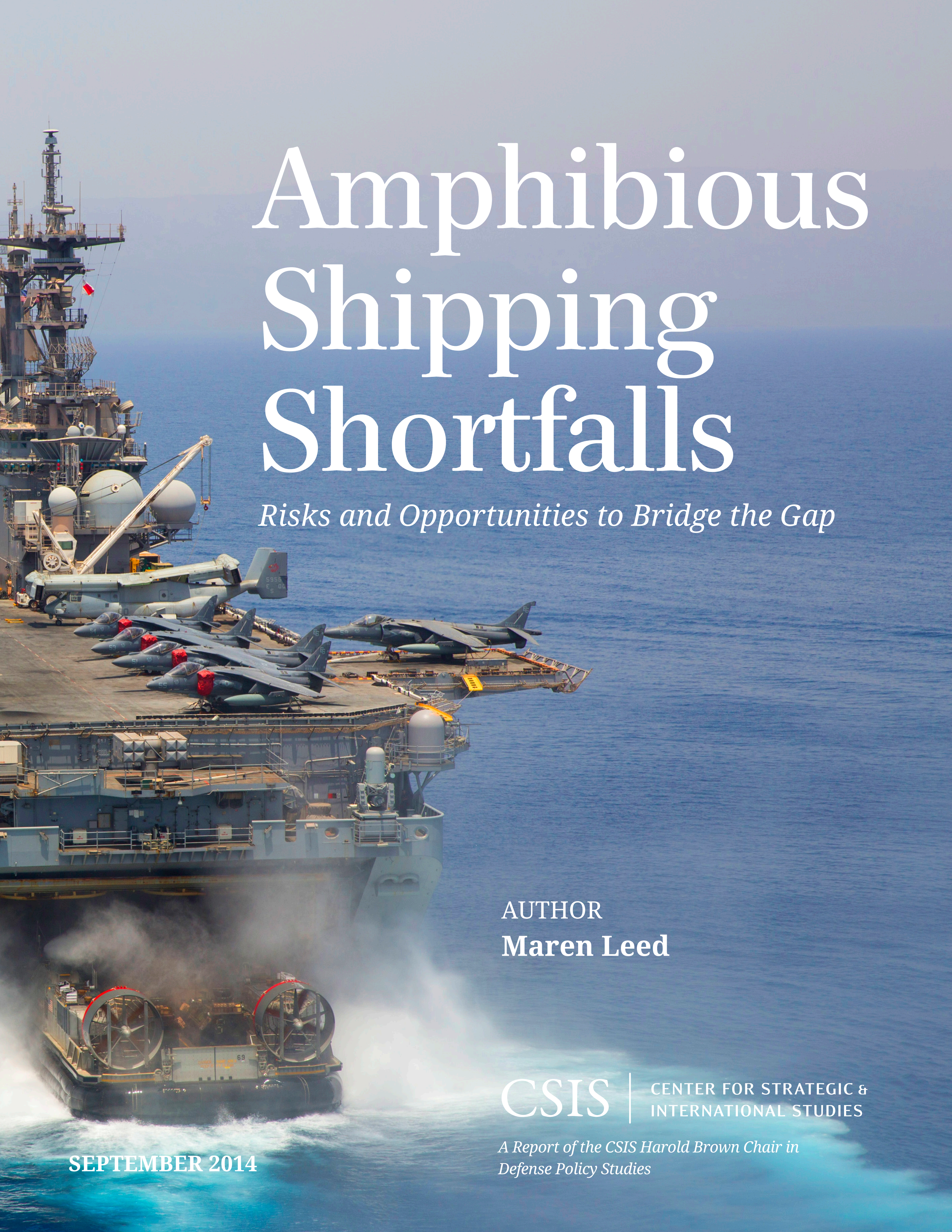

Amphibious Shipping Shortfalls

Risks and Opportunities to Bridge the Gap

AUTHOR
Maren Leed

CSIS | CENTER FOR STRATEGIC & INTERNATIONAL STUDIES

A Report of the CSIS Harold Brown Chair in Defense Policy Studies

SEPTEMBER 2014

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Contents

Acknowledgments v

Executive Summary vii

Introduction 1

1. The Demand for, and Supply of, Amphibious Shipping 3
2. Mitigating the Amphibious Capability Gap 17
3. A Framework for Assessing Risk 23
4. Risk across the Spectrum of Operations 35
5. Mitigating Risks Associated with Alternative Platforms 45
6. Conclusion 54

Appendix A. Attribute and Characteristic Ratings by Operational Type 60

Appendix B. Attribute and Characteristic Ratings by Ship 64

Appendix C. Ships' Attribute and Characteristic Gaps by Mission 68

Appendix D. Ship Designations and Acronyms 70

Bibliography 72

About the Authors 81

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The study team is particularly grateful to Huntington Ingalls Industries (HII) for their sponsorship of this effort. As momentum to make greater use of non-amphibious ships grows, we believe there is an important opportunity to shape a more structured way of considering the options. HII's support allowed us to develop the framework offered here, and respected our independence at each step along the way.

While this study could not have occurred without the generous participation of all of those mentioned above, they are not responsible for its contents. Any errors are the fault of the main author alone.

Executive Summary

> "It is not enough to do your best. You must know what to do, and then do your best."
>
> —W. Edwards Deming

For those in the amphibious operations business, these are tough times. Amphibious ships—the "workhorse of the fleet"[1]—are in short supply, and demand for the capabilities they bring to the table shows no sign of abating. Navy and Marine leaders, the Department of Defense, and the Congress are actively engaged in managing the risks that result from this gap in capability, though they are by no means unique to amphibious ships, the Navy, or the joint force more broadly.

The magnitude of unmet demand for many U.S. military capabilities has forced a shift in mindset from one of what regional commanders need to what the "system" can reliably provide. In the amphibious context, this shift has prompted an examination of whether greater use can be made of other ships currently in the fleet that may be able to offer some aspects of the broader capability set resident in amphibious vessels.

For the Navy in general and the amphibious fleet in particular, hindsight offers some clarity about the path to today. Projected fleet requirements had been based on presumed warfighting demands of the Cold War, and were late taking into account the utility of the full range of attributes ships possess for steady-state, new normal, or presence operations. Inventory levels of both amphibious and support ships fell, in some cases vessels were followed by less capable replacements, and efficiency-driven process changes to manning, maintenance, and other enabling functions ate into the availability of the ships that remained. The result is a fleet under significant stress.

For the Marine Corps, this has engendered almost continuous reevaluations of how to best meet short- and longer-term demands for the specific capabilities amphibious ships bring to bear. These efforts have spawned multiple initiatives, from the creation of new units to investments in new technologies to the development of new concepts. The need for

1. Assistant Secretary of the Navy Sean Stackley, testimony at hearing on Department of Defense Authorization of Appropriations for Fiscal Year 2015 and the Future Years Defense Program, U.S. Senate Subcommittee on Seapower, Committee on Armed Services, April 10, 2014, 14.

innovation is not yet satisfied, however, as the strain on the existing fleet—and thus how the Marine Corps prefers to do business—will remain for some time.

One area of increasing focus has been how to more broadly leverage non-amphibious platforms. This approach requires that we view these ships not just as transports or sea bases (in many cases), but as operational platforms. This study offers a framework to evaluate what such an expansion of their roles might involve. It begins by identifying key attributes and supporting characteristics of amphibious capabilities. It then uses them as a basis for comparison between what is needed for various types of military operations and a range of amphibious and non-amphibious ships.

This comparison helps to illuminate the degree to which non-amphibious ships can be utilized in ways that exceed the purposes that drove their original design. The commercially based vessels we evaluated, for example, are (by design) less survivable than amphibious ships, which are specifically constructed to operate in hostile environments. Many of those same commercially based ships, however, have attributes that are relevant to at least some portions of some operational missions, and can thus make useful—if circumscribed—contributions.

To facilitate this analysis, this study describes amphibious attributes and supporting characteristics in some detail. It then offers an initial assessment of how some of those characteristics relate to a range of operations. In comparing operational needs and specific ships, it identifies shortfalls that serve as indicators of increased risk if those ships were to be used independently. For example, at the individual ship level we find that:

- The lowest risk options are in applying alternative platforms to humanitarian and civic assistance operations such as medical, dental, and engineering services for local populations, and in security force assistance operations in which Marines train and exercise with partner militaries;
- All ships, to varying degrees, lack the requisite breadth and projection capabilities and/or capacity to independently support humanitarian assistance and disaster relief operations, to such an extent that providing the same level of support that would be resident in a single large deck amphibious ship would require the employment of multiple ships in combination;
- Alternative platforms might be able to conduct counter-drug operations against adversaries that present a low threat, but would need augmentation directly or through the presence of other ships to lower risks in the areas of air and surface capabilities; command and control; intelligence, surveillance and reconnaissance; and crew capacity;
- The use of alternative platforms for maritime interdictions or in support of foreign internal defense operations, even in an environment expected to be benign, would involve even more substantial risks that would require mitigation; and

> The most serious challenge for future U.S. amphibious capabilities is the lack of a common, comprehensive, and systems-based strategy to serve as a guide for difficult choices.

- Survivability concerns would almost certainly preclude the potential for non-amphibious platforms to "substitute" for the capabilities provided by amphibious ships in operations with a reasonable or likely chance of hostilities.

Some of the shortfalls identified in our analysis are more amenable to resolution than are others; many, for example, could be overcome by operating ships in combination. We do not examine alternatives in detail, as options to mitigate specific areas of risk are often bespoke, but we do offer broad areas of consideration that can inform perspectives on the range and level of effort that might be involved in addressing particular areas where shortfalls were common.

However, while this analysis may provide useful insights about aspects of platform employment or a particular ship modification, its utility is intended to be greater. In conducting this analysis, the study team concluded that the most serious challenge for future U.S. amphibious capabilities is the lack of a common, comprehensive, and systems-based strategy to serve as a guide for the difficult choices that must continue to be made. At present, while individual decisions can and are being taken, their system-level effects are not obvious but are critically important.

The lack of a comprehensive strategy means that policymakers do not have a shared understanding of how much amphibious capability is "enough," nor about how best to allocate scarce resources among the many contributors to those capabilities—be they amphibious ships, support or transport vessels, "connectors" that enable Marines' ability to get and continue to operate ashore, or Marines themselves. It inhibits clear debates about how best to prioritize within shipbuilding funding accounts that are under growing pressure, and it encourages short-term focused point solutions while obscuring their interdependence and long-term implications.

Ultimately, these distinctions among ships, when coupled with more specific and measurable attributes and supporting characteristics, help to establish a foundation for a broad-based strategy to help guide the evolution of U.S. amphibious capabilities. Developing a clear, shared strategy to understand and manage the risk that already exists, and to shape it in a way that is evident and purposeful going forward, is the primary challenge at hand. This study is aimed at contributing to that effort.

Introduction

In 2011, the Center for Strategic and International Studies (CSIS) released an analysis of how U.S. amphibious capabilities contribute to strategic-shaping activities, and what some of the implications might be to conducting those activities differently. Three years later, though much has remained the same, there has also been change. One constant has been the high level of demand for amphibious ships by regional commanders, driven by a continuously dynamic and complex security environment. Another is the continued rise of weapons systems, to include ships, which erodes Defense Department (and in this case the Navy's) buying power. Both have intensified the pressures resulting from one key area of change: the Defense Department's budget was just starting to tighten when our previous study was released, has since been cut further, and—more significantly—has been highly uncertain.

As policymakers face the prospects of very difficult choices about how best to allocate defense resources for many years to come, the Harold Brown Chair at CSIS undertook a more focused reexamination of U.S. amphibious capabilities. While the previous study explored these capabilities in a broad sense—ships, aircraft, surface connectors, and ground vehicles—this effort focuses specifically on shipping. This is because, despite challenges across the board, ships remain the cornerstone of amphibious operations. Like the entire Navy fleet, the inventory of amphibious ships falls far short of what regional commanders are requesting—not just for potential large conflicts, but also for the day-to-day activities that aim to preclude it, as well as to respond to crises that continue to emerge in every region. To that end, the Navy and Marine Corps are pursuing multiple avenues to bridge the gap, to include examining the degree to which "alternative platforms"—that is, non-amphibious ships—can be leveraged. As Marine Corps Assistant Commandant General John Paxton recently testified, "In the near term, the Navy and Marine Corps are looking at alternative platforms that can complement the current amphibious inventory."[1]

There are multiple efforts—some complete, others ongoing or not yet under way—that explore the potential contributions of alternative platforms for missions that would otherwise be performed by amphibious ships if there were sufficient numbers. Some focus on specific missions, while others consider specific vessels or combinations thereof. Each of

1. Statement of General John M. Paxton Jr., assistant commandant of the Marine Corps, before the Readiness Subcommittee of the Senate Armed Services Committee on Readiness, March 26, 2014, 17, http://www.armed-services.senate.gov/imo/media/doc/Paxton_03-26-14.pdf.

these yields insights and recommendations that help to inform the realm of the possible—technically, fiscally, or otherwise.

What is lacking, however, is a broader framework within which policymakers can develop a strategy—or at least a common basis of consideration for informed analysis—for determining where alternative platforms offer the most potential, or where the marginal dollar or steaming day might be better invested in preserving or enhancing amphibious ships. Absent such a framework, leaders are forced to make a series of incremental decisions based on their individual merits. This approach masks system-level interactions, and could result in a fleet over the long term that is even more poorly aligned to the environment than the amphibious fleet of today.

This study aims to develop such a framework, or at least the basic outlines of one that can be further refined. Chapter 1 describes the amphibious shipping gap, summarizing the evolution of amphibious shipping goals and relating those to current and projected future supply. Chapter 2 describes the range of alternatives to address what will be a continuing gap, of which the use of alternative ships is just one. Chapter 3 builds on the approach used in our previous study by updating and refining a list of the key attributes of amphibious ships, and then relating those attributes and the characteristics that comprise them to various military operations, with ratings appearing in Appendix A. Chapter 3 then delineates 16 ships chosen for the study, both amphibious and non-amphibious, along those same attributes and characteristics. Ratings for these ships are shown in Appendix B. Chapter 4 describes the types of operations in which ships fall short of providing necessary capability or capacity (also shown graphically in Appendix C). Where shortfalls exist, employing ships with insufficient capabilities indicates areas of higher risk. Chapter 5 explores some of the key differentiators among those risks, as they are not all of similar importance and many can be partially or fully mitigated. It then describes some of the additional factors that should be considered as mitigation options are weighed. Finally, Chapter 6 offers concluding observations about how the attribute framework can be applied more broadly to inform a holistic strategy to guide amphibious capabilities going forward.

1 The Demand for, and Supply of, Amphibious Shipping

Current efforts to examine how some aspects of the demand for amphibious capabilities can be met in alternative ways have been borne of necessity. In recent years, the gap between the demand for those capabilities and their supply has been growing. This chapter explains the evolution of how the Defense Department has come to view the requirement for amphibious ships and capabilities, how that relates to their supply, and the prospects for reversing the growing gap between the two in the short and medium term.

Demand for Amphibious Ships

Over time, perspectives on how many amphibious ships (i.e., the inventory) the Department of Defense requires has been a function of at least four variables: (1) defense strategy and the Marine Corps' contributions to that strategy; (2) spending priorities; (3) operational concepts; and (4) Marine Corps force structure, equipment size, and weight.[1] As these variables have shifted, goals for how much total lift capacity and the number of ships required to provide it have fluctuated significantly, with 15 modifications since 1951. In recent decades, however, the goal for lift has remained relatively stable, changing just once since 1991.[2]

After the Cold War ended and up until the mid-2000s, the official goal for amphibious ships remained at a level sufficient to carry the assault echelon (AE) of 2.5 Marine Expeditionary Brigades (MEBs), with the remainder of the Marine Expeditionary Force (MEF) being carried by other, less survivable sealift platforms. In 2006, however, the goal was further reduced to 2.0 MEB AEs arriving via amphibious shipping (again, with the remaining equipment and supplies coming on less survivable platforms), a goal that remains in place today.[3]

1. This is a slightly modified version of the causes described in Matthew T. Robinson, *Integrated Amphibious Operations Update Study (DON Lift 2+)*: *A Short History of the Amphibious Lift Requirement* (Alexandria, VA: Center for Naval Analyses, July 2002), 2.

2. Ronald O'Rourke, *Navy LPD-17 Amphibious Ship Procurement: Background, Issues, and Options for Congress* (Washington, DC: Congressional Research Service, January 9, 2012), 10.

3. It is important to note that the Marine Corps' determination that the risk associated with this approach was acceptable was in part predicated on the assumption that the then-planned Maritime Prepositioning Force-Future (MPF(F)) would provide sea-based support to a Marine Expeditionary Brigade ashore. The Navy formally canceled MPF(F) in its FY2011 budget request for affordability reasons, eliminating two large-deck

Defense Department goals for amphibious shipping have changed 15 times since 1951, but have been stable at an inventory of 42 ships (or a fiscally constrained inventory of 33) since 2007.

Based on the size of the MEB AE, this requirement translated into a need for 19 amphibious ships per MEB, or 38 ships. Assuming that approximately 10 percent of the fleet would be in maintenance at any given point in time (i.e., almost four additional ships), the total inventory goal was 42 ships. However, this level was deemed unaffordable; in 2007, the Navy and Marine Corps leaders agreed that the MEB AE could, by displacing some of the AE's supplies and equipment onto other sealift, be transported by 17 total amphibious ships (or 34 for two MEBs, with an additional four ships assumed to be in maintenance, for a total inventory level of 38). Budgetary conditions were such that they agreed to take even more risk (i.e., push an even higher percentage of equipment and supplies onto cargo-type ships), setting the fiscally constrained inventory requirement at 15 ships per MEB AE. This translated in an available inventory of 30 ships, or a total inventory goal of 33 ships with the inclusion of the 10 percent "maintenance tax."

The 2007 reduction in the lift goal from 2.5 to 2.0 MEB AEs came at a time of growing recognition that U.S. forces from all the military services were needed not only for warfighting missions, but also to engage in regional activities associated with deterrence, crisis response, and (of particular interest more recently) partnership activities.[4] While Defense Department processes continue to emphasize force requirements based on approved war plans, the weight given to presence demands has continued to increase over the last few decades.[5]

Historically, the warfighting demand for amphibious ships (i.e., the number of ships required to support Marine forces as reflected in approved war plans) either exceeded the day-to-day presence or peacetime demand for amphibious ships or formations as expressed

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amphibious ships and three Large Medium-Speed Roll-on/Roll-off (LMSR) ships. In subsequent years, the MPF(F) was restructured to include less capable ships than originally envisioned, especially with respect to the Mobile Landing Platform (MLP), as reflected by the fact that the revised ships are not, as they would have originally been, considered Navy battle force ships. Ronald O'Rourke, *Navy Force Structure and Shipbuilding Plans: Background and Issues for Congress* (Washington, DC: Congressional Research Service, June 4, 2014), 2–3. Marine Corps leaders might have made a different determination about the acceptability of reducing the official requirement from delivering 2.5 to 2.0 MEB AEs if they had foreseen the loss of planned MPF(F) capabilities.

4. That is, conducting training and exercises with friendly nations.

5. It should also be noted that presence requirements—as expressed by the requests for forces submitted by regional combatant commands (COCOMs)—are largely unconstrained, and thus often viewed as an inflated estimate of "true need." This view has become even more prevalent since fiscal year 2008, when the Joint Staff explicitly directed the COCOMs, who were perceived to have been suppressing their requests because they understood the priority being placed on support for operations in Iraq and Afghanistan, to ignore the needs of current operations and ask for what they felt they required to best accomplish their missions in their respective geographic areas of responsibility.

by the combatant commands (COCOMs),[6] or was considered to be the most critical driver of amphibious fleet size.[7] However, for a number of years steady-state demands have exceeded those driven strictly by war plans, though the two sources are not entirely mutually exclusive. Given available open-source information, it is impossible to discern how much overlap there might be in the requirements to satisfy war plans as compared to more routine peacetime activities.[8] Despite this ambiguity, leaders from both the Navy and the Marine Corps have repeatedly stated that the combined requirements from the two sources represent 50 or more amphibious ships.[9] The basis for these figures, which are significantly higher than the needs expressed throughout much of the 2000s, is described more fully below.

