) 30-35.

Raunu, Mika and Rory Berke. "Preparing for Arctic Naval Operations." *U.S. Naval Institute Proceedings* vol. 144, no. 12 (December 2018): 70-72.

Reagan, Ronald. *Executive Order 12356*. Washington, D.C.: The White House, 1982.

Reinhardt, Forest and Michael Toffel. "Managing Climate Change: Lessons from the U.S. Navy." *Harvard Business Review* vol. 95, no. 4 (July/August 2017): 102-111.

Robinson, Matthew, James Jondrow, Laura Junor and Jessica Oi. *Avoiding a Hollow Force: An Examination of Navy Readiness*. Alexandria: Center for Naval Analyses, 1996.

Roston, Eric. "Major Military Bases Unprepared for Climate Change, U.S. Watchdog Finds." *Bloomberg*, June 13, 2019. <https://www.bloomberg.com/news/articles/2019-06-13/major-military-bases-unprepared-for-climate-change-u-s-watchdog-finds>

Roughead, Gary, J. Stephen Morrison, Thomas Cullison, and Seth Gannon. *U.S. Navy Humanitarian Assistance in an Era of Austerity*. Washington, D.C.: Center for Strategic and International Studies, 2013.

Rubel, Robert. "Posture Versus Presence: The Relationship between Global Naval Engagement and Naval War-Fighting Posture." *Naval War College Review* vol. 69, no. 4 (Autumn 2016): 19-29.

Rundquist, Barry, and Thomas Carsey. *Congress and Defense Spending: The Distributive Politics of Military Procurement*. Norman: University of Oklahoma Press, 2002.

Sanders, Gregg. "Let the Squadrons Decide." *U.S. Naval Institute Proceedings* vol. 143, no. 4 (April 2017): 48-52.

Scott, Shirley V. and Shahedul Khan. "The Implications of Climate Change for the Military and for Conflict Prevention, Including through Peace Missions." *Air & Space Power Journal: ASPJ Africa & Francophonie* vol. 7, no. 3 (Third Quarter 2016): 82-94.

Shafley, Bill. "Humanitarian Assistance Test Leaders." *U.S. Naval Institute Proceedings* vol. 145, no. 8 (August 2019): 75-77.

Shoemaker, Michael. "Interview with the 'Air Boss.'" *U.S. Naval Institute Proceedings* vol. 143, no. 9 (September 2017): 22-26.

Sindico, Francesco. "Climate Change and Security." *Carbon & Climate Law Review* vol. 11, no. 3 (2017): 187-190.

Smith, Russell, Sean Robinson, Kate Hermsdorfer and Bill Kerr. "Environmental Prediction is a Weapon System." *U.S. Naval Institute Proceedings* vol. 144, no. 12 (December 2018): 72-74.

Snodgrass, Guy M. "Keep a Weather Eye on the Horizon: A Navy Officer Retention Study." *Naval War College Review* vol. 67, no. 4 (Autumn 2014): 64-92.

Standford, Julianne. "Navy Secretary: Resolving Shipyard Backlog is Crucial." *Kitsap Sun*, October 17, 2017. <https://www.kitsapsun.com/story/news/local/2017/10/17/navy-secretary-resolving-shipyard-backlog-crucial/772440001/>

Stewart, Kenneth and Dale Kuska. "Operation HA/DR – NPS Efforts to Improve Humanitarian Assistance and Disaster Relief Operations." *Naval Postgraduate School*, March 28, 2014. <https://web.nps.edu/About/News/Operation-HA/DR-NPS-Efforts-to-Improve-Humanitarian-Assistance-and-Disaster-Relief-Operations.html>.

Thomas, Jeffrey, Amy Adler, and Carl Andrew Castro. "Measuring Operations Tempo and Relating it to Military Performance." *Military Psychology* vol. 15, no. 3 (2005): 137-156.

Tompkins, Phillip, Kurt Heppard, and Craig Melville. "Deviance from Normality or the Normalization of Deviance? Making Sense of the *Challenger* Launch Decision." *Organization* vol. 5, no. 4 (1998): 620-629.

Turner, Stansfield. "Is the U.S. Navy Being Marginalized?" *Naval War College Review* vol. 56, no. 3 (Summer 2003): 97-104.

Tyler, David. "Leadership Forum Make Morale Our First Priority." *U.S. Naval Institute Proceedings* vol. 142, no. 11 (November 2016): 70-72.

Union of Concerned Scientists. "The U.S. Military on the Front Lines of Rising Seas: Growing Exposure to Coastal Flooding and East and Gulf Coast Military Bases." *Union of Concerned Scientists*, July 27, 2016. <https://www.ucsusa.org/resources/us-military-front-lines-rising-seas>

United States Navy. *Annual Report of the Judge Advocate General of the Navy*. Washington, D.C.: Department of the Navy, 1970 through 2017.