Translating Demand into Presence

As noted above, the 2.0 MEB AE requirement is based on existing war plans, accepting some unknown level of risk associated with having other elements of the Marine force's equipment and supplies transported by less survivable means. The fiscally constrained inventory goal of 33 ships is designed to produce 30 amphibious ships along timelines that would meet operational needs. That is, it is *not* assumed that a 33-ship inventory would result in 30 available amphibious ships for use during peacetime, but that 30 could be deployed if all available national means (shipyard facilities, workers, materials, etc.) were surged to get any ships that were not immediately ready able to leave port in sufficient time to support the mission.

On a day-to-day basis, the Navy's fleet is managed in accordance with the planning assumptions in the Fleet Response Plan (FRP). The FRP has multiple phases that include maintenance, crew and unit training, and deployments. At present, the FRP cycle for amphibious ships is colloquially referred to as "7:27," or a 7-month deployment within each 27-month cycle. Under FRP planning, therefore, each amphibious ship should be available for deployment 26 percent of the time.[10] This does not mean, however, that 26 percent of the inventory could be assumed to be supporting a COCOM at any given point in time, as ships must also transit to and from the COCOMs' areas of responsibility (AORs). (The size of the

---

6. These are captured in the force allocation process, in which COCOMs submit requests for various capabilities in support of planned activities and, through requests for forces (RFFs), for emergent needs. These requests are received by the Joint Staff, which passes them to the military services to provide the requested capabilities, offer alternative solutions, or state that they cannot support a request.

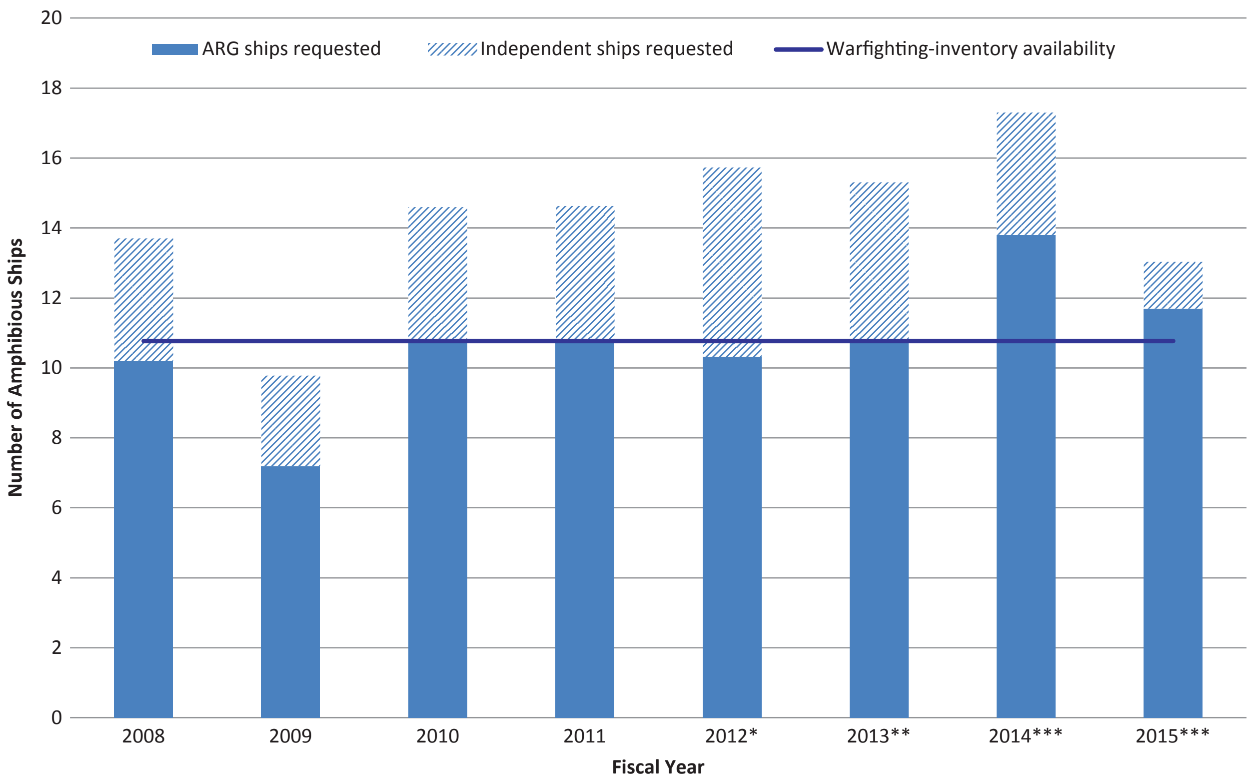
7. That is, the other activities COCOMs might conduct with amphibious ships that would be in excess of war plan–derived levels were not considered to be of sufficient import to justify increasing the number of desired ships.

8. To further complicate the issue, Department of Defense planning models make varying assumptions about which routine operations might be ceased, with supporting assets reassigned, should a given operational plan be initiated.

9. See, for example, Hope Hodge Seck, "Amos, retired generals: Marines need more amphibious ships," *Marine Corps Times*, March 27, 2014, http://www.marinecorpstimes.com/article/20140327/NEWS/304070018/Amos-retired-generals-Marines-need-more-amphibious-ships.

10. The FRP cycle also includes seven months of training time for pre-deployment workups. On the whole, then, the FRP cycle assumes that ships will be available for training or deployment 52 percent of the time (14 of 27 months).

Figure 1.1. Presence Demands Relative to Peacetime Levels of Wartime Inventory Availability, Fiscal Years 2008–2015



Based on data provided by Marine Corps Combat Development Command, April 2014.
* = Estimated May 2012, ** = estimated December 2012, *** = estimated April 2014.

"transit tax" depends on where a ship is deploying from and how far it has to travel. It is smaller, for example, for ships stationed on the U.S. East Coast deploying across the Atlantic to Europe than for ships stationed on the West Coast deploying to the Pacific.[11]) This analysis assumes an average transit tax of 10 percent of an amphibious ship's deployed time (excluding the four ships forward deployed in Japan).

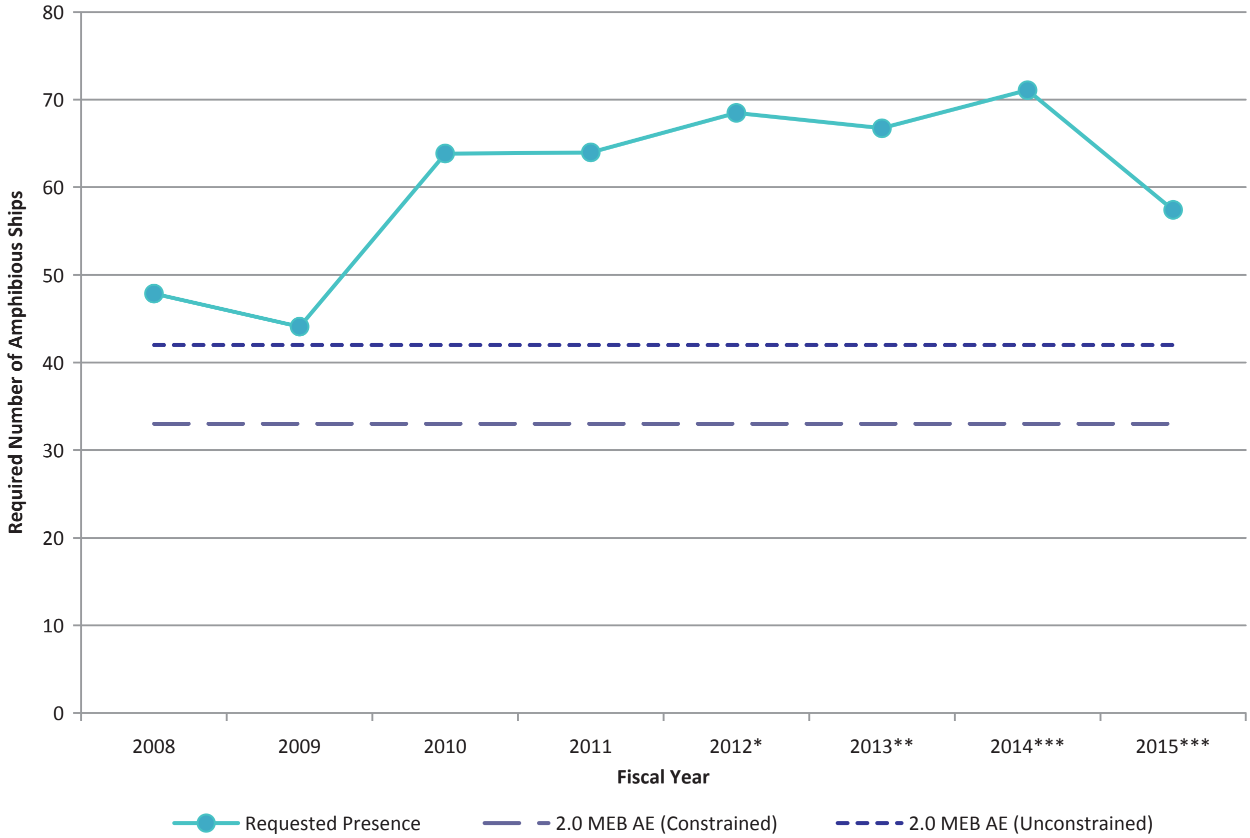
When FRP cycles and transit tax are taken into consideration, the average amphibious ship is planned to be available to support COCOM missions 23 percent of the time.[12] For a fleet of 33 ships (four of which are already assigned to the Pacific), this translates into average day-to-day availability of 10.8 ships.

So how does the peacetime supply level, as derived from the wartime demand–shaped fleet, compare to actual peacetime demands? Figure 1.1 shows the number of amphibious

11. The transit tax is further reduced by forward stationing ships in or closer to the areas where they are expected to operate. This currently applies to four amphibious ships that are assigned to the Forward Deployed Naval Force (FDNF), or 7th Fleet, stationed in Japan.

12. The FRP cycle is incorporated into a variety of Navy processes, from scheduling to funding to determining future requirements. As is discussed later in this chapter, however, the 7/27 cycle has not been supportable in practice and overestimates sustainable levels of available shipping across the fleet, to include amphibious ships.

Figure 1.2. Amphibious Ship Inventory Levels to Meet Presence and Warfighting Demands, Fiscal Years 2008–2015



Inventory projections conducted by CSIS study team based on data provided by Marine Corps Combat Development Command, April 2014.
* = Estimated May 2012, ** = estimated December 2012, *** = estimated April 2014.

ships the COCOMs have requested each fiscal year (FY) since 2008, projected through FY 2015.[13] In each year except 2009 the number of ships is higher, and in some cases substantially higher, than the levels a warfighting-based amphibious ship inventory of 33 provides. This situation—where combatant command commanders would like to have more of a given capability than exists in Defense Department inventories—is by no means unique to amphibious ships. And, as noted earlier, combatant command commanders are not responsible for taking supply into account, and thus their demand signal is unconstrained. Nevertheless, the data clearly indicate that regional commanders have a strong desire for amphibious capabilities, either in the aggregate (i.e., as ARG/MEUs) or in smaller force packages aboard individual amphibious ships.

Figure 1.2 presents the same data differently, by calculating the amphibious ship inventory levels that would be required to satisfy the peacetime demand shown above. The

13. COCOMs request either Amphibious Ready Groups (ARGs) with embarked Marine Expeditionary Units (ARG/MEU), which are composed of three amphibious ships, or individual ships. They can request them for a full year or any portion thereof, which results in fractions of ships (e.g., three ships for six months would be reflected as 1.5 ships).

Box 1.1. “National” Demand

In addition to demands from regional military commanders, the unique features of many Navy ships (to include amphibious ships) also make them useful tools for other national-level missions. For example, the U.S. container ship *Cape Ray* is currently stationed in the Mediterranean Sea and is being used to demilitarize Syrian chemical weapons. Other ships have been used to hold and transport high-value detainees back to the United States for prosecution. While such missions are critically important, supporting them can require diverting ships, disrupting maintenance, and placing other stresses on a Navy fleet already under strain.

Defense Department makes assumptions about availability and transit tax that dictate these calculations. According to study team interviews, the Defense Department’s 2014 Quadrennial Defense Review assumed that 4.1 ships in the inventory would produce one year’s worth of presence in a given region.[14] Using this calculation, the inventory to satisfy COCOM demand for amphibious ships over the past seven years has fluctuated between 44 and 71, though again some of this overlaps with demand to meet warfighting needs. The inventory levels associated with meeting peacetime demands for amphibious ships are substantially higher than those that would be needed to quickly deploy two MEB AEs, with either some (unconstrained) or most (constrained) of their equipment transported by other, less capable ships.

Overall, the two sources of demand for amphibious ships indicate that current regional commanders (as expressed through their formal requests for ARG/MEUs or single ships) as well as potential future commanders (should operational plans be employed) would require an inventory of amphibious ships that falls somewhere between 33 (with risk) and 50+ ships. These levels were further validated by analysis associated with the Marine Corps’ 2014 order addressing what the Corps terms the “new normal,” or its strategy to deliver crisis response forces of varying composition to regional commanders around the world. Although that order is classified, the underlying analysis reportedly found that an inventory of between 38 and 42 amphibious ships would be needed to support the envisioned level of crisis response capabilities with an acceptable degree of risk.[15]

As the Navy struggles to maintain all elements of its fleet, amphibious ship inventory levels, even the ones associated with the lowest expression of the requirement (the fiscally constrained inventory of 33) are so unattainable as to almost be moot. As the following section describes, the Navy has struggled not only to sustain the overall size of the amphibious fleet, but to adhere to its plans for the availability of the ships within that fleet.

14. Interview with Doug King, director, Ellis Group, Marine Corps Combat Development Command, May 23, 2014.

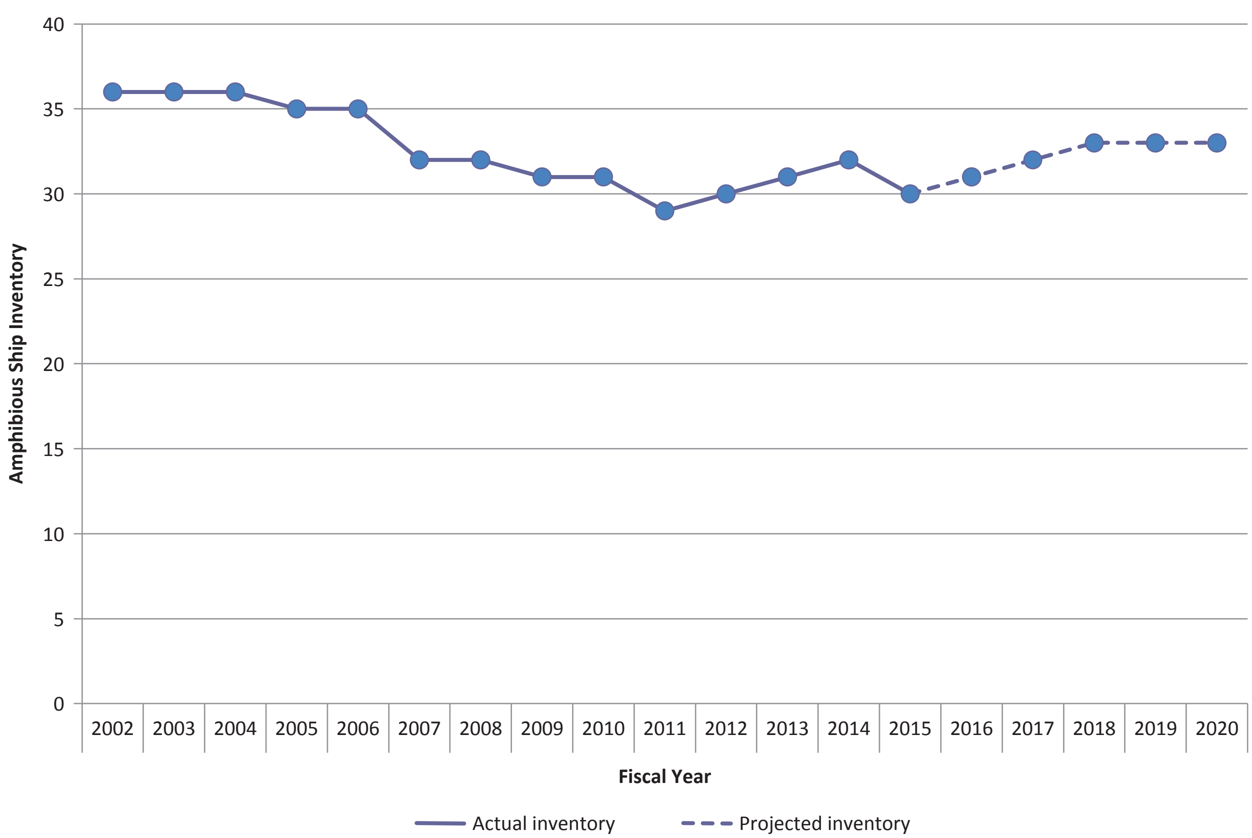
15. Study team interview with general officer within Headquarters Marine Corps, May 30, 2014.

The Supply of Amphibious Ships

At its most basic, the number of amphibious ships that comprise the total inventory is a factor of the rate at which new ships are built and how long existing ships are kept in service. (These both, in turn, are the product of a number of other variables, to include resources for new construction as well as for maintenance, shipyard performance, ship manning levels, shipbuilding budget priorities, and so on.)

As Figure 1.3 shows, the amphibious ship inventory dropped over the 2000s, going below the war plan–required level of 33 in FY 2007 and fluctuating between 29 and 32 thereafter. The effects of declining inventories have been exacerbated by other factors that have further reduced the availability of what has remained, to include mid-life upgrades and testing associated with the integration of new aviation capabilities. In the first instance, both the LSD 41-class and LHD 1-class amphibious ships have been undergoing major mid-life maintenance periods to extend their service lives and add new self-defense and other capabilities. Depending on the configurations of each specific ship, these upgrades take at least six months in a shipyard, and may last as much as a year or longer. If two are planned annually, this equates to one ship in the inventory that is unavailable for

Figure 1.3. Amphibious Ship Inventory, Fiscal Years 2002–2020



Historical data provided by Marine Corps Combat Development Command, April 2014; future year projections based on FY 2015 Navy shipbuilding plans, as described in O'Rourke, *Navy Force Structure and Shipbuilding Plans*, 7.

that year. Integrating other new capabilities into the fleet has imposed an additional, short-term “inventory tax”: as the F-35B aircraft is being brought on line, the USS *Wasp* has been dedicated to associated test and evaluation.[16]

Both of the above factors are temporary (though spread over years), and will ultimately result in a more capable fleet. Other factors that have affected amphibious ship availability, however, are unequivocally negative. Since the early 2000s, the entire naval fleet, to include amphibious ships, has experienced readiness challenges. The problems had become sufficiently acute that, in 2009, the commanders of the Navy’s Fleet Forces Command and Pacific Fleet directed an external review of the Navy’s entire surface fleet. The results of that review, led by retired Vice Admiral Phillip Balisle, became known as the “Balisle Report.” That report confirmed that the readiness of surface ships had been degrading for the previous decade. It attributed those declines to a series of independent decisions taken to achieve efficiencies in the manpower, training, equipping, command and control, and maintenance realms.[17] Though each was well intentioned, the review panel’s analysis indicated that the systemic effects of these decisions were poorly understood. As a result, the group concluded that “the material readiness of the fleet is well below acceptable levels to support reliable, sustained operations at sea and preserve ships to their full life expectancy.”[18]

The Balisle Report made a number of recommendations to improve ship readiness. Unfortunately, many required a number of years to implement. They also came at a time when budgets were just beginning to be cut, a problem that has become more acute in the intervening years. Though Navy and Marine Corps leaders have dedicated immense attention and focus to reversing readiness declines, challenges persist. Indeed, one internal Navy analysis reportedly found that, from 2010 to 2012, continued maintenance issues resulted in a loss in annual availability of 3.5 amphibious ships.[19]

While we were not able to obtain specific information about the availability of amphibious ships since 2012, our interviews indicate that readiness has not substantially improved. One further indication is that the degree to which the Marine Corps has been able to satisfy COCOM demands has fallen in recent years despite a slowly rising amphibious ship inventory, as shown in Figure 1.4.

To summarize, the ability of regional commanders to obtain amphibious shipping to meet their needs has been falling in recent years, in part because of a declining inventory but compounded by poor readiness of the remaining ships. Planned upgrades, F-35B testing, and maintenance challenges have led to a decline in available inventory of four to five

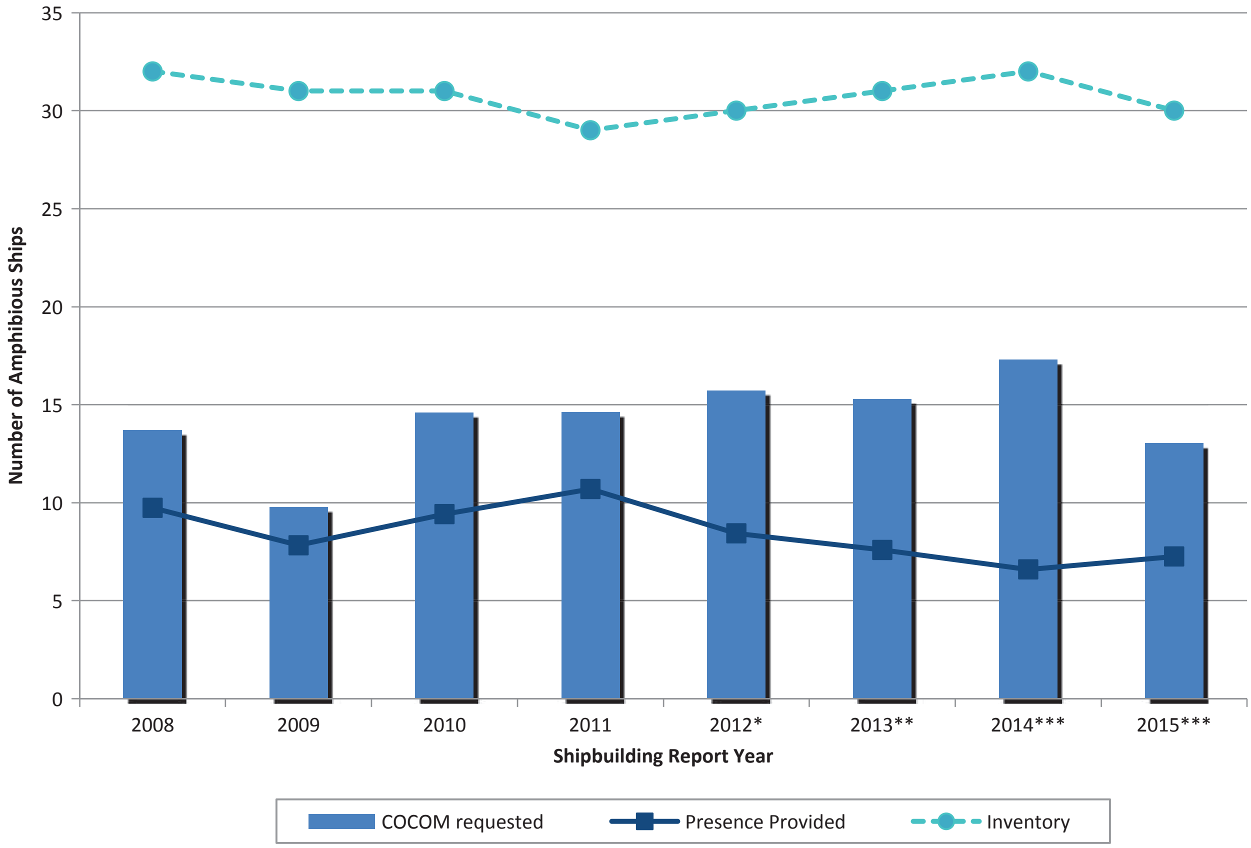
16. In both cases mentioned here, the ships directly affected are still counted as part of the inventory, as they could be made available to deploy (though perhaps at some reduced level of capability) if urgent needs arose. In the absence of such conditions, however, the effect on the rest of the fleet is some combination of higher operational tempo than would otherwise be the case, lesser ability to support COCOM needs, or both.

17. Vice Admiral Phillip M. Balisle, “Final Report: Fleet Review Panel of Surface Force Readiness,” February 26, 2010.

18. Ibid., 7.

19. Study team interviews, April 2014.

Figure 1.4. Amphibious Ship Presence Relative to Requests and Total Inventory, Fiscal Years 2008–2015



Data provided by Headquarters Marine Corps and Marine Corps Combat Development Command, April 2014.
* = Estimated May 2012, ** = estimated December 2012, *** = estimated April 2014.

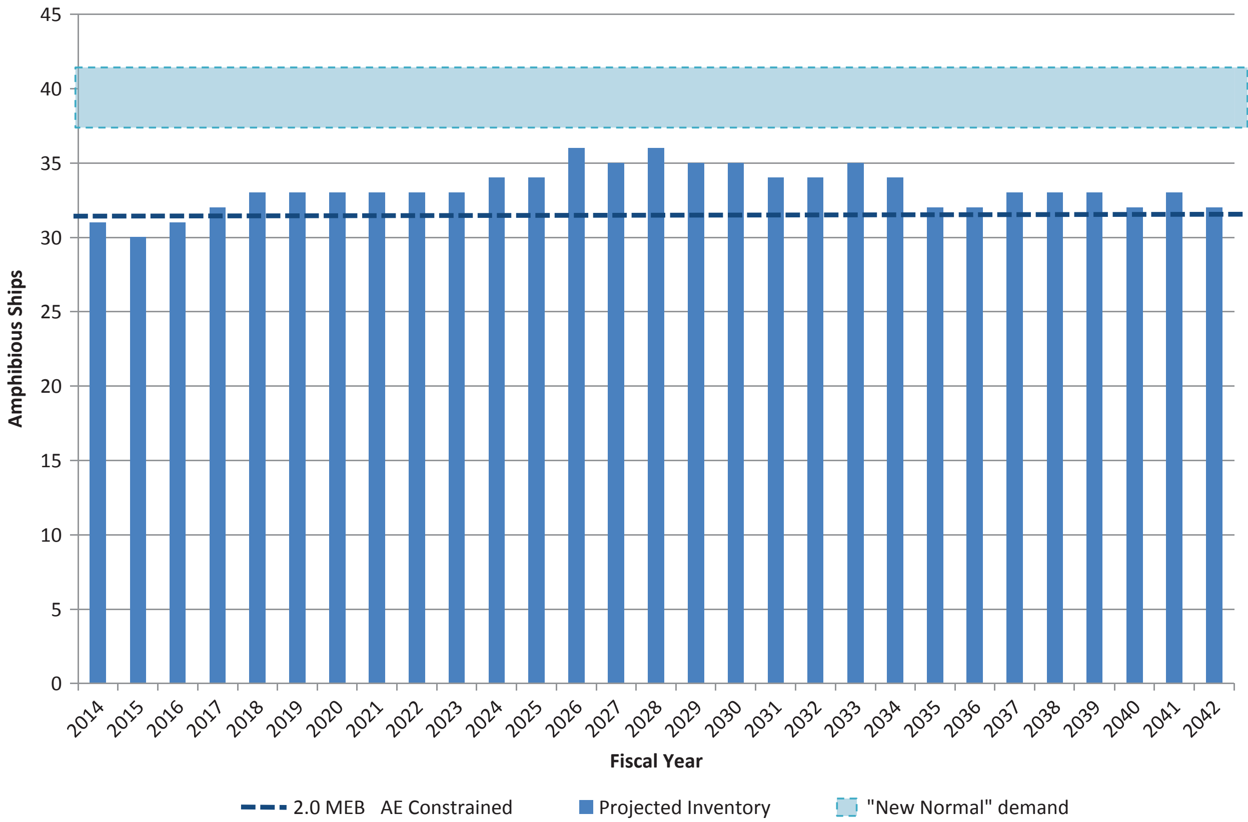
ships per year since 2008. As a result, amphibious ship inventories or 32 or lower in recent years are the practical equivalent to an inventory of 27 or 28 or fewer. While some portion of the ships that comprise this gap might be able to be put to sea in a case of extreme national need, the current amphibious fleet would still fall short, and potentially well short, of even the most conservative current projections of amphibious ship requirements.

Amphibious Supply Going Forward

How long the current shortfall in amphibious shipping persists has both an inventory and availability component. From an inventory perspective, Figure 1.5 shows the projections contained in the Navy's FY 2014 30-year shipbuilding plan. Under the plan, the inventory does not reach the (already constrained) warfighting inventory level of 33 ships until FY 2025, and it hovers around that level until FY 2040 and beyond.

It remains to be seen, however, if these plans can even be realized. The 30-year plans are—perhaps not surprisingly given the length of the projection and (in recent years in

Figure 1.5. Future Amphibious Ship Inventory Projections Relative to Demand, Fiscal Years 2014–2042



Projected inventory based on FY 2015 Navy shipbuilding plans, as described in O'Rourke, *Navy Force Structure and Shipbuilding Plans*, 7; other demand levels reflect CSIS study team calculations and Marine Corps leadership statements.

particular) volatility of the overall defense budget—generally unstable. (Box 1.2 describes this instability in more detail.)

In recent years, amphibious inventory projections have been repeatedly revised downward in the short term, with increases being pushed to the mid- and far-term. In order to sustain inventory levels that otherwise would have dropped due to delays in the delivery of new LPD-17-class ships, the Navy put off some planned decommissionings, but it has also proposed accelerating others to help provide budgetary relief. The Navy's plan in the FY 2014 budget request was to retire two LSD ships prior to the end of their service lives. Congress prohibited these retirements and created a new fund to provide for their continued operation and maintenance. Rather than continue to operate them, in the FY 2015 budget request the Navy instead proposed placing three LSDs into a pool to be modernized on a rolling basis.[20] Each is planned to be retained in the inventory but de-manned for up to four years, followed by a one-year phased maintenance and modernization period. This would be substantially cheaper than retaining the ships in a normal operational status, but

20. Department of the Navy, *Highlights of the Navy Fiscal Year 2015 Budget*, February 2014, 3–3.

Box 1.2. Reliability of the 30-year Shipbuilding Plan

In 2002, Congress mandated that the Department of the Navy (DON) annually submit a 30-year plan laying out the Navy fleet, by ship class, for the coming three decades.[1] These reports describe the Navy's plans in some detail, and include tables of projected inventories by fiscal year (FY).

DON staff provided the study team with some of the data underlying the annual plans from FY 2007 through FY 2014.[2] These included projections about ship procurements, deliveries, and retirements.

The shipbuilding plans are often criticized for being unaffordable, and thus unrealistic.[3] As some study interviewees noted, the DON has an incentive to underprice future ships, in order to help sustain pressure on suppliers to keep costs to the requested (and hopefully authorized and appropriated) levels. At the same time, this practice introduces churn into the plan when actual costs rise, which, if funded closer to requested rather than experienced levels, forces displacements elsewhere in the plan.

Cost is just one variable that can influence the stability of future projections about ship inventories. Multiple factors (of which cost is one) can either accelerate or delay retirements of individual hulls from year to year. Problems in production (the causes of which can be from both the government and private-sector sides) can slow expected deliveries. And shifts in strategy, or congressional actions, can result in adjustments to future procurement plans.

The study team's analysis of past plans indicated that such adjustments were common for the amphibious fleet. Table 1.1.A below summarizes the frequency and

Table 1.1.A. Changes in Planned Inventory of Amphibious Ships, Fiscal Years 2007–2014

	Five-Year Period					
Fiscal Year	*Y1–5*	*Y–10*	*Y11–15*	*Y16–20*	*Y21–25*	*Y26–29*
FY07–08	0	–1	0	—	—	—
FY08–09	–3	0	—	—	—	—
FY09–11	+1	+3	+5	+5	0	–5
FY11–12	–2	–1	+1	+3	+2	+4
FY12–13	–3	–2	–3	0	+3	+2
FY13–14	0	–1	–1	0	+1	+1

0 = Changes within the period, net equal at end of the period, + (plus sign) = net increase in inventory at end of period (the number indicates the increase from the previous year's plan), – (minus sign) = net decrease in inventory at end of period (the number indicates the decrease from the previous year's plan), — (long dash) = no changes within the period.

continued

size of year-to-year changes in the planned inventory of amphibious ships in the FY 2007 through FY 2014 plans, at the end of each five year period, by ship class.

The table reflects the frequency of year-to-year changes: plans remained stable from one year to the next less than 20 percent of the time. Though the time frame is somewhat limited, the chart also suggests that amphibious inventories have been under increasing pressure in recent years: since the FY 2011 plan, each year's plan has continued to shrink the planned amphibious ship inventory in the near- to mid-term (1-15 years), and pushed (ever growing) inventories further out into the longer term (21–29 years).

1. The Navy first submitted a 30-year plan for FY 2001, as directed in the FY 2000 National Defense Authorization Act (NDAA). The requirement for an annual 30-year plan was included in the FY 2003 NDAA (passed in December 2002), and annual plans are now typically submitted along with each year's President's Budget Request. See Ronald O'Rourke, *Navy Force Structure and Shipbuilding Plans: Background and Issues for Congress* (Washington, DC: Congressional Research Service, February 10, 2014), 10–11.

2. With the exception of FY 2010, when the Navy did not submit an annual plan.

3. For example, an assessment conducted by the Congressional Budget Office (CBO) estimated that the FY 2014 30-year plan would cost an average of $2.5 billion per year more than the Navy's projections. Congressional Budget Office, *An Analysis of the Navy's Fiscal Year 2014 Shipbuilding Plan* (Washington, DC: CBO, October 2013), 11–14; see also O'Rourke, *Navy Force Structure and Shipbuilding Plans*, 11–12, and Ronald O'Rourke, testimony before House Armed Services Committee Subcommittee on Seapower and Projection Forces, October 23, 2013, 3–4.

would also have the effect of artificially inflating the amphibious ship inventory by one ship for each of the next 15 years, as the ships would still be counted but unavailable for anything but national emergencies. Thus if the proposed inactivation (but not decommissioning) of the LSDs is endorsed by the Congress, according to the FY 2015 30-year shipbuilding plan[21] the inventory of usable amphibious ships will not reach the minimum expressed requirement of 33 amphibious ships for at least another decade.

Another factor contributing to lower inventory levels has been the evolving plan for LX(R), the LSD replacement. In the FY 2012 shipbuilding plan, the contract was supposed to have been awarded in FY 2017. In each of the three subsequent years, the LX(R) has been delayed an additional year; it is reportedly now planned for FY 2020, and how capable the Navy can afford to make it remains under negotiation.[22]

On the availability side, as mentioned above, Navy and Marine Corps leaders have taken strong actions aimed at improving the readiness of the surface fleet, to include amphibious ships. The most prominent of these is adoption of an Optimized Fleet Response Plan (OFRP). Not yet extended to the amphibious fleet, OFRP lengthens the current

21. O'Rourke, *Navy Force Structure and Shipbuilding Plans*, 7.

22. See, for example, Sam LaGrone, "NAVSEA: Affordability Prompted Second Look at LX(R)," *USNI News*, May 29, 2014, http://news.usni.org/2014/05/29/navsea-affordability-prompted-second-look-lxr; and Kris Osborn, "Navy Considers Commercial Technology for New Amphib," *DoD Buzz*, June 1, 2014, http://www.dodbuzz.com/2014/06/01/navy-considers-commercial-technology-for-new-amphib/.

Under current plans, the amphibious ship inventory will not reach the minimum warfighting-required level of 33 ships until Fiscal Year 2024.

27-month FRP cycle to 36 months, and extends the deployment period within the cycle from 7 to 8 months. It also extends planned maintenance periods, and accounts for interim, shorter maintenance periods to address emerging issues. Finally, it includes an 8-month post-deployment period of “sustainment,” during which ships and their crews would be stationed at their home ports but remain intact and trained, and would be available for some level of taskings short of the full panoply of the potential missions in a typical deployment period.

The proposed adjustment is a de jure recognition of the vicious cycle that has been occurring de facto in the fleet. Reportedly, from 2010 through 2012, maintenance periods repeatedly exceeded their planned timelines, sometimes by as much as 165 percent.[23] The challenges of getting ships to sea meant that the majority of MEUs trained on ships other than the ones on which they deployed, and the training for *every* deployed ARG/MEU was compressed or incomplete. And getting ships into maintenance was complicated by operational demand. Only three of eight MEU deployments kept to the planned seven months; the remaining five lasted for eight-and-one-half months or more.[24]

Addressing these realities within the current system has proven extremely disruptive, as each departure from the plan creates a ripple effect throughout the fleet.[25] Shipyard maintenance schedules and associated funding are constantly being adjusted, personnel movements are affected, and training quality is compromised. Managing some of those realities means leaders have to constantly engage in trades between the readiness of one ship versus another in an attempt to keep the entire system functioning while not disabling a specific ship or ARG within it.

While OFRP appears to be a critical step to arrest the downward cycle of surface fleet readiness, in the short term it will further reduce the availability of existing amphibious ships. Even if deployments are extended to eight months from the currently planned seven, deployments will comprise 22 percent of a given ship’s cycle rather than the planned 26 percent under FRP as it is currently constructed. More broadly, under ORFP it will take five rather than four ships in the inventory to provide one ship’s worth of capability to a regional commander.

23. Study team interviews, May 7, 2014.
24. Untitled HQMC Plans, Programs and Operations briefing provided to study team, May 15, 2014.
25. Some interviewees took an even broader view of the problem, arguing that, as one senior leader put it, “we have been cheating at solitaire” by rushing ship construction and taking delivery of ships before they are fully ready, failing to adequately fund maintenance, underestimating the true price of construction and maintenance, and adjusting the budgets to meet fiscal rather than operational wickets. Study team interviews, April 2014 and June 12, 2014.

How much actual presence will result from the implementation of OFRP will not in fact be this grim, depending on what decisions are made for how ships in the sustainment (post-deployment) phase of the new planning cycle will be utilized. If that period is too heavily leveraged, either for extending planned deployments or for supporting missions like regional exercises, it runs the risk of perpetuating some of the maintenance challenges that have led to the current situation. (However, the resulting ripple effects would be much less pronounced because the revised OFRP cycles reflect a greater degree of slack built in.) Thus Navy and Marine Corps leaders will have to be judicious as they work through the rule set that will govern that period in particular.

Looking ahead, there seems little reason to expect that demand for amphibious capabilities will fall. Recent congressional testimony by the regional combatant commanders, as well as a number of futures documents, reflect a shared view that the conditions that call for amphibious solutions will continue, if not become more prevalent.[26] This suggests that the current pressures on the amphibious fleet will persist, at least for the next 6 to 10 years. Given the length of ship construction, substantial increases in inventory are unachievable in the short term (though any additions would help). Inventory levels beyond that point are still highly likely to fall short of operational needs (warfighting or otherwise) would suggest, probably by a substantial margin. And inventory levels could fall further than is currently envisioned if planned construction is delayed, and/or if ships are decommissioned earlier than their originally design supports. Improvements in fleet availability, whether a result of the implementation of OFRP or other initiatives, will also take years to manifest. Sustained funding to support necessary maintenance is uncertain in the current budget environment, and the continued high usage of the amphibious fleet suggests just keeping pace will remain very difficult.