United States Navy. *A Cooperative Strategy for 21st Century Seapower*. Washington, D.C.: Department of the Navy, 2015.

United States Navy. "Navy Recruiting Achieves Highest Quality Enlisted Force in Navy History." *Naval Recruiting Command Public Affairs*. Accessed August 15, 2018, http://www.navy.mil/submit/display.asp?story_id=50926.

United States Navy. "Navy Suicide Data." *Navy Personnel Command*. Accessed August 15, 2018, https://www.public.navy.mil/bupers-npc/support/21st_Century_Sailor/suicide_prevention/Pages/Statistics.aspx

United States Navy. *Report on the Collision between USS FITZGERALD (DDG 62) and Motor Vehicle ACX CRYSTAL*. Washington, D.C.: Office of the Chief of Naval Operations, 2017.

United States Navy. *Report on the Collision between USS JOHN S. MCCAIN (DDG 56) and Motor Vessel ALNIC MC*. Washington, D.C.: Office of the Chief of Naval Operations, 2017.

United States Navy. "Status of the Navy." Accessed August 15, 2018. http://www.navy.mil/navydata/nav_legacy.asp?id=146

United States Navy. *United States Navy Arctic Roadmap for 2014 to 2030*. Washington, D.C.: Department of the Navy, 2014.

United States Navy. "U.S. Navy Active Force Ship Levels." *Naval History and Heritage Command*. Accessed August 15, 2018, <https://www.history.navy.mil/research/histories/ship-histories/us-ship-force-levels.html#2000>

U.S. Naval Institute, "Congressional Budget Office Report on 355-Ship Navy Costs." Accessed August 15, 2018. <https://news.usni.org/2018/03/15/congressional-budget-office-report-355-ship-navy-costs>.

Vaughan, Diane. *The Challenger Launch Decision*. Chicago: University of Chicago Press, 1996.

Vaughan, Diane. "Theorizing Disaster: Analogy, Historical Ethnography, and the Challenger Accident." *Ethnography* vol. 5, no. 3 (2004): 377.

Ventimiglia, Matthew. "Experienced Technicians Matter." *U.S. Naval Institute Proceedings* vol. 142, no. 9 (September 2016): 80-82.

Werner, Ben. "USS John S. McCain Now In Japan For Repairs Following Deadly August Collision." *U.S. Naval Institute News*, December 13, 2017.
<https://news.usni.org/2017/12/13/uss-john-s-mccain-now-japan-repairs-following-deadly-august-collision>.

Whiteneck, Daniel, Michael Price, Neil Jenkins, and Peter Swartz. *The Navy at a Tipping Point: Maritime Dominance at Stake?* Alexandria: Center for Naval Analyses, 2010.

Wicker, Roger and Jerry Hendrix. "The Naval Imperative." *The National Interest* no. 155 (May/June 2018): 70-77.

Williams, Cindy. "Accepting Austerity: The Right Way to Cut Defense." *Foreign Affairs* 92 no. 6 (November/December 2013): 55-64.

Williams, Cindy. "State of the Nation: A Costly Defense." *Boston Review* vol. 8, no. 5. (May/June 2013): 5.

Wood, Dakota L. ed. *2016 Index of U.S. Military Strength*. Washington, D.C.: The Brookings Institution, 2016.

Wood, Dakota L. ed. *2017 Index of U.S. Military Strength*. Washington, D.C.: The Brookings Institution, 2017.

Wood, Dakota L. ed. *2018 Index of U.S. Military Strength*. Washington, D.C.: The Brookings Institution, 2018.

Ziezulewicz, Geoff. "Worse Than You Thought: Inside the Secret Fitzgerald Probe the Navy Doesn't Want You to Read." *Navy Times*, January 13, 2019.
<https://www.navytimes.com/news/your-navy/2019/01/14/worse-than-you-thought-inside-the-secret-fitzgerald-probe-the-navy-doesnt-want-you-to-read/>.

About the Author

Lieutenant Justin Witwicki is an active duty U.S. Navy officer and an instructor at the Airborne Command & Control and Logistics Weapons School in Point Mugu, California. From 2013 to 2017, he was assigned to the Forward Deployed Naval Forces in Atsugi, Japan as an E-2C Hawkeye mission commander and deployed four times onboard the USS *Ronald Reagan* and the USS *George Washington*. In 2013, he was awarded the Armed Forces Humanitarian Service Medal for his role in Operation Damayan, the humanitarian assistance and disaster relief operation in the Philippines following Super Typhoon Haiyan. In 2009, he earned a Bachelor of Arts in Political Science from Saint Joseph's University, *summa cum laude*, and he is a member of the Phi Beta Kappa Society. He studied in residence at Saint Louis University in Madrid, Spain in 2007. Thereafter, he served as an intern in the Office of Vice President Richard Cheney at the White House. After receiving his Master of Arts in Government from Johns Hopkins University, he will be designated as a naval strategist by the Department of Defense.