Given these realities, it is not surprising that Navy and Marine Corps leaders have been exploring a range of options to help mitigate the effects of amphibious shipping shortfalls. Chapter 2 provides a broad overview of potential solutions, a brief synopsis of some of the ongoing efforts in that regard, and the process we employed to examine the operational risks associated with one specific approach, that of making greater use of non-amphibious ships.

26. These include Joint Chiefs of Staff, *Capstone Concept for Joint Operations, Joint Force 2020* (Washington, D.C.: Department of Defense, September 10, 2012); Joint Chiefs of Staff, *Joint Information Environment White Paper* (Washington, D.C.: Department of Defense, January 22, 2013); Joint Chiefs of Staff, *Joint Operational Access Concept (JOAC)* (Washington, D.C.: Department of Defense, January 17, 2012); U.S. Joint Forces Command, *Joint Operating Environment 2010* (Washington, D.C.: Department of Defense, February 18, 2010); and the 2014 posture statements to various congressional oversight committees by the commanders of U.S. Special Operations Command, U.S. Southern Command, U.S. Pacific Command, U.S. Africa Command, U.S. Central Command, U.S. European Command, U.S. Transportation Command, and the U.S. Chief of Naval Operations.

2 Mitigating the Amphibious Capability Gap

As described in Chapter 1, the inability of amphibious ship inventory to meet growing demand has been a problem that has been increasing in scope for years. Not surprisingly, therefore, there have been a number of different efforts aimed at developing solutions that would satisfy at least some portion of that gap.

As the study team interacted with various organizations undertaking some of the current efforts, one point became clear: a shared view of the nature of the problem is lacking. More specifically, while the capabilities of amphibious ships in particular have evolved substantially since World War II, to varying degrees they now play at least three roles. The first is to transport Marines and the Naval Expeditionary Combat Command (and sometimes Special Operations Forces) and their equipment. The second is to serve as a sea base, or an operating platform from which forces ashore can be logistically supported, decreasing the footprint of U.S. forces on land. The third is as warfighting systems in and of themselves that conduct missions ranging from delivering fires at sea and ashore to intelligence, surveillance, and reconnaissance (ISR).

The inherently utility of amphibious platforms' multi-role nature is not always fully accounted for as various Defense Department entities consider how best to address shortfalls in amphibious capabilities. This is in part due to the evolution of the requirement, as discussed in Chapter 1: the size of the amphibious fleet has historically been expressed in terms of lift, a term which reinforces the conception that the ships' principal purpose is transportation.

As Department of the Navy leaders have begun to talk more frequently about the demands associated with presence, the exact nature of the roles that are most valued is not clear. COCOM requests are only expressed numerically (i.e., they ask for an ARG/MEU or single ship) and the Joint Staff, which receives those requests, does not collect systemic data on the *purposes* for which those capabilities are being requested. As a result, the Defense Department as a whole has no objective basis from which to determine which roles the associated ships play are most in need: transport, sea base, weapons system, some combination of two, or all three.

The distinction was less critical when the war plan–derived requirement was perceived to exceed the one associated with presence, because any mitigation solution would be

Amphibious ships play at least three roles: as transporters, as a sea base, and as warfighting systems.

evaluated against its ability to support specific plans. But in the current environment where an ill-understood presence and crisis response–driven requirement exceeds the levels demanded by operational plans, the study team found no shared view of which role or roles are most important, nor, necessarily, of the implications of providing single- or dual-role platforms as alternatives to address some portion of unmet amphibious demand. While many are pursuing options, a shared strategy to guide those efforts is lacking. Alternative platform use is just one of at least four potential ways to address portions of the amphibious gap, however. Each is briefly described below.

Reduce the Requirement

One way to bridge the supply-demand gap is to take actions that would reduce the demand. This could be done by continuing to push a greater proportion of the assault echelon's equipment and supplies to non-amphibious ships, reducing the number of ashore MEBs that are needed, or some combination of both. The study team talked with some in the Defense Department who argued that the 2.0 MEB AE objective is too high, for example, and that the emergence of anti-access/area denial (A2/AD) threats make the forcible entry mission upon which that requirement is predicated much less relevant to current warfighting.[1]

At least at present, however, this view is at odds with official Department of Defense (DOD) policy pronouncements. The *Quadrennial Defense Review 2014* stated, "We will need capabilities . . . that can execute forced entry," and that the proficiency to conduct that mission will be regained.[2] In April 2014, the chairman of the Joint Chiefs of Staff approved a joint concept for entry operations,[3] which validates the need for the mission and is designed to account for A2/AD advances.

Importantly, Defense leaders appear to accept that presence requirements are even greater than those associated with current war plans, by a substantial amount. As noted above, views about the exact nature of this need are varied both in the Defense Department and in Congress. However, at present there appears to be a broad consensus that the

1. This argument assumes that the general strategic framework governing Defense Department objectives will remain in place, but that the means (in this case, a 2.0 MEB AE-sized mission) would be ineffective. There are also broader arguments that could lead to a lower requirement for amphibious ships, e.g., shifting the desired strategic ends away from U.S. global leadership, and/or placing lesser emphasis on military means to achieve national security goals.

2. Department of Defense, *Quadrennial Defense Review 2014* (Washington, DC: Department of Defense, February 2014), 61–62 and 37, respectively.

3. Joint Chiefs of Staff, *Joint Concept for Entry Operations* (Washington, DC: Department of Defense, April 14, 2014), http://www.dtic.mil/doctrine/concepts/joint_concepts/jceo.pdf.

currently stated objective of at least 33 for the amphibious ship inventory is, if anything, under- rather than over-stated.

Buy More Ships

A second option to narrow the gap in amphibious capabilities is to increase inventory by buying more ships. This is certainly the Marine Corps' preferred solution, and would be the most straightforward response to addressing current shortfalls. The primary difficulty, of course, is fiscal. For years, planned ship construction has been canceled, delayed, or down-scoped (i.e., reducing the desired ship features) as defense budget pressures have tightened and shipbuilding construction costs have escalated across the fleet. The problem is particularly acute given that amphibious ships are funded through the Shipbuilding and Conversion, Navy (SCN) account. This account is also the source of funding for the refueling of the reactors from the Navy's nuclear aircraft carriers, as well as for the replacement for the *Ohio*-class submarine, both extremely expensive, high-priority programs that are putting additional pressure on the amounts available for amphibious ships.[4] The Navy's FY 2014 30-year shipbuilding plan explicitly acknowledges this pressure (which becomes particularly problematic in the 2030s), but does not specify how it will be addressed.

As some experts have noted, both the Defense Department and Congress have the option to decide that amphibious ships are of such importance that additional funds are warranted, and to reallocate or add funds within the Department of the Navy or the broader Department of Defense.[5] The prospects of such an option may seem bleak given the conventional wisdom that defense budgets will at best be stable but will more likely continue to decline; nonetheless, the potential still exists. If additional ships are pursued, however, their benefit would not be realized in the short term, as they typically take at least five to seven years for construction and full integration into the fleet.

If additional amphibious ships are deemed too expensive, another option is to buy less capable amphibious or non-amphibious ships that offer some subset of the desired capabilities. This option was endorsed by some of the experts interviewed by the study team. While outside the scope of this particular effort, this option would be amenable to examination subject to the same logic used here: that is, the risks associated with other platforms, whether existing or newly constructed, should be clearly understood, as should the utility of any such platform across a broad set of missions, all in the context of the entire amphibious portfolio.

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4. There is an ongoing debate within the defense policy community about the wisdom of using incremental funding, or a relaxation of the rules that require full, up-front funding for ships so that portions (increments) can be funded each year. Those in favor argue that this approach helps shipyards to have a more predictable, stable workload and thus reduce costs, and that it enables better management of the entire SCN portfolio by avoiding major funding "spikes" that displace other programs. Opponents counter that this masks the true costs of ships and encourages cost creep, increasing inefficiency.

5. O'Rourke, *Navy Force Structure and Shipbuilding Plans*, 33.

Increase Ship Availability

A third alternative for mitigating gaps in amphibious shipping is to increase the availability of the current and planned fleet. As noted in Chapter 1, the adoption of the Optimized Fleet Response Plan (OFRP) is aimed precisely at that objective, though in the short term it will result in decreased availability to some yet-unknown degree (and remains dependent, especially for amphibious ships, on congressional approval of FY 2015 contingency funding).

Though OFRP is the most comprehensive effort to improve amphibious ship readiness, a variety of other options are either actively being considered by various organizations within the Defense Department or have been in the past. These include changing manning practices (e.g., relying more heavily on civilian mariners rather than military personnel or making greater use of rotational crews that "fall in" on ships), and/or increasing the number of ships that are permanently stationed overseas (which vastly reduces transit time).

Increasing civilian manning of Navy platforms is a possibility, though analysis indicates this involves organizational, cultural, and operational adjustments.[6] It also invokes legal issues associated with the types of actions that can be taken by uniformed military versus civilian personnel. In a related idea, the Navy is again examining whether it should expand crew swaps, where a ship stays on station and one crew replaces another. Past experience suggests crew swaps do increase forward presence, but that the practice can also result in greater maintenance issues, increased administrative burdens, and lower levels of crew proficiency and morale.[7] As one senior Navy official noted, "Experiments in which this has been done with military crews on large complex warships have not turned out well."[8]

The Navy is also pursuing options to position more of its ships overseas, most notably the Littoral Combat Ships (LCSs) in Singapore. It is unlikely, however, that significant opportunities exist to forward deploy more amphibious ships beyond the four that are stationed in Yokosuka, Japan. While there may be some potential to do so, it is likely limited given political sensitivities both abroad and here at home. That said, multiple offices in the Defense Department recognize the utility for presence that comes from any increase in forward stationing, which, if successful, could provide some relief of the pressures on the amphibious fleet.[9]

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6. See Anthony DiTrapani and John Keenan, *Applying Civilian Manning Practices to USN Ships* (Alexandria, VA: Center for Naval Analyses, May 2005); and Steven Wills, "Moving the Navy/CIVMAR Integration Experiment Forward," Center for International Maritime Security, November 7, 2013, http://cimsec.org/moving-navycivmar-integration-experiment-forward/.

7. Eric Labs, *Crew Rotation in the Navy: The Long-Term Effect on Forward Presence* (Washington, DC: Congressional Budget Office, October 2007), 3.

8. As quoted in O'Rourke, *Navy Force Structure and Shipbuilding Plans*, 28.

9. The same unnamed Navy official acknowledged that greater forward home porting "always comes up as the first choice," but that few countries beyond those who already permit it are willing to do so. O'Rourke, *Navy Force Structure and Shipbuilding Plans*, 28.

Provide Amphibious Capability Differently

A fourth option for relieving that pressure is to change how amphibious capabilities are provided. This is another area that is receiving a substantial amount of attention in different organizations with the Defense Department, and in the Department of the Navy in particular. Indeed, the Marine Corps' latest operational concept explicitly acknowledges that "there are not enough amphibious ships to meet all [regional commanders'] operational demands," and therefore "we need to modify traditional employment methods and augment amphibious warships by adapting other vessels for sea-based littoral operations."[10]

The Marine Corps has numerous efforts under way to support this direction, some in collaboration with or being directed by the Navy. These include examining options to adjust the composition of Amphibious Ready Groups, developing new concepts of operations to leverage non-amphibious platforms, and identifying packages of equipment that could be added to Maritime Prepositioning Force (MPF) ships in particular to help increase their ability to support Marine Corps missions at the more benign end of the spectrum of operations.

Shortfalls in amphibious shipping have also prompted the Marine Corps to stand up additional ground-based units to meet needs that it would have preferred to support with sea-based forces. The Special Purpose Marine Air Ground Task Forces-Crisis Response (SP MAGTF-CR), a rotational force stationed in Moron, Spain, is a company-sized unit that self-deploys with four MV-22 tilt-rotor Ospreys. While a useful capability, SP MAGTF-CRs are a visible manifestation of the challenges in the amphibious fleet. The first such unit's experiences to date illustrate why the Marine Corps prefers to be ship rather than land based: when the force deployed to Italy in May 2014 to prepare for a possible response in Libya,[11] airspace restrictions precluded the MV-22 pilots from retaining their qualifications to fly at night, a problem that does not exist at sea. The MAGTF-CR also needs to share assets such as KC-130 aircraft and supporting battalions with others,[12] affecting its training and readiness.

The Way Ahead

From a glass half full perspective, Navy and Marine Corps leaders share the view that additional amphibious capabilities are needed. On the half empty side, funding to address the shortfall is in shorter supply than it has been in over a decade. The fact that poorly understood presence requirements exceed those associated with specific war plans adds

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10. U.S. Marine Corps, *Expeditionary Force 21* (Washington, DC: Headquarters Marine Corps, March 4, 2014), 21, http://www.mccdc.marines.mil/Portals/172/Docs/MCCDC/EF21/EF21_USMC_Capstone_Concept.pdf.

11. Gina Harkins, "Crisis response Marines positioned closer to Africa," *Marine Corps Times*, May 14, 2014, http://www.marinecorpstimes.com/article/20140514/NEWS/305140058/Crisis-response-Marines-positioned-closer-Africa.

12. Study team interviews with staff at Headquarters Marine Corps, May 21, 2014.

further complications, as various organizations are attempting to alleviate stresses in whatever way they can without a shared sense of priority.

There does not appear to be any serious effort aimed at revising the amphibious shipping requirement downward. Nor are Navy or Defense Department leaders taking actions to increase the rate at which new amphibious ships will be bought. Some efforts are being made to increase the availability of the existing amphibious fleet, the most ambitious of which is the adoption of the OFRP model (though it will decrease availability in the short term, and funding to fully execute it is uncertain).

The most promising near-term option to partially address amphibious shipping shortfalls, therefore, is to find alternative ways to deploy Marines. None of the available platforms, however, provide the same level of capability in each of the three roles amphibious ships play: transport, sea base, and weapon system. Fiscal pressures may drive policymakers to compromises they would prefer to avoid. But while they may be unavoidable, policymakers should have a clear picture of the risks and opportunity costs they are assuming in pursuing the use of alternative platforms to ensure they can make the best possible decisions for the future.

To characterize those risks, the study team undertook a four-step process. The first was to identify the key attributes associated with amphibious capabilities, and the specific characteristics they comprise. The second was to look across the spectrum of military operations to determine the minimum requirements, by attribute and characteristic, associated with each operational type. The third step was to assess each amphibious ship, as well as ships in the Combat Logistics Force (CLF), Maritime Prepositioning Force (MPF), and a few others, relative to the attributes and characteristics. The fourth and final step was to compare, by attribute and characteristic, the ability of each ship to meet the minimum requirements of each type of operation. Cases in which ships fall short of mission needs represent areas that threaten successful completion of the mission, which we term "operational risk."

Chapter 3 describes the first three steps in additional detail, as a foundation for the analysis that follows. The results of the fourth step are presented in Chapter 4.

3 A Framework for Assessing Risk

Navy and Marine Corps leaders at multiple levels clearly see a need to try to maximize the utility of existing assets in support of COCOM needs. At the same time, those leaders must ensure that they preserve the ability to support those needs over the medium and longer terms. There is the potential, however, that as policymakers seek answers now, longer-term risks are rationalized or downplayed. Objectively and systematically framing those risks helps to guard against optimism bias, the natural tendency to (in this instance) underestimate the risks, over time, that are associated with making greater use of less capable platforms in order to help satisfy existing demand.

There are multiple dimensions of risk that are relevant. The first is operational—that is, the risk to successful completion of any given operation. Another is fiscal, or the risk associated with increasing the deficit or paying more for something than might be truly necessary. Both operational and fiscal risk also involve opportunity costs. On the operational side, if a mitigation strategy for addressing insufficient numbers of amphibious ships involves the use of other platforms, then a complete assessment of the associated risk must also include the impact of diverting those other platforms from what they might otherwise be doing. If those ships require reconfiguration to resume their primary tasks, this too must be considered. The same holds for fiscal risk: if the intent is to mitigate it by taking money from elsewhere, the risk to its source (which could be operational, fiscal, or both) must also be taken into account.

This study takes operational risk as its start point, based on the assumption that, in general, defense policymakers value effectiveness most highly. (That is, it is more important to accomplish the mission than to be efficient, though efficiency runs a close second.) Policymakers in the executive and legislative branches previously determined that the fiscal risk of buying additional amphibious ships was greater than the operational risk associated with foregoing those investments. Even if that determination were to change, given construction timelines, options to expand the inventory of amphibious ships are limited in the short term.[1] Whether policymakers should do so in order to increase inventory levels five to seven years from now should be at least partially informed by a better

1. The only exception would be to slow the pace of projected retirements. There are four scheduled in the next five years, the deferment of which would increase the overall inventory. If those ships are in the same material condition as the fleet as a whole (or are in even worse shape, as is likely if they are planned to be decommissioned), then they would likely require significant amounts of maintenance time (and money). This in turn could take resources away from other ships in the fleet or from other important activities. Thus, while it is likely that some increased availability would result from delaying ships' planned exits from the fleet, the

understanding of the operational risks that have already been accepted, which this study aims to illuminate.

In order to characterize the operational risks associated with the use of platforms other than amphibious ships, the study team identified how well each platform met operational requirements across the spectrum of conflict. Doing so required identifying the main attributes of ships that provide amphibious capability, mapping those to attributes and their supporting characteristics to both operations and to ships, and finally comparing how well specific requirements could be met by different platforms.

Attributes and Supporting Characteristics

Amphibious ships possess five main attributes that underpin their contributions to operations across the spectrum of conflict:

- ***Survivability,*** or the ability of a ship to withstand damage and continue conducting its mission. The degree to which a ship needs to be able to anticipate and avoid, or if need be, absorb, and recover from any damage is highly variable. Many operations are planned to be conducted in benign environments; indeed, these are the types for which alternatives to amphibious ships are specifically being sought. Some caution, however, that the diffusion of lethal capabilities has made this assumption more vulnerable to failure. There are multiple options for accounting for this reality (e.g., providing protection for less survivable ships with other platforms), but it remains a highly salient factor when considering using non-battle force ships in new ways.
- ***Breadth,*** or the range of functions a given ship can support. One of the main contributions of amphibious ships is their inherently multi-mission capability. Because they typically carry embarked forces and some number of both aircraft and surface connectors,[2] have some degree of both offensive and defensive armament, and communications, command and control (C2), and intelligence, surveillance, and reconnaissance (ISR) capabilities, amphibious ships provide commanders with multiple tools that can be either employed on their own or as part of a joint or combined[3] force. By design, most other ships have a narrower purpose, and thus offer less breadth.
- ***Projection capacity,*** or the amount of various capabilities a given ship possesses to support operations ashore. As alluded to above, amphibious ships' primary purpose is to deploy, project, and sustain Marine air, ground, and

marginal contributions they might continue to make would likely be modest. Buying additional ships would do much more to alleviate pressures in the mid-term, which in a few years will become the short term.

2. That is, small boats and landing craft, as well as rotary-wing and tilt-rotor aircraft that can deliver equipment, supplies, and/or forces ashore.

3. That is, with other U.S. military services or with military forces from other countries, respectively.

logistics elements ashore. While they occasionally support operations at sea, purely maritime operations are the core competency of the Navy. Similarly, extended ground force operations, and/or those that can or should be accessed and sustained from land, are the primary purview of the Army. Therefore, the degree to which various ships can enable sea-based operations ashore is a key distinguishing attribute in evaluating how much they contribute to the unique competencies of the Marine Corps.

- ***Responsiveness,*** or the speed with which a given ship can deliver effects ashore once given a mission. The Marine Corps has often been called the nation's "9-1-1" force, and its leaders have recently reinforced that orientation by placing crisis response at the center of the Corps' strategy and direction.[4] How quickly various ships can fulfill those responsibilities is a function of a variety of factors, from where they are stationed, to the speed of the platforms themselves, to the operating status in which they are maintained.
- ***Persistence,*** or the ability to remain in an operating area over time. Although the Marine Corps does not plan or structure to remain engaged in operations for periods over 90 days, there are some types of operations whose initiation is uncertain or that could continue for long enough that a ship would require resupply to remain on station. While not important for every operation, persistence can be a critical attribute in certain instances.

Each of these attributes has a number of more specific elements or characteristics. Breadth, for example, includes whether (in the case of a given mission) the capability to support air operations is needed, and (in the case of ship) whether that ship offers that capability. Different operations similarly require varying levels of responsiveness, to include how quickly a ship would need to get under way if the need arose. The funded readiness level of ships also varies, making them more or less suitable to meet this element of responsiveness. A list of the most salient amphibious attributes and their supporting characteristics appears in Box 3.1.[5]

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4. See, for example, U.S. Marine Corps, *Expeditionary Force 21*; Secretary of Defense Chuck Hagel's remarks on the fiscal year 2015 budget, "Remarks by Secretary Hagel and Gen. Dempsey on the fiscal year 2015 budget preview in the Pentagon Briefing Room," February 24, 2014, http://www.defense.gov/Transcripts/ Transcript.aspx?TranscriptID=5377; and 2014 Report to the Senate Appropriations Committee Subcommittee on Defense on the Posture of the United States Marine Corps, 113th Cong. 5 (2014) (Statement of General James F. Amos, Commandant of the Marine Corps), March 26, 2014, http://www.appropriations.senate.gov/sites/default/files/hearings/Gen%20Amos.pdf .

5. In considering the attributes and characteristics most relevant to this study, the intent was not to be comprehensive but to capture those that were most likely to vary across mission type and across the range of ships included in the analysis. We did not, for example, include speed and range as characteristics of responsiveness, although they vary substantially across the ships we examined. This is because a given ship's ability to be responsive is also a function of location relative to the operation, how quickly a response is required, the load (of both personnel and cargo) the ship is carrying, etc. Because these are so highly variable and not intrinsic to the platform, they fell outside the bounds of this analysis.

Box 3.1. Five Amphibious Attributes and Supporting Characteristics

Survivability

- Susceptibility (able to detect or avoid an attack)
- Vulnerability (able to be hit and continue the mission)
- Recoverability (able to be hit, recover, and sustain the mission)

Breadth

- Ability to support air and surface operations
- Capability and manner of cargo onload and offload
- Warship classification
- Ability to deliver water ashore
- Crew capacity

Projection capacity

- Crew composition
- Air and surface connector capacity
- Command and control capacity
- Intelligence, surveillance, and reconnaissance (ISR) capacity
- Medical capacity
- Capacity for ashore delivery of water
- Non-crew berthing capacity
- Self-defense capacity

Responsiveness

- Time to get under way
- Sea state limitations

Persistence

- Capability and capacity to accept underway replenishment, and, if no capability, of typical days of supply
- Habitability

Relating Attributes to Operations

As noted above, the relevance of various ships' characteristics varies across the spectrum of conflict. Though all of the ongoing internal Defense Department analyses of which the study team became aware focus on how non-amphibious ships can contribute to low-end operations in non-hostile environments, the study team took a more comprehensive approach. This is both because non-amphibious platforms may be capable of making additional contributions in areas that might be obscured by a narrower examination, and because only considering their contributions to partnering and humanitarian activities might downplay their limitations should the conditions in a given operation become more challenging.

The range of operations we considered was drawn from joint doctrine,[6] which describes three broad categories of military activities: (1) engagement, security cooperation, and deterrence; (2) crisis response and limited contingencies; and (3) major operations. Within these categories, there are numerous examples of specific types of operations. We refined the list used here by focusing on those types of operations that would likely include a significant maritime component, or that would specifically benefit from the application of amphibious capabilities. This excluded operations such as counter-insurgency, which, although they might include one or more amphibious ships at some point, would not typically require their unique capabilities, over time, to ensure success. There were also missions that *could* be performed from amphibious platforms (but could also be accomplished differently), for example, security force assistance (SFA) training with other nations. For these operational types, we attempted to treat their amphibious application. That is, we viewed the requirements of that operational type in the context of it being performed by the Marine Corps rather than some other service, and thus assumed it involved some need for ship-based capabilities.[7] Once refined, the study team arrived at the following list of 12 types of operations that could or would likely be conducted by Marines or other sea-based forces (e.g., Special Operations Forces or elements of the Navy Expeditionary Combat Command).

1. **Humanitarian or civic assistance**,[8] or providing medical, dental, or engineering services to foreign populations in support of U.S. strategic objectives.

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6. Joint Chiefs of Staff, *Joint Operations across the Range of Military Operations*, Joint Publication 3-0 (Washington, D.C.: United States Joint Forces Command, August 2011), 12–171, passim.

7. The implication of this approach is that that the mission requirements identified in this study are not generalizable to the joint force as a whole. That is, they do not represent the full range of requirements that would be needed for security force assistance (SFA) operations, for example, only those that would be needed if SFA activities were conducted by ship-based Marines.

8. Humanitarian and civic assistance differs from humanitarian assistance and disaster relief operations in that the former is a planned activity specifically aimed at providing necessary services to foreign populations to build good will. (The U.S. military typically refers to these some operations as MEDCAPs [medical civic assistance programs] or DENTCAPs [dental civic assistance programs], where small numbers of U.S. military forces provide medical or dental services to local populations while also gaining necessary training and validation of their skills.) Humanitarian assistance and disaster relief, on the other hand, are crisis response operations in the wake of events such as a refugee crisis or natural disaster.

2. **Security force assistance**, which involves conducting training or exercises with foreign militaries.[9]
3. **Counterdrug** operations to interdict drug shipments or engage traffickers consistent with relevant authorities.
4. **Humanitarian assistance and disaster relief**[10] to provide emergency aid in the wake of natural or man-made disasters, either within the United States or abroad.
5. **Foreign internal defense** operations that provide training or advisory assistance to foreign militaries that are addressing internal security challenges.
6. **Maritime intercepts**[11] to halt other maritime vessels, and in some instances board and take control of cargo, personnel, or the vessels themselves.
7. **Combating terrorism** by taking actions either directly against terrorist networks or in the environments in which they operate in order to impede their success.
8. **Shows of force**, which involve positioning a military force with offensive capabilities in an area to illustrate U.S. commitment and deter undesired foreign actions.
9. **Non-combatant evacuations** to extract endangered civilians from foreign environments deemed to be unsafe.
10. **Recovery operations** to search for, locate, recover and return personnel or sensitive equipment.
11. **Strikes and raids**, which involve conducting attacks to damage or destroy a particular target (strikes) or to temporarily seize an area (raids).
12. **Major operations and campaigns** consisting of multi-phased operations, typically of both large scale and long duration, and that could include large-scale combat.

Each of these operational types has a number of key features that determine the kinds of capabilities that are required. The expected threat level, for example, drives needs for survivability and self-defense, and the degree to which an operation is planned in advance (e.g., humanitarian and civic assistance vs. a strike operation) influences requirements for

9. These first two operational types (humanitarian or civic assistance and security force assistance) together comprise what is often referred to as theater security cooperation (TSC) activities. They are conducted according to plans developed by regional commanders to best meet the needs within a particular geographical area.

10. In joint doctrine the domestic and foreign versions of these operations are treated separately. We have combined them here under the assumption that the types of required capabilities, while not identical, are sufficiently similar to highlight the most meaningful issues.

11. Maritime intercept operations (MIOs) are not explicitly named as an example of military operations in Joint Publication 3-0 (Joint Chiefs of Staff, *Joint Operations across the Range of Military Operations*). They are more accurately characterized as a task that could be conducted in support of multiple operational types (e.g., counterdrug, counterterrorism, or combating weapons of mass destruction). MIO mission needs are relatively specific, however, and are a core task upon which all amphibious ships are certified before they deploy. Because of the importance of the mission and the range of capabilities ships must have to support it, we treated it on the level of an operational type in this study.

responsiveness. To differing degrees, the requirements are situationally dependent. For example, combating terrorism operations would likely occur in a hostile environment, but the case is less clear for non-combatant evacuations. Some could be driven by general instability unlikely to involve any violence against U.S. citizens or forces while an evacuation is being conducted, while in other instances the potential for combat could be quite high.

To address this variability, the study team rated the operational requirements associated with attributes and characteristics using a 75 percent standard—that is, the level of capability planners would anticipate in order to meet the needs of 75 percent or more of the incidences of a given type of operation. So while some foreign internal defense operations might not require aviation support, for example, if most would, the assigned rating reflects the most likely planning assumption.

In order to provide some basis for comparison at the ship level, the study team developed broad ratings for each characteristic. Some were subjective (e.g., low, medium, or high), while others were objective (e.g., no operating room or assigned medical personnel). The study team then assigned ratings, based on expected tasks or missions, within a given operational type, to represent the required capabilities.

After developing our initial ratings, the study team vetted those judgments with knowledgeable staff directorates in Headquarters Marine Corps and Combat Development and Integration. We also validated them against other studies and modeling efforts those offices had directed or conducted.[12] Appendix A summarizes the rankings, by operational type, for each of the amphibious ship characteristics.

Relating Attributes to Ships

The next stage in our analysis involved taking the same attributes and characteristics associated with amphibious ships and rating them relative to a broader range of platforms. Typically, the Marine Corps plans to meet operational needs with forces embarked on a combination of ships (e.g., a Marine Expeditionary Unit on board the three amphibious ships that comprise an Amphibious Ready Group [ARG]). In order to enable a common basis for comparison, however, the study team used individual ships, as they are typically deployed, as the unit of analysis.

There are a wide variety of ships currently being considered as potential contributors to amphibious operations. Most are either other Navy combatants (especially the Littoral Combat Ship) or are owned by Military Sealift Command (MSC). The MSC ships that have

12. Some of these were based on very specific vignettes that were developed by the Joint Staff and the Office of the Secretary of Defense for various analytic activities. The rankings in this study are consistent with those efforts.

been deemed most useful are primarily those that comprise the Combat Logistics Force (CLF) and Maritime Prepositioning Force (MPF).[13]

For the purposes of this study, the CSIS team selected a range of ships currently in the Navy inventory that possess or could be modified to possess the most relevant types of capabilities that would contribute to the range of amphibious operations under analysis. The team did not include single (i.e., one-of-a-kind) ships that are expected to soon be out of service such as the USS *Ponce*, an interim afloat forward staging base that is not intended to be replicated, or the LPD-4, the last of which is scheduled to be retired in the near future. The team attempted to collect data for the T-AK 3017 *Stockham*, a particularly interesting MSC ship because it has been substantially modified in the past to support a broader range of missions. While this ship remains in the fleet, the study team was unable to clearly identify its current capabilities. For future analyses, however, the *Stockham* may present an interesting case study of the potential of some platform modifications.

In instances where there are multiple variants of a class in the MSC fleet as a whole (e.g., T-AKR roll-on/roll-off cargo ships and T-AKE cargo ships), the study team focused on a single version. Additional variants may exist in the broader MSC fleet, and, as with any other ship, could be included in future analyses utilizing the framework described here. The team also did not include ships not yet built where requirements are not yet clear (e.g., the replacements for the large deck amphibious ship, amphibious landing ship, or fleet oiler).

Finally, the study team gathered data on but ultimately decided not to explicitly include the Mobile Landing Platform (MLP) ships. MLP 1 is currently undergoing testing, and is expected to be fully operational in FY 2015. MLPs 3 and 4, which are a substantially different design, are currently under construction and expected to enter the fleet beginning in FY 2016. MLP 1 and 2 were difficult to evaluate in a manner consistent with other ships because they are intended to be transfer stations rather than be used as transport or warfighting ships. Thus they are specifically designed to operate in conjunction with other ships, and have little relevant capability in and of themselves. For example, they do not and cannot carry surface connectors or equipment. Instead, they are designed to marry up with a ship that does, but that lacks the capability to offload them directly at sea. The MLP would load landing craft or equipment onto its deck, which would then be lowered and launched. Given this design, there was no straightforward way for us to integrate these ships into our analysis.

The MLP 3 and 4 will differ substantially from the earlier versions; rather than serve as transfer ships, they are intended to be a sea base from which forces could operate. Much of their capability is intended to be provided through mission modules that can be taken on and off the ship as required, none of which are yet constructed. As a result, it was difficult

13. MSC owns a range of ships that extend beyond the CLF and MPF, though most were not included in this study. The mission of CLF ships is to provide critical supplies to the fleet at sea with oilers and dry cargo/ammunition ships. MPF ships comprise the Maritime Prepositioning Squadrons, which carry Marine supplies and equipment forward to shorten Marines' response times.

for the study team to assign meaningful values that reflected the intrinsic capabilities of the platform in a manner consistent with what we did for other vessels.

Using these basic guidelines, the study team examined 16 ship classes that fall into four general categories: amphibious ships, two categories of MSC-owned ships (those in the Combat Logistics Force and Maritime Prepositioning Force), and other ships. The specific ships included are detailed below.

AMPHIBIOUS SHIPS

The study team's analysis included six amphibious ships.

1. **LHD-1,** the *Wasp*-class amphibious assault designed to carry landing craft, helicopters, and short takeoff and landing aircraft to support forces ashore.
2. **LHA-6,** the *America*-class amphibious assault ship maximized for aviation (and thus without a well deck for carrying landing and surface craft).
3. **LHA-8,** the *America*-class amphibious assault ship with the well deck restored, the contract for which is currently under negotiation.
4. **LPD-17,** the *San Antonio*–class amphibious transport dock ship designed to deliver Marines via both land and air.
5. **LSD-41,** the *Whidbey Island*–class dock landing ship optimized for transport of Marine Corps landing craft.
6. **LSD-49,** the *Harpers Ferry*–class dock landing ship, which carries fewer landing craft than the *Whidbey Island* class but more cargo.

COMBAT LOGISTICS FORCE (CLF) SHIPS

CLF ships are owned by Military Sealift Command (MSC), the Navy component command of U.S. Transportation Command. MSC operates over 100 different commercially based ships that support the combatant fleet, primarily with civilian crews. CLF ships provide fuel, supplies, and ammunition to other ships in the fleet while at sea, either by connecting with hoses or cables, with helicopters, or both. The study team's analysis included two ships.

7. **T-AO,** the *Henry J. Kaiser*–class oiler.
8. **T-AOE,** the *Supply*-class supply ship used to rearm, refuel, and restock.

The CLF also includes T-AKE hulls, as does the Maritime Prepositioning Force (MPF). The study team focused its analysis on the MPF's T-AKEs, under the assumption that policymakers would be more inclined to put those hulls into service for alternative missions.[14]

14. The CLF T-AKEs routinely resupply Navy ships, an ongoing priority mission from which they would be unlikely to be diverted. MPF T-AKEs, on the other hand, carry portions of the sustainment block for a MEB and

MARITIME PREPOSITIONING FORCE (MPF) SHIPS

MPF ships are also owned by MSC, and are designed to station Marine Corps equipment and supplies in forward locations. They are organized into two Maritime Prepositioning Squadrons (MPSRONs), the loads for which are carefully tailored to support expected operations in different regions. Box 3.2 describes recent adjustments to the MPSRONs. The MPF ships studied include the following three:

9. **T-AKE,** the *Lewis and Clark*–class dry cargo ship that carries most classes of supply for MEBs as part of the Maritime Prepositioning Squadrons.
10. **T-AK**, the *2nd Lt. John P. Bobo*–class ship designed to carry vehicles, ammunition. and dry and liquid cargo.
11. **T-AKR/LMSR**, the *Bob Hope*–class[15] Large, Medium-Speed, Roll-on/Roll-off (LMSR) vehicle cargo ship.

OTHER SHIPS

The study team also considered five other ships that are included in some of the ongoing analyses of alternative platform use. Though the T-AVB was initially acquired as part of the MPF, it is not included in the Maritime Prepositioning Squadrons and is thus considered here as an "other" MSC-owned ship. The hospital ship and Joint High Speed Vessel (JHSV) are also both MSC-owned, while the two versions of the Littoral Combat Ship are part of the Navy's surface combatant fleet.

12. **T-AVB,** the *Curtis*-class ship that provides aviation logistics support.
13. **T-AH,** the *Mercy*-class converted oil tanker now hospital ship, designed to provide large-scale medical support and normally kept in reduced operating status.
14. **JHSV**, the *Spearhead*-class, a high-speed, shallow-draft vessel designed for rapid regional transport of people or limited amounts of cargo.
15. **LCS-1,** the *Freedom*-class fast, relatively shallow-draft surface combatant designed to carry specific mission modules for greater tailorability.
16. **LCS-2,** the *Independence*-class, based on a trimaran hull, with a larger flight deck than LCS-1 but a fewer number of mission modules.

While there are some other ships that could make contributions to missions ideally performed by the six class/types of amphibious ships included here, the 16 the study team examined represent a wide range: purpose built and commercially modified, combatants

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do not have a day-to-day requirement. As a result, MPF T-AKEs operate with reduced crews, which means additional berthing could be available for embarked forces.

15. The other class of T-AKR/LMSRs, the *Watson*-class, is slightly different from the *Bob Hope*–class ships discussed here. Both classes have comparable troop berthing and medical and aviation maneuver capabilities, but have significant differences in fuel consumption.

Box 3.2. The Evolution of the Maritime Prepositioning Fleet (MPF)

Another element of the Marine Corps' efforts to enhance the utility of existing assets is to update the loads of its MPF ships. While the primary mission of the MPF remains to support the requirements of a Marine Expeditionary Brigade (MEB) for major combat operations, the planned adjustments are intended to increase their usefulness for other, more frequent operations. This has two key elements: changes to the equipment that will be put on each ship, and changes to how the lighterage (barges, ferries, floating ramps, etc.) that support getting that equipment off of the ship for use will be distributed across the two Maritime Prepositioning Squadrons (MPSRONs).

On the equipment side, for the last 15 years, two MPF ships in each MPSRON have been loaded with a "MEU slice." This included the preponderance of equipment and supplies required in order to stand up a Marine Expeditionary Unit (MEU). The remainder of the MPSRON carried the equipment and supplies that would be needed to stand up a MEB. The distribution of MEB equipment across the MPSRON was typically determined administratively—that is, for reasons that maximized available space or that facilitated maintenance—rather than with the objective of maximizing its relevance during operations (which might result in less efficient use of space, for example, but be much faster to get to when needed).

During the ongoing ship maintenance cycle, which extends through FY 2017, these loads are being reconfigured. As each ship comes in for maintenance, its equipment is being taken off and replaced with an equipment set tailored such that each ship will be able to provide some level of crisis response capability on its own, or can be combined to meet the needs of larger or more specific types of operations. Each MPSRON will have the ability to support multiple specifically tailored and scalable crisis response force packages (CRFPs) that will enable commanders to select the equipment sets most useful to the need at hand. Each MPSRON will be capable of forming two "Light" CRFPs of one to three ships each, one "Medium" CRFP of three to five ships, or one "Heavy" CRFP that would include all of a MPSRON's ships. The ships in the Light CRFPs will primarily carry the equipment and supplies required for small-scale crisis response operations in a benign environment. To support larger or contested operations (i.e., those that would require a Medium CRFP or Heavy CRFP), additional select MPF ships in each MPSRON would be deployed that, in the aggregate, would support the sustainment of a MEB for up to 30 days of operations.

Having the right equipment is only half the battle, however; it must also be delivered ashore. In the past, MPF lighterage has also been allocated to ships administratively and non-uniformly across the two MPSRONs. The current maintenance cycle will adjust the distribution of all assigned lighterage to ensure that each CRFP has organic ship-to-shore connectors and that the lighterage/CRFP assets in each MPSRON are identical. Should the need arise, this parity will allow for ship substitutions between MPSRONs, reducing operational risk.

and support ships, military- and civilian-manned, small and large. They thus offer sufficient insights to demonstrate the utility of an attributes-based methodology.

After identifying the range of ships within the scope of the study, we began assembling data about each to support characteristic ratings. Those ratings, by ship, are summarized in Appendix B, and illustrate key differences among ships built for very different purposes. MSC-owned ships are less survivable than are combatants, for example, which are designed for the purpose of going into harm's way. And multi-role capabilities, such as a crew that is sized and trained to conduct disparate and simultaneous operations, are integral to the purpose of amphibious ships but less relevant for oilers. What is of most interest is not the differences in and of themselves, but rather in making them explicit in order to evaluate how useful ships that were *not* purpose built to conduct sea-based littoral operations might be in satisfying some aspects of current COCOM demand, and how much risk and opportunity cost that might entail.

To better understand the operational environments in which these differences matter, Chapter 4 summarizes the results of our comparison of the 16 ship classes and the minimum requirements for the 12 types of operations we explored.

4 Risk across the Spectrum of Operations

Expanding the use of various platforms beyond the original purposes for which they were built will result in the assumption of some risk, the characterization of which should be a key factor in subsequent decisions. Having an objective, uniform assessment of that risk informs choices about how much might be acceptable, and about operational and fiscal tradeoffs that can be made to help mitigate it.

As a point of departure, the dominant attribute that relates to whether non-combatant ships can be utilized for some amphibious operations is survivability. Leveraging non-combatants (in this study, those in the CLF and MPF, as well as the T-AVB, T-AH hospital ship, and the Joint High Speed Vessel [JHSV]) is principally being considered for low-end or Phase 0/Phase 1[1] operations or activities in which the assumed threat is very low. In this context, the low levels of survivability these ships possess is not a constraint, and in some cases can even be an asset. Because MSC ships are not warships, they do not carry visible weapons systems. This lower profile can be more politically acceptable in some countries where populations are sensitive to a U.S. military presence. In addition, certain MSC ships (e.g., the JHSV) and the two LCS versions have shallower draft than do amphibious ships, which allows them access to a greater number of ports. In missions aimed at helping foreign nations where the threat is assumed to be low, this greater access may offer expanded geographical opportunities or make already planned interactions less logistically challenging.

Operations in a Non-hostile Environment

Of the operational types examined here, four were assumed to typically occur in a non-hostile environment:

1. humanitarian or civic assistance (e.g., medical, dental, or engineering support to other nations' populations);

1. Joint doctrine describes various phases of operations that range from pre- to post-hostilities. The phrase "Phase 0," or "Phase 0/Phase 1," is sometimes used to refer to operations or activities undertaken when there is little or no perceived threat, and often to actions that might be taken specifically to attempt to preclude escalation. See Joint Chiefs of Staff, *Joint Operations across the Range of Military Operations*, 112.

2. security force assistance, or planned exercises or training with other nations' militaries;
3. humanitarian assistance/disaster relief; and
4. counterdrug operations.[2]

It is for these four operational types, then, that the contributions of non-amphibious vessels might be expected to be most relevant. Our analysis finds that this is most true for the first two, but less so for the last two.

HUMANITARIAN AND CIVIC ASSISTANCE (HCA)

Conducting HCA operations with non-amphibious ships poses the least amount of operational risk (i.e., involves the fewest number of capability shortfalls) of any of the operational types we examined. The most important limitations relate to surface connector capabilities. The study team assumed that if naval (as opposed to land-based) forces were conducting HCA operations, it must be because ship-based capabilities were required. This assumption in turn suggests that relevant ships would at a minimum need the ability to launch or offload small craft (boats, utility craft, or assault vehicles) to put people and/or equipment ashore.

Five of the ships we examined are unable to do so: the LHA-6, the T-AO and T-AOE, the T-AVB, and the T-AH. Two more, the T-AKE and T-AK, can meet some of the requirement, as they can launch very small boats (11 meters or smaller, and, in the case of the T-AK, amphibious assault vehicles [AAVs] and Navy lighterage).

SECURITY FORCE ASSISTANCE (SFA)

SFA operations are in many ways similar to HCA operations. They are thus highly amenable to being conducted, with little or no risk, by a broad range of ships. Here too the most significant shortfalls are in capabilities associated with surface connectors. These shortfalls result from an assumption that if Marines are conducting SFA operations, their unique core competency (coming ashore from the sea) would be an integral part of whatever training was being conducted. As such, these operations were assumed to typically involve the need to launch a variety of craft at sea, though not in large numbers.

Overall, most ships could transport equipment and a small number of forces to meet almost all the needs of SFA missions. The non-amphibious ships (and the LHA-6), however, would not be able to train or demonstrate a key amphibious core competency, the ability to put forces ashore from the sea in large boats. If this element is crucial to an SFA operation's success, these shortfalls suggest that such operations would either need to be conducted

2. This operation could involve some type of armed opposition, but the study team assumed that in most instances adversaries would lack the capacity to pose serious harm to the ship itself, and therefore that less survivable ships could be reasonably considered.

from amphibious ships or that other steps would have to be taken to inject this element into the operation.

HUMANITARIAN ASSISTANCE AND DISASTER RELIEF (HA/DR)

Providing aid in the form of supplies, medical help, engineering support, and potentially security in the aftermath of a natural disaster or other crisis is an all too frequent activity, especially for sea-based forces. Projections indicate that tens of millions more will be exposed to cyclones and floods in 2030, for example, than they were in 1970.[3]

Responding to these types of crises is thus likely to remain a central activity for U.S. Marines. Though HA/DR operations have typically occurred in benign environments, some argue that this could change. Opportunists seeking to exploit either governance challenges or the presence of U.S. forces, coupled with the increasing availability of lethal technologies, may inject hostile elements into purely humanitarian efforts, making these operations more dangerous in the future.[4] For the purposes of this analysis, the study team posited operations in which there is no significant threat to ships, and thus that the use of ships with low survivability poses little risk. However, such operations are likely to involve at least some small security force to protect supplies from looting or diversion, and potentially more significant threats ashore. For this analysis, the study team assumed that any initial HA/DR response would be provided by military forces, with the expectation that these and other functions would be transitioned to other organizations (host nation security, other U.S. government agencies, or nongovernmental organizations, for example) as rapidly as possible.

Overall, HA/DR operations are sufficiently large in scale and breadth that they pose challenges for every one of the ships we examined if they were operating on their own, with the exception of the large-deck amphibious vessels (LHA-8 and LHD-1). While each of the ships could contribute, in some cases substantially, to such operations, each would require at least one additional ship to provide all the requisite capabilities, and possibly many more. Thus, even though non-combatants may be attractive to help assume portions of HA/DR responsibilities, except in large force packages (and possibly not even then) they are unlikely to be able to meet *all* the demands of such operations.

These missions frequently rely heavily on airlift, especially in environments where ports and other infrastructure may be damaged. There is thus a need for at least a moderate amount of rotary-wing lift, which exceeds the capabilities and capacities of all the CLF and MPF ships examined, as well as the T-AVB, T-AH, and JHSV. The LCS ships have some capacity, but the LCS-1 may be unable to sustain lift operations as it lacks the ability to do

3. Intergovernmental Panel on Climate Change (IPCC), *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation*, ed. Christopher B. Field et al. (New York: Cambridge University Press, 2012), 240–241, https://www.ipcc.ch/pdf/special-reports/srex/SREX_Full_Report.pdf.

4. See, for example, Nathan Freier, *Beyond the Last War* (Washington, DC: CSIS, April 2013), 48–49, http://csis.org/files/publication/130424_Freier_BeyondLastWar_Web.pdf; and National Intelligence Council, *Global Trends 2030* (Washington, DC: National Intelligence Council, December 2012), 52, http://www.dni.gov/files/documents/GlobalTrends_2030.pdf.

on-board aviation maintenance. For amphibious ships, the LPD-17, LSD-41, and LSD-49 each have only two operating spots, and thus might be challenged to sustain high levels of cargo or equipment transfer over time. On the other hand, the LHAs have the most air capability and capacity of all the ships the study team assessed.

In addition to airlift, however, there is also a need to move equipment that can assist with reestablishing road and rail networks ashore, and to help distribute supplies once it arrives. In the ship context, this creates a demand for lighterage (barges, ramps, and other vessels) that can receive that equipment from larger vessels and then transport and offload it, or for landing craft that can transport it directly.[5] While most of the amphibious ships can transfer trucks, bulldozers, or other equipment ashore via LCAC or LCUs launched directly from the well deck, this requirement poses a major challenge for most non-amphibious ships—and for the LHA-6. Some of the MPF vessels typically deploy with lighterage (e.g., the T-AK and T-AKR), and many others can onload or offload in ports that provide cranes or other means of cargo transfer as long as the seas are relatively calm. But ships such as the T-AO oilers and T-AVB aviation maintenance ships would only be able to support this element of an HA/DR operation if a developed port were available. Similarly, while the JHSV is capable of carrying heavy equipment, it would only be able to deliver the cargo if it was transloaded to and from a Mobile Landing Platform (MLP) ship, or if there was a functioning pier. Of the remaining ships, the T-AH would not typically carry heavy equipment, nor be able to deliver it. Neither version of the LCS would be able to either carry or deliver necessary equipment.

Other major shortfalls non-amphibious ships have for this operational type include insufficient command and control (C2) and medical capabilities, the latter of which could be particularly important in the case of either hostilities or mass casualties.[6] The C2 capabilities of LSDs would also likely be inadequate to support independent operations due to limited planning and operational spaces. Some ships (T-AVB, T-AH, and JHSV) also lack sufficient capability or capacity to deliver water ashore for U.S. forces or civilian populations. Finally, the Combat Logistics Force ships (T-AO and T-AOE) and the MSC ships all have berthing spaces for less than 100 embarked forces, numbers that would likely be insufficient to independently support the needs of an HA/DR mission.

In sum, HA/DR operations, while probably not requiring high levels of survivability, do call for breadth, projection, and sustainability at levels that are uniquely resident in the large-deck amphibious ships. Each of the other ships addressed has relevant capabilities, but most have multiple shortfalls that represent significant operational risk if they were to be employed on their own. (In combination, however, their potential would be substantially greater.)

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5. While there may be instances where ships can pull directly into ports, prudent planning requires assuming this condition may not be met.

6. The T-AH hospital ship is the only non-amphibious ship with sufficient medical capability to minimize risks in this regard.

COUNTERDRUG

For this analysis, the study team assumed that counterdrug (CD) operations would, in most instances, not involve threats that could pose serious danger to large ships.[7] In such circumstances many of the non-amphibious ships we examined could meet most operational needs, but with a few common areas of shortfalls. The first is in surface capabilities: we assumed that CD operations would require the ability to launch at least small boats at sea, a capability the LHA-6, T-AO, T-AOE, and T-AH lack. The T-AKR has capability only for boats up to 11 meters, and the T-AK has capability for 6.7 meter boats but would require modifying the typical load if boats are included.

Such operations would also call for the capability not only to support air operations, but to arm and re-arm helicopters in order to provide air support. None of the MSC ships[8] have this capability. Another area of important shortfalls involves crew capacity and composition. All the MSC ships we evaluated are civilian-manned, and would require an embarked force of military personnel to carry out an offensive mission. In some instances (for the T-AKE, T-AK, T-AKR, and LCS-2), because of size, training, or both, the crews are unable to support multiple missions simultaneously without additional augmentation. Because CD operations would necessitate operating the ship, as well as the possible launch and/or recovery of both air and surface craft, the crews for these ships would be unable to provide the necessary support.

C2 and intelligence, surveillance, and reconnaissance (ISR) are two other areas where all the MSC ships face shortfalls. With respect to C2, with the exception of the T-AKE, T-AVB, and, to a lesser degree, the JHSV, most ships have very limited capabilities, as noted above. (Most, however, could augment their bandwidth capacity if the decision was made to purchase some from commercial satellites.) ISR capabilities are limited not only by secure communications channels but by the lack of assigned intelligence personnel, collection assets, and secure areas for communications or analysis.[9]

In general, for counterdrug operations the combatant ships[10] (again, with the exception of the LHA-6's limitations in deploying small boats and the LCS-2's crew constraints) are capable platforms. MSC ships face shortfalls in both breadth and projection that would make them high-risk platforms for such operations if mitigation steps were not taken.

Table 4.1 summarizes the key shortfalls, by ship, across the four operational types envisioned to be most amenable to support by non-amphibious vessels. An entry in a cell indicates that the specific ship has a shortfall in that characteristic for that mission set.

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7. There could, of course, be specific instances in which the threat assessment suggested a much higher risk; in those cases, we assume that battle force ships would be employed rather than one of the other ships explored here.
8. That is, those in the CLF and MPF, as well as the T-AVB, T-AH, and JHSV.
9. The T-AVB can support an embarked module, but most of the other MSC ships are not designed to do so.
10. That is, the six amphibious ships and two LCS variants.

Table 4.1. Summary of Ships with Capability Shortfalls for Operations in Non-hostile Environments

	Humanitarian and Civic Assistance				*Security Force Assistance*				*Humanitarian Assistance/Disaster Relief*				*Counterdrug*			
	Amphibious Ships	*CLF*	*MPF*	*Other Ships*	*Amphibious Ships*	*CLF*	*MPF*	*Other Ships*	*Amphibious Ships*	*CLF*	*MPF*	*Other Ships*	*Amphibious Ships*	*CLF*	*MPF*	*Other Ships*
Breadth																
Surface capability	LHA-6	T-AO, T-AOE	*T-AKE*, *T-AK*	*T-AVB*, T-AH	LHA-6	T-AO, T-AOE	T-AKE, T-AK, T-AKR	T-AVB, T-AH, JHSV, LCS-1, LCS-2	LHA-6	T-AO, T-AOE	T-AKE, T-AK, T-AKR	T-AVB, T-AH, JHSV, LCS-1, LCS-2	LHA-6	T-AO, T-AOE	*T-AKE*, *T-AK*	*T-AVB*, T-AH
Air capability						T-AO	T-AKR	T-AVB	*LSD-41*, *LSD-49*	T-AO, T-AOE	T-AKE, T-AK, T-AKR	T-AVB, T-AH, JHSV, *LCS-1*, *LCS-2*		T-AO, T-AOE	T-AKE, T-AK, T-AKR	T-AVB, T-AH, JHSV
Projection																
Surface capacity									LHA-6	T-AO, T-AOE	T-AKE	T-AVB, T-AH, JHSV, LCS-1, LCS-2				
Air capacity								LPD-17, LSD-41, LSD-49	T-AO, T-AOE	T-AKE, T-AK, T-AKR	T-AVB, T-AH, JHSV, LCS-1, LCS-2					
Ashore water delivery									T-AO, T-AOE	T-AKE, T-AKR	*T-AVB*, T-AH, LCS-1, LCS-2					
Command and control									LPD-17, LSD-41, LSD-49	T-AO, T-AOE	T-AKE, T-AK, T-AKR	T-AVB, T-AH JHSV, LCS-1, LCS-2	LSD-41, LSD-49	T-AO, T-AOE	T-AKE, T-AK, T-AKR	T-AH
Intelligence, surveillance, and reconnaissance (ISR)													LSD-41, LSD-49	T-AO, T-AOE	T-AKE, T-AK, T-AKR	*T-AVB*, T-AH, JHSV
Medical									LHA-6, LSD-41, LSD-49	T-AO, T-AOE	T-AKE, T-AK, T-AKR	T-AVB, JHSV, LCS-1, LCS-2				
Berthing space										T-AO, T-AOE	T-AKE	LCS-1, LCS-2				
Crew											T-AK, T-AKR	T-AVB, LCS-2		T-AO, T-AOE	T-AKE, T-AK, T-AKR	T-AVB, T-AH, JHSV, LCS-2

Notes: Italics indicate the ship meets the minimum capability requirement with limitations. CLF = Combat Logistics Force, MPF = Maritime Prepositioning Force.

Operations in a Potentially Hostile but Discretionary Environment

All the other types of operations we examined were assumed to involve at least some level of likely hostilities, and would thus need ships with some degree of survivability. For some operational types, however, the requirements may not be as stringent as for others. The study team considered three aspects of survivability: susceptibility, vulnerability, and recoverability,[11] with susceptibility being the ability to anticipate and avoid damage, vulnerability the ability to withstand it, and recoverability the ability to withstand it and continue to conduct operations.

There are certain types of operations that, if undertaken, would presumably require seeing them through to completion. There are others, however, that are less central to immediate U.S. security interests, and that thus could be delayed or aborted if a ship were or could reasonably expect to be damaged. In these instances, a ship would not necessarily need high levels of all three aspects of survivability. Instead, the ability to detect and avoid damage would be important (as no commander would want to risk loss of life or potential national embarrassment), but the ability to recover and continue would be a lower priority. In the terms of the study framework, then, the four "permissive environment" missions discussed above (HCA, SFA, HA/DR, and CD) are assumed to require low levels of all three aspects of survivability. In other cases, ships would still need to be able to anticipate, avoid, and withstand damage (i.e., have low susceptibility and vulnerability), but if completion of the mission were less critical, could in theory have lower levels of recoverability.

The study team identified two types of operations that were assumed to meet these conditions: foreign internal defense (FID) operations and maritime intercept operations (MIOs). These operations could be conducted in environments with some low level of threat; if a ship were harmed, however, it would not require continued involvement. FID operations are conducted in support of other nations' forces that are combating an internal threat. If conducted from a ship, the study team's assumption was that this capability was necessary, and thus that the forces operating in support of the mission would be primarily based on one or more ships. We posited that most of these operations would be relatively small, and that if a ship were to sustain damage, the likely decision would be to remove it rather than expect it to continue.

The second operational type is the maritime intercept operation (MIO), and in particular the visit, board, search, and seizure missions. Assumed to be limited in size, these operations involve putting a force aboard another ship (either by surface, air, or both) in order to conduct inspections, interdict contraband, counter piracy, or combat terrorism. The study team assumed that if a non-combatant was being considered to conduct such

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11. These are laid out in Office of the Chief of Naval Operations, *Survivability Policy and Standards for Surface Ships and Craft of the U.S. Navy* (Washington, DC: Department of the Navy, September 13, 2012), http://doni.daps.dla.mil/Directives/09000%20General%20Ship%20Design%20and%20Support/09-00%20General%20Ship%20Design%20Support/9070.1A.pdf.

operations, that the threat environment was deemed to be low. If damage was sustained, or seemed likely, we postulated that the operation would be aborted, delayed, or reassigned.

Against this backdrop—that leaders felt sufficiently comfortable with the threat level to employ a non-combatant ship—the study team found shortfalls in many of the same areas as discussed above.

FOREIGN INTERNAL DEFENSE (FID)

If policymakers were to decide to employ an MSC ship to support FID operations, that ship would have limited capabilities to detect and avoid an attack. FID operations from a sea base also require capability and capacity to move forces, supplies, and equipment to and from the shore, and thus the capability to launch and recover surface landing craft, as well as conduct air operations and aircraft storage. The LHA-6, TA-O, T-AOE, and T-AH have shortfalls with respect to the former (as do the T-AKE, T-AK, and T-AKR for boats larger than 11 meters). For the latter, all the MSC ships other than the T-AKE and T-AH lack a hangar and/or are unable to fuel helicopters. Neither version of the LCS can support the full range of tilt-rotor or rotary-wing helicopters; LCS-1 has a hangar for smaller rotorcraft, and LCS-2 can fit one in a hangar with the doors ajar. All the MSC ships, as well as the LSDs and LCSs, also lack sufficient air capacity to meet assumed operational needs.

Crews for the T-AKE, T-AK, T-AKR, and LCS-2 would be challenged to conduct multiple missions without augmentation. The LSDs and all the MSC ships other than the T-AKE and T-AVB have C2 shortfalls for this operational type, and none can provide the necessary ISR support. The LSDs have sufficient medical support, in contrast to all the MSC ships other than the T-AH. The CLF ships, T-AKE, and LCS ships would be unable to provide sufficient berthing spaces for an embarked force of more than 100 people without modifications.

MARITIME INTERCEPT OPERATIONS (MIO)

As with FID operations, even if policymakers determined that ships would not need to continue operating if they sustained damage, MSC ships employed for MIO would be challenged to identify and avoid most threats. Because these operations are typically conducted in blue water at distances far from shore, the requirements to survive if damaged are higher than for many other amphibious operations; as such, MSC ships have vulnerability shortfalls as well.

MIOs are also assumed to require the ability to launch small boats, which is beyond the capability of the LHA-6, T-AO, T-AOE, and T-AH, and for which the T-AKE, T-AK, and T-AKR are only partially capable. These operations also require armed helicopter operations, which none of the MSC ships are capable of supporting.

In terms of crew capacity and composition, the necessity in MIOs to support multiple missions simultaneously exceeds the typical crew size and/or level of training, thereby presenting a challenge for all the MSC ships, as well as LCS-2. None of the MSC ships other

Table 4.2. Summary of Ships with Capability Shortfalls for Operations in Likely Low Threat, Discretionary Operations

	Foreign Internal Defense				*Maritime Intercept Operations*			
	Amphibious Ships	*CLF*	*MPF*	*Other Ships*	*Amphibious Ships*	*CLF*	*MPF*	*Other Ships*
Survivability								
Susceptibility		T-AO, T-AOE	T-AKE, T-AK, T-AKR,	T-AVB, T-AH, JHSV		T-AO, T-AOE	T-AKE, T-AK, T-AKR	T-AVB, T-AH, JHSV
Vulnerability						T-AO, T-AOE	T-AKE, T-AK, T-AKR,	T-AVB, T-AH, JHSV, LCS-1, LCS-2
Breadth								
Surface capability	LHA-6	T-AO, T-AOE	*T-AKE*, *T-AK*	*T-AVB*, T-AH	LHA-6	T-AO, T-AOE	*T-AKE*, *T-AK*	*T-AVB*, T-AH
Air capability		T-AO, T-AOE	*T-AKE*, T-AK, T-AKR	T-AVB, JHSV		T-AO, T-AOE	T-AKE, T-AK, T-AKR	T-AVB, T-AH, JHSV
Projection								
Air capacity	LSD-41, LSD-49	T-AO	T-AKE, T-AK, T-AKR	T-AVB, T-AH, JHSV, LCS-1, LCS-2	LSD-41, LSD-49	T-AO	T-AKE, T-AK, T-AKR	T-AVB, T-AH, JHSV, LCS-1, LCS-2
Command and control	LSD-41, LSD-49	T-AO, T-AOE	T-AKE, T-AK, T-AKR	T-AH	LSD-41, LSD-49	T-AO, T-AOE	T-AKE, T-AK, T-AKR	T-AH
Intelligence, surveillance, and reconnaissance (ISR)	LSD-41, LSD-49	T-AO, T-AOE	T-AKE, T-AK, T-AKR	*T-AVB*, T-AH, JHSV	LSD-41, LSD-49	T-AO, T-AOE	T-AKE, T-AK, T-AKR	*T-AVB*, T-AH, JHSV
Medical		T-AO, T-AOE	T-AKE, T-AK, T-AKR	T-AVB, JHSV, LCS-1, LCS-2				
Berthing space		T-AO, T-AOE	T-AKE	LCS-1, LCS-2				
Ship self-protection		T-AO, T-AOE	T-AKE, T-AK, T-AKR	T-AVB, T-AH, JHSV		T-AO, T-AOE	T-AKE, T-AK, T-AKR	T-AVB, T-AH, JHSV
Crew			T-AK, T-AKR	T-AVB , LCS-2		T-AO, T-AOE	T-AKE, T-AK, T-AKR	T-AVB, T-AH, JHSV, LCS-2

Notes: Italics indicate the ship meets the minimum capability requirement with limitations. CLF = Combat Logistics Force, MPF = Maritime Prepositioning Force.

than the T-AOE typically deploy with helicopters, and thus all lack sufficient organic air assets to meet mission needs. All MSC ships other than the T-AVB and JHSV would face C2 shortfalls. The same is true for ISR, though both could have some limited capabilities with modifications.

All the MSC vessels would also have very limited capabilities to protect passengers (a different factor than survivability) if the ship came under attack. Table 4.2 summarizes the primary shortfalls various ships would face should they be employed for FID or MIO. An entry in a cell indicates that the specific ship has a shortfall in that characteristic for that mission set.

Operations in Contested or Hostile Environments

The remainder of the operational types we examined—combating terrorism, show of force, non-combatant evacuation operations, recovery operations, strikes and raids, and major operations—were all assumed to take place in mid- to high-threat environments. In each case, therefore, the low survivability of all MSC ships represents a potential shortfall and operational risk.[12] It is therefore unlikely that any MSC ship or combination of MSC ships would ever be employed without at least one combatant. The combination of ships could have significant implications for how many of the other shortfalls associated with a given MSC ship might be mitigated, but also for how much of the MSC ships' primary mission (support to combatants) might be required, and thus in competition with any additional duties under consideration.

Most MSC ships have shortfalls to conduct these missions that have already been raised: insufficient C2, ISR, medical, berthing (in some cases), and air and surface connector capability and/or capacity.[13] Again, many of these can be mitigated, if not by modifications to the ships themselves, then by combining them with other platforms. Considerations that affect the viability of those options are the subject of Chapter 5.

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12. Some reviewers pointed out that non-combatant evacuation operations, in particular, may not involve hostilities. This may well be true, and in specific instances survivability concerns about MSC ships may be sufficiently minimal that they could be used to conduct such operations. Again, however, the study team assumed that if planners applied the 75 percent rule, in at least 75 percent of the cases planners would anticipate at least some level of hostilities (even if none actually occurred). As a result, the team assumed that policymakers would not expect to be able to use an MSC ship for these missions, though they might be able to on a case-by-case basis.

13. Many of the combatants we examined also have some limitations in one or more of these areas, either because of the scale or scope of demands for some types of combat operations.

5 Mitigating Risks Associated with Alternative Platforms

The analysis in Chapter 4 offers a method for objectively considering where alternative platforms could be used to assume, in part or as a whole, operations that might otherwise be conducted by amphibious ships. (The results of the total analysis, by ship and attribute, are presented in Appendix C.) Clearly, the risks are lowest for humanitarian and civic assistance and small-scale security force assistance. For other operational types, the existence of shortfalls does not necessarily indicate those platforms cannot provide the necessary capabilities, but that doing so would involve some level of risk. Many of the risks associated with various shortfalls can be mitigated, at least to some degree. Some steps can be taken for relatively low cost and with relative ease, while others would be much more expensive and complex.

One way to overcome shortfalls in any individual ship is by pairing it with one or more other types—indeed, this is the rationale behind the combinations of platforms that comprise the Amphibious Ready Group and the Maritime Prepositioning Squadrons (though for different purposes). Given the breadth of the fleet, the variety of potential ship combinations is vast, and a detailed analysis of the potential exceeded the scope of this study. (As is discussed briefly below, pairing the Mobile Landing Platform (MLP), which is specifically designed to operate in conjunction with other ships, should provide a significant advance in the realization of sea basing.) In some cases, however, individual ships can be modified to enhance their capabilities irrespective of other ships, which offers another avenue for risk mitigation.

Opportunities for modifications are less expensive and complex when they do not involve structural modifications to the ship, which can be time and materiel intensive. Unfortunately, it is precisely these kinds of modifications that would be required to address the survivability shortfalls of most MSC ships. There is also the potential to enhance various ships' abilities to operate with various types of air or surface connectors, though these too are complicated by structural constraints. Many steps to remediate command and control, medical, and crew shortfalls, and (to a lesser extent) some intelligence, surveillance, and reconnaissance gaps can be pursued without significant structural change to the ships (and thus lower cost and difficulty), though their apparent relative ease can be misleading.

Box 5.1. T-AH Hospital Ship

Just as with every other ship, the physical shortfalls of the T-AH may be amenable to adjustment. The study team included the T-AH hospital ship because it has underlying capabilities and capacity that is relevant to many low-end operations in particular. However, it also has a unique legal status: under international law, attacking a hospital ship is a war crime. Any use of the ship in a different capacity would compromise that status, and would have to be undertaken with very careful deliberation. Thus, even though the T-AH has characteristics whose utility extends beyond the operations it currently supports (e.g., the capacity to embark large numbers of personnel or amounts of cargo), it would not likely be used for operations beyond its current remit. While it is in theory possible that a T-AH could be used to support theater security cooperation activities, the modifications that would be required (e.g., painting over the large red cross) may not merit the limited additional benefit it might offer. In addition, shifting the ship back and forth between protected versus non-protected status may confuse its status for future operations, undermining its utility for its primary mission. As a result, the study team did not consider T-AH modifications for this phase of the analysis as it did the other platforms included in the study.

The ability of a ship to be modified can be generalized across a class, but ultimately depends on the specific ship itself. Each adjustment requires careful modeling to determine placement of materials or weight that might affect the ship's signature, communications capabilities, stability, and other factors. This must in turn be followed by experimentation to gauge overall feasibility and to refine procedures for conducting new tasks. These results must then be incorporated into various funding, manning, doctrine, planning, and other processes. In instances where the adjustments are relatively minor this can be accomplished rapidly. In other cases (e.g., if structural changes are needed that can only be made during a large-scale maintenance period), fully integrating the change may take years.

Given the level of effort required to make modifications, policymakers must carefully consider which ones make the most sense. While specific recommendations for change were beyond the scope of this analysis, the study team has endeavored to highlight some of the basic considerations for policymakers as they weigh potential investments to mitigate some of the risks identified in Chapter 4.

Survivability Risk

The survivability of any ship derives from its construction: the materials and design, how many compartments it might have, whether it is a single or double hull, and so on. It is thus very challenging to affordably make substantial improvements in a ship's survivability.

Some steps could be taken to reduce a ship's susceptibility to damage, such as adding additional radars or decoy systems. But meaningfully fortifying a vessel's ability to sustain damage would likely involve major structural adjustments that would be costly and could have major implications for stability, speed, or other performance parameters. Recoverability could be improved to some degree by adding additional crew members that could focus on continued operations while others attempted to contain or repair any damage, but this could be very inefficient and reduce the relative cost advantages of many civilian-manned ships in particular.

On balance therefore, it would be very challenging to mitigate the risk of ships with low survivability at the individual ship level. Instead, the traditional approach of operating them either beyond the range of possible threats or in conjunction with other ships that can offer protection is likely the most effective and may well be the most efficient. This in turn suggests that, unless policymakers wish to take substantial operational risk, MSC ships should be used in support of a very limited set of operations: humanitarian and civic assistance, security force assistance, counterdrug, and humanitarian assistance/disaster relief.

Their employment in foreign internal defense operations would involve some degree of risk associated with their susceptibility to damage, which policymakers might choose to accept if they felt sufficiently confident in their understanding of the threat environment, and/or if they invested in additional capabilities to enhance the ships' ability to identify or evade threats. MSC ships' independent support to maritime intercept operations would involve even greater risk, as those ships' ability to sustain damage if they were far from shore could prove particularly problematic.

MSC ships do have capabilities that would be useful in other types of operations. For example, the JHSV has significant carrying capacity that could be used to transport hundreds, and possibly more than 1,000, civilian evacuees in a non-combatant evacuation. However, employing it independently would require putting the ship into an environment that is on the verge of or already experiencing some level of hostilities. In some situations this risk may prove acceptable; another alternative could be to extract civilians to a safe distance with more survivable assets and then put them onto a JHSV for further transport.

Connector Risk

Adequate survivability of a ship is just the first consideration for policymakers. There are numerous other characteristics that speak to the potential contributions of a given ship to various operations. If Marines are involved, then the study team assumed that there were inherent operational advantages to operating from the sea, and to employing Marine Corps competencies in particular.

On the aviation side, the LCS and MSC ships are all limited by a small number and the weight-bearing capacity of their operating spots. However, some (e.g., T-AKR/LMSR, T-AKE, and T-AVB) have large decks that could offer some potential for additional operating spots and the associated control facilities.[1] These would obviously take space away from those ships' primary mission of transport, and might require reinforced decks or other modifications that could affect ship performance. They would also require an air control element and possibly maintenance personnel, which would have to be provided either through a permanent expansion of the ship's crew or possibly by embarked forces (but which could well mean another air mission elsewhere would be going unsupported). Aviation support presents challenges for all but the big-deck (LHA or LHD) amphibious ships as well if they are not operating together. LSDs lack hangars and maintenance areas, though they could be augmented with aviation personnel, supplies, and equipment prior to deployment. LPDs have hangars and an air department, but would need additional support for sustained independent air operations.

The inability of MSC ships to arm helicopters presents risks in any operation that is likely to involve hostilities, or that require close air support. The MPF ships lack storage areas for rockets or missiles, and again the crews are not trained for these missions. Adding munitions storage also requires the addition of munitions handling personnel.

That said, in some instances MSC ships have the space to enhance their air capabilities and/or capacities. With modifications, more may eventually be certified for heavy rotary-wing (CH-53) or tilt-rotor (MV-22) aircraft.[2] Adding personnel and/or taking cargo transport space to create hangars or refueling capabilities, or adding maintenance support (which involves hangars, support equipment, and certified crews), are possibilities, but would likely be expensive, require significant additional training, and could substantially affect MSC ships' abilities to conduct their primary missions. Thus, while modifications may be possible, they should be undertaken with a clear understanding of the specific operational benefits that are being sought, weighed against the financial costs and impacts on capacity for other missions.

Overcoming shortfalls in surface connector capability or capacity is an equally complex proposition for individual ships. The limitations matter most for operations that require getting large numbers of forces or equipment ashore quickly, or on a sustained basis. This obviously applies to major operations, where the use of MSC ships is likely impractical, but also to humanitarian assistance/disaster relief and non-combatant evacuations.

The ability to deliver people, cargo, and equipment at scale quickly over water requires the ability to launch large craft at sea, which in turn requires a well deck and a significant amount of cargo space. While many MSC ships have the latter, they do not have well decks. This limitation is the primary reason why the Mobile Landing Platform (MLP), designed to act as a transfer mechanism between MSC ships and landing craft or lighterage, remains such a high priority for the Marine Corps. The MLP has been reconceived (and in many ways made less capable) over time to reduce costs. There are now two ship designs, each

1. Adding basing and operations capabilities to the ships themselves can be relatively affordable. For example, it is estimated that the modifications to the T-AKR/LMSR to support MH-60 operations would cost about $4 million. Study team interviews, April 2014.

2. The T-AKE is already certified for V-22.

with two ships, scheduled to enter the fleet by the end of FY 2017. Those that will be assigned to the MPF (MLP 1 and MLP 2) will—when paired with MSC ships that are best suited to transport equipment, cargo, or personnel—vastly increase the ability of those ships to deliver capabilities ashore. The afloat forward staging base (AFSB) variants (MLPs 3 and 4) will be assigned to the MSC (and may shift designations to become battle force ships should the environment require it). They will offer some transfer capability but are primarily designed to function as a basing platform from which the Marine Corps or Special Operations Forces can conduct operations ashore from a distance.

Given their limited numbers, it is likely that these ships will be in high demand from the outset. They will likely be able satisfy some but by no means all unmet regional demand, even for operations in benign environments.[3] And because MLPs are also based on a commercial design, they too will present survivability challenges and their use will almost certainly be restricted to low-threat areas. And, finally, transfer at sea is always a complex proposition, with complexity rising as the equipment or cargo increases in size. Thus the degree to which such transfers will be limited by sea state, weather conditions, and other factors remains to be seen as testing and experimentation continues.

While less impactful across the full range of military operations, it would be simpler and more cost effective to enhance the small boat capabilities and capacities of some MSC ships. T-AKEs, for example, can only launch small boats less than 11 meters long, which would in many cases be insufficient to demonstrate or train many amphibious-focused tasks in security force assistance operations.[4] Obtaining the certifications to carry larger vessels is planned, and could increase the number of such operations (and others) that T-AKEs could support in the future. There may also be opportunities to change traditional loading plans. The T-AVB, for example, is capable of launching small boats but does not typically carry them.

Command and Control Risk

Overall, while not easy, adding some level of additional command and control as well as communications capabilities can be more readily addressed than remedying other shortfalls. As a combatant, the LCS is the only non-amphibious ship we examined with adequate command and control capabilities to independently support low-end missions. (Even the LSDs, which were not designed to operate alone, might require more capability for independent operations). In various combinations, most MSC ships lack sufficient planning and operating spaces (the JHSV is the exception), redundant exterior communications capabilities, and/or equipment (radios, etc.).

3. One Marine general recently suggested that MLP 3 could potentially be deployed to Africa in order to enhance the Marine Corps' ability to provide crisis response on the continent, though he noted that he would still prefer to have the greater capabilities of an amphibious ship to meet this need. Megan Eckstein, "Glueck: Marines need more LPDs to help with crisis response in Africa," *Defense Daily Network*, June 26, 2014, http://defensedaily.com/print-view/?post=63247.

4. The same is also true for T-AKs and T-AKRs.

Many of these shortfalls may be able to be overcome with containerized modules. Again, such modules would require space (which would then be unavailable for other missions). They would also require power and places to mount antennas that would not interfere with other ship tasks. Tactical operations center modules for limited operations being developed for the LCS are relatively affordable (about $2 million each), and may be able to be expanded to other platforms like the MLP or T-AKE.

Providing a more permanent capability would likely be a much more complicated proposition, involving extensive rewiring and additional power. Many ships have limited bandwidth but could access commercial satellite communications with additional funding. Adding antennas or masts to enhance communications could work with many ships.

Intelligence, Surveillance, and Reconnaissance Risk

Ships' ISR capabilities include personnel (analysts), secure communications capabilities to access other sources of information and disseminate analysis to subordinate forces, separate secure facilities to adequately protect information, and organic sensors to collect or relay sensitive data. Navy combatants are designed with some level of inherent ISR capability, though not all routinely embark with sufficient capacity to support the full range of military operations. The LHA/LHDs are the most capable amphibious ships, and if LPDs or LSDs were to conduct independent operations, they could require augmentation of analysts in particular. The two LCS versions would be enhanced by embarking H-60 helicopters, as well as Fire Scout or other unmanned aerial or undersea vehicles.

MSC ships' shortfalls include but extend beyond manning and sensor deficiencies. For operations that require some level of basic intelligence support, they would also need enhanced communications (redundant UHF and VHF channels, for example, and possibly bandwidth to support video-teleconferencing), some would need wiring to support secure networks, and most would require secure spaces. Again, modules (containers, antennas, etc.) could offer some level of capability, probably at reasonable cost, but would require careful engineering study and reallocation of existing space. Adding capability to support operations of unmanned platforms could be expensive, though not in every case. For example, the T-AKE may be able to be certified to operate small unmanned aerial systems either for logistics or intelligence support, though if intelligence functionality is added then it might also require enhanced communications, analysts, or other elements of the processing, exploitation, and dissemination chain.

Medical Risk

Operations have disparate requirements for ship-based medical support. As in other areas, the LHA/LHDs are the most capable (other than the T-AH). LPD-17 class ships can provide significant surgical capabilities if surgical teams are embarked, but LSDs lack the requisite spaces even if the teams are on board. Expeditionary surgical teams, which are currently deployed only when necessary,[5] are less capable than the full fleet surgical teams but can enhance any ships' capabilities if adequate facilities are available. Depending on mission needs, these include medical waste storage capabilities, sterilization and laboratory equipment, and exam, laboratory, and surgical areas. On the scale needed for lower-end operations, many of these capabilities could be provided by a containerized module.

A more difficult challenge may be that such augmentation also requires the capability to conduct medical evacuation (MEDEVAC). Given that most MSC ships do not routinely deploy with helicopters, they would either have to do so (and not all are capable) or this capability would have to be provided by another ship or shore-based asset in the vicinity.

Crew Risk

Shortfalls in the capability and/or capacity of ships' crews are a function of their overall size and what they are trained to do. Addressing these shortfalls is therefore a function of increasing manning and expanding their training and certifications. The JHSV crew, for example, is limited to four hours of mission support daily, which can be allocated to some combination of air operations, launch and recovery of small boats, or other tasks. Requirements beyond that limit could be met either by adding crew (and training) or by assigning tasks to embarked forces (who also may need to be trained and certified).

Crew challenges are intensified when ships that traditionally operate as part of a larger formation operate independently or in smaller task forces. Such changes can mean that support typically offered by other ships, from maintenance to public affairs, must now be accomplished organically. Adding personnel to perform these tasks can strain berthing capacity of some ships where it is already limited (e.g., the LCS, which was originally designed for a very small crew that is now being expanded). Some ships have space for additional berthing and habitability modules, but these will compete for space with other mission needs. Deploying separate berthing barges could obviate the need for housing personnel on a particular ship, but purchasing and then transporting those barges to the appropriate locations complicate this alternative.

Opportunity Costs

Almost every ship can be modified to reduce risks that stem from using them in ways beyond that for which they were originally designed. Some of those modifications are relatively straightforward; others, especially those that would involve structural changes to address capability and survivability concerns, might be possible but the costs would likely outweigh expected benefits. At the individual ship level, each modification involves trades. Increasing the breadth of a given crew's responsibilities would require additional

5. These are technically referred to as "Expeditionary Resuscitative Surgical Teams." They are not a program of record and thus are not routinely funded or planned for in operations.

training, and would presumably mean decreasing their depth in some other area. Expanding that crew would require taking space currently being used for one purpose and reallocating it for berthing and other support (e.g., additional bathrooms and showers). Adding cranes to enable a ship to deploy a broader range of boats or to onload or offload cargo more efficiently would also take space from something else, and may complicate antenna placement or ship stability. Thus while the possibilities are almost endless, considering them carefully and comprehensively is a very large task.

Many efforts are ongoing, both for individual ships and select combinations of ships. These efforts are well warranted, but policymakers must also consider these issues on a broader scale. Every specific ship modification mitigates some degree of some type of risk for some subset of the range of operations. Each also requires funding that would otherwise be spent elsewhere. The costs include not only the specific modifications, but any additional personnel and training costs that might be needed to support a new function. If modifications enable a ship to be operated in a new way, either independently or in combination with other platforms, then this may drive other requirements (e.g., for additional oilers to support a larger number of dispersed formations). Thus what appears to be a relatively modest initial investment ($1 million for enhanced air operations capabilities, for example), can in fact result in a much higher resource requirement, one that must be weighed against the amount of operational benefit that is expected to be gained. At some point, the costs associated with multiple small enhancements to MSC ships aimed at improving their capabilities or capacity to support low-end operations will exceed those for an additional amphibious ship that offers capabilities across the full range of operations.[6] The incremental nature of enhancements, however, may mask that reality. Policymakers must also consider the degree to which greater use of MSC ships will affect their expected service lives, and thus the frequency with which they must undergo maintenance and/or be replaced. Funding to meet these costs will also have to come from somewhere, whether from within the shipbuilding accounts, elsewhere within the Navy budget, or somewhere else.

Fiscal opportunity costs are important, but so too are operational ones. As noted above, every enhancement that involves putting something new on a ship means the space now occupied is not being used for its prior purpose. Some ships face so many shortfalls that there is not likely the space to mitigate all the associated risk, which would thus have to be prioritized. More broadly, each ship in the fleet—combatant or MSC—was procured to perform specific missions; if additional functions are added, the laws of physics demand that something will be taken away (even if temporarily) somewhere else. The JHSV, for example, is designed to transport people and equipment. If it is used as a command and control platform, which it has the potential capacity to support, then it will have less space available to support embarked forces and the equipment they need to operate ashore. There are well-developed processes in place to manage these trades at various levels, but

6. For example, one Navy study reportedly found that the 20-year costs of enhancing various MSC ships and then funding them to support small security force assistance operations were lower than they would be for LPD, but that LPDs were cheaper when the range of supported operations was extended to include maritime intercept operations, larger-scale security force assistance, and noncombatant evacuations. Study team interviews, April 2014.

high-level policymakers must consider those trades across the entire fleet. For MSC ships in particular, most of which are tailored for a relatively small set of purposes, making them multi-purpose enhances their utility. However, it also shifts some risk from whatever immediate demand is being satisfied to a potential future demand that might be unmet if restoring the ship (either through reloading it, or, in more extreme cases, un-modifying it) cannot be accomplished in the requisite timelines. That risk may be deemed acceptable, but it deserves explicit consideration.

6 Conclusion

This study is an examination of the suitability of a subset of Navy ships to independently perform a subset of operations that require amphibious capabilities. It is not comprehensive, and any specific determination about how an individual ship might be modified to increase its relevance would require much more thorough and informed analysis. What it does offer, however, is a number of important points for policymakers to consider as they weigh questions about allocating resources and accepting risk in the range of ships that support sea-based operations.

Figure 6.1 offers a representation of some of the dimensions of the decisionmaking space, depicting a notional amphibious ship relative to a commercially based design along five attributes of amphibious capabilities (see Chapter 3): survivability, breadth, projection capacity, responsiveness, and persistence. Each ship would be different, of course—among amphibious ships, for example, the LHA-6's air projection capacity is greater than that of an LHD, but its surface projection capacity is much more limited.[1]

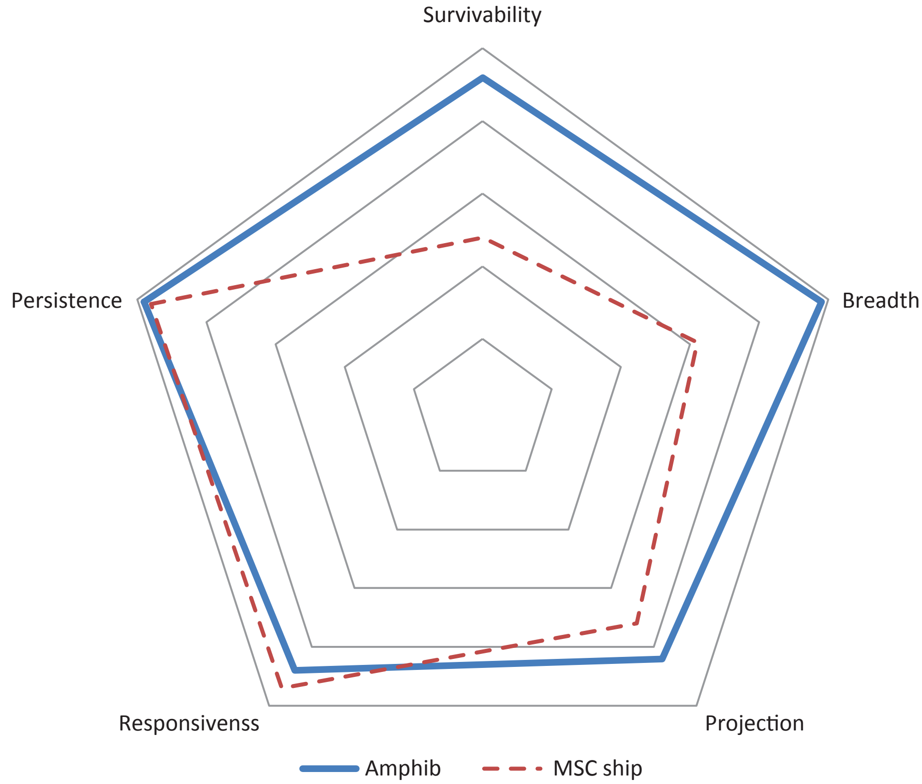
Such differences only matter relative to operational needs, which vary among operational types as well as within them. Assembling the best match of ships-to-need is, on an individual basis, the responsibility of commanders, who must then articulate the risks associated with any shortfalls to their superiors.

The challenge for policymakers, both within the Department of the Navy and beyond, is to allocate resources today in ways that anticipate the attribute profile future operations will require. They must do so both for individual types of operations, but (even more challenging) in the aggregate. They must then use those judgments to inform their management of the portfolio of assets that contribute to amphibious capabilities, from ships to connectors to the Marines themselves.

As described in Chapter 1, the amphibious portfolio is under-invested. There are too few amphibious ships to meet regional commanders' needs, whether one takes a purely warfighting perspective or one that takes the demands of day-to-day crisis response and engagement with partners into account. Demand has risen, and supply is strained beyond a sustainable level.

1. The LHD-8 actually offers even greater aviation storage and transport capability than does the LHA-6, due to a redesign of the flight island. However, it carries less fuel, a slightly modified hangar, and fewer aviation stores than the LHA-6.

Figure 6.1. Notional Tradespace among Amphibious Attributes



The challenge is that closing the gap between the two with amphibious ships, the most capable platform, is expensive and is in direct competition with other critical shipbuilding requirements. Policymakers are the ones that must then determine how best to invest scarce dollars, but absent the system-level vision, process, and supporting tools to better support those decisions.

The creation of land-based Special Purpose MAGTF-Crisis Response units has been one answer to the lack of amphibious ships. Another is the embarkation of Marines on alternative platforms that offer a lesser degree of survivability, breadth, projection capacity, responsiveness, and persistence than would a similar force on an amphibious ship, but more than would otherwise have been possible. Each of these options provides a degree of capability, but also results in a loss of both flexibility and adaptability that more capable platforms offer.

To varying degrees, and at various levels of expense, ships designed principally for lift or transport can expand their breadth, enhance their projection capacity, or (if they are elevated from reserve to full operating status, for example) increase their responsiveness. Meaningful increases in survivability are cost prohibitive, which in turn implies that these ships' utility must be limited to operations where these risks are low or that survivability enhancements must be provided by other assets.

The analysis in Chapters 3 and 4 highlight some of these trades in its assessments of the shortfalls between a range of ships and types of operations. It finds that without modifications, CLF, MPF, and the other ships we examined are best suited to support humanitarian and civic support activities and security force assistance operations. There is some risk in using them to support other relatively low-threat taskings such as humanitarian assistance and disaster relief and counterdrug operations, and (with greater risk) foreign internal defense and maritime intercepts.

Chapter 5 provides an overview of the considerations that should be taken into account when evaluating how such risks might be best addressed. When considering platform modifications, all of the associated costs should be taken into account, both those directly associated with the modification and expanded usage as well as the associated opportunity costs.

There are clearly some areas where enhancements to existing MSC or LCS ships are possible, and would broaden the range of options for their use. Determining when and where such investments are warranted—across the amphibious portfolio, from ships to connectors, or from modifications to ships that exist to the design and construction of new platforms—is all about making choices and managing risk, both operational and fiscal. Reducing the capabilities of future amphibious ships to make them more affordable increases the likelihood that funding might actually be approved, and may permit investments in other key areas. But it also reduces the projection capacity of the amphibious enterprise as a whole. Investing in the development of new connectors to enhance (indirectly) the breadth or power projection of ships built for another purpose can reduce the risks of insufficient or untimely responses to certain crises. But it can also take money that might otherwise be spent preserving projection capacity in the amphibious ship fleet.

Such trades are clearly necessary, and may even be desirable. However, they are often made narrowly and with a short term view, rather than in a systems context. Efforts like *Expeditionary Force 21* offer a vision of what the amphibious system should be able to do, but realizing that vision is complicated by processes that trade across shipbuilding construction or science and technology as a whole, rather than across a broadly construed amphibious portfolio. This encourages the treatment of each decision as a static event: whether there is a favorable cost-benefit analysis for a particular enhancement to ship Y, for example, or a decreased requirement for ship X, or for increasing the readiness status of one vessel or the crew of another. Each of these decisions might be well-informed and supported by solid analysis, but the lack of a common systems view masks their synergistic effects.

Ultimately, the lack of a comprehensive, common, affordable, and systems-based strategy guiding the amphibious capability portfolio creates the potential for a future "Balisle Report 2,"[2] in which a task force will look back at decisions being made today and deter-

2. As noted in Chapter 2, the 2010 Balisle Report found that U.S. surface ship capabilities had been severely degraded by a series of sub-optimized decisions that masked their interdependence.

mine that they collectively will have substantially eroded U.S. amphibious capabilities. Policymakers are charged with making such choices deliberately; they should not be made unintentionally. Framing the amphibious portfolio appropriately, and along the dimensions that offer the most meaning, will be a critical step toward the development of a larger strategy to guide future choices. The analysis offered here will hopefully assist in that important effort.

Amphibious Ships

LHD 1 *Wasp-class* is a large deck amphibious assault ship with both aviation and surface assault capabilities. It is the most versatile ship in the amphibious fleet with robust communications and medical capabilities and vehicle stowage capacity. Typically serves as the flagship with a crew of over 1,000 Sailors and an embarked force of up to 1,700 Marines.[1]

LHA 6 *America-class* (flight 0) is a large-deck amphibious assault ship optimized for aviation. It lacks a well deck, but its large flight deck supports a mix of aircraft including MV-22B transport and F-35B attack aircrafts and CH-53K heavy transport, AH-1Z/UH-1Y attack/utility and Navy MH-60S helicopters, though the exact makeup will vary by mission.

LHA 8 *America-class* (flight 1) is the same design as the flight 0, but with the well deck restored and a redesigned flight deck that will allow the carriage of even greater numbers of aircraft. Expected to be delivered in Fiscal Year 2022, it will also have enhanced capabilities to interface with unmanned systems.

LPD 17 *San Antonio-class* is the latest landing platform dock ship, and is designed to carry 800 Marines ashore via landing craft, amphibious assault vehicles and helicopters.

LSD 41 *Whidbey Island-class* dock landing ship has a large well deck that supports more landing craft or other equipment than any other amphibious ship. Due for a mid-life upgrade, these LSDs will have numerous systems replaced or improved. Its crane capacity and shallow draft enables it to enter austere or degraded ports otherwise inaccessible.

LSD 49 *Harpers Ferry-class* dock landing ship has a well deck designed to support all types of landing craft. Modified from the Whidbey Island class, it sacrifices some landing craft capacity for more cargo space. It also has the ability to enter austere or degraded ports.

Other Ships

LCS 1 *Freedom-class* littoral combat ship is one of two variants of the Navy's most recent small, fast multipurpose combatants. The Freedom class is designed with a small flight deck and the capability to swap out multiple mission modules (e.g., anti-submarine warfare) that will allow it to be tailored for specific operational needs.

LCS-2 *Independence-class* is longer, has a slightly deeper draft than the Freedom-class LCS, and is based on a trimaran hull. It is also intended to carry tailored mission modules, but without one embarked can carry some amount of ground equipment or support both manned and unmanned air operations.

[1] The specifics of an amphibious ship's load (such as number of personnel, quantity and types of large and small equipment and supplies, etc.) are tailorable by mission; these values are thus approximate.

Combat Logistics Force

T-AO ***Henry J. Kaiser-class*** fleet replenishment oiler is the smallest CLF ship. It is designed to provide underway fuel for ships and aircraft, and has multiple cranes for cargo but no surface craft.

T-AOE ***Supply-class*** fast combat support ship is typically loaded with fuel, ammunition, and other supplies it can transfer underway to support Navy and Marine Corps operations. It also embarks with two MH-60 helicopters to enable vertical replenishment, and is capable of minimal aircraft support.

Maritime Prepositioning Force

T-AK ***Lt John P. Bobo-class*** cargo ship is designed to carry vehicles and other cargo, along with barges and cranes to offload cargo ashore. It also carries a bulk liquid transfer system that enables it to transfer water and fuel quickly and in mass quantities.

T-AKR/LMSR ***Bob Hope-*** **and** ***Watson-class*** vehicle cargo ships have a smaller cube capacity than the T-AKs, but provide over twice the square footage for storage. In general, both classes are quite similar; however, the fuel-consumption of the Watson-class is significantly higher than its counterpart.

T-AKE 3 ***Lewis and Clark-class*** dry cargo ship carries supplies, ammunition, and fuel in support of the initial Marine assault echelon. It is certified for V-22 operations, and has already been employed to conduct engagement exercises on a limited scale in the Pacific.

Other Ships

T-AVB ***Wright-class*** aviation logistics support ship is designed to carry mobile facilities to conduct limited aircraft maintenance offshore. Its roll-on/roll-off deck allows maintenance containers to be easily loaded onto the ship at port; it is usually kept in reserve operational status.

T-AH ***Mercy-class*** hospital ship is designed to provide medical care for over 1,000 individuals. Its medical mission gives it special protected status under international law; if this status is to be retained, this limits its ability to support other missions, despite its large cargo capacity.

Joint High-Speed Vessel (JHSV) ***Spearhead-class*** is designed for fast, inter-theater transport. While it lacks substantial cargo space, its shallow draft enable it to operate where larger vessels cannot and its speed allows it to rapidly carry a small force element with some equipment to many littoral areas.

Appendix A. Attribute and Characteristic

Attribute	Characteristic	Description	Ranking	Humanitarian/ Civic Assistance	Security Force Assistance
Survivability	*Susceptibility*	Required level of ability to be able to avoid or defeat an attack	1= Low (minimal ability to avoid or defeat attack); 2= Medium; 3= High	1	1
	Vulnerability	Required level of ability to withstand damage if hit and continue to perform	1= Low (minimal ability to withstand damage and continue); 2= Medium; 3= High	1	1
	Recoverability	Required level of ability to take action to contain and control damage, restore and sustain operations	1= Low (minimal ability to recover and keep fighting); 2= Medium; 3= High	1	1
Breadth	*Surface maneuver capability*	Required surface launch capability	1= no at sea launch capability; 2= small boat launches at sea; 3= large craft launch at sea	2	3
	Air manuever capability	Required level of acft support capability	1 = vertical replenishment; 2 = land; 3 = land and fuel; 4 = land, fuel, and hangar; 5 = land, fuel, hangar and maintenance; 6 =land, fuel, hangar, maintenance and rearm	2	3
	Offload location capability	Minimum acceptable conditions under which ships can offload	1 = immaterial/developed port only; 2 = austere port; 3 = in stream; 4 = at sea	2	1
	Method of in stream offload	Manner in which ship offloads cargo	1 = immaterial/vertical replenishment; 2 = lift on/lift off; 3 = roll on/roll off; 4 = float on/float off	2	1
	Classified as warship	Whether capability is required	0 = No; 1 = Yes	0	0
	Ashore water and fuel delivery	Whether capability is required	0 = no water production; 1 = can produce water but no organic assets to deliver; 2= can produce/deliver water; 3 - bulk production/delivery of fuel OR water; 4 bulk production/delivery of food AND water	0	0
	Crew capacity	Range of functions crew must be able to support given size and training	1 = transit only; 2 = support multiple missions (e.g., launch air or surface craft) sequentially; 3 = support multiple missions simultaneously (e.g., launch air and surface craft while operating the ship)	1	1
Projection	*Crew composition*	Required legal status of crew	1 = civilian; 2 = civilian/military; 3 = military	1	1
	Air capacity	Numbers and types of air connectors required	1 = low (few, light aircraft) ; 2 = medium (some, medium acft); 3 = high (many, fixed & rotary wing)	1	1
	Surface connector capacity	Numbers and types of surface connectors required	1= none or small boats/AAVs; 2 = lighterage; 3 = < 2 LCACs/1LCU	1	1
	Command and Control (C2) capability	C2 spaces, personnel, systems, bandwidth	1= none or limited spaces for planning and operating; 2= moderate capabilities; 3= highly capable C2	1	1

Ratings by Operational Type

Counterdrug	Humanitarian Assistance/ Disaster Relief	Foreign Internal Defense	Maritime Intercept Operations	Combating Terrorism	Show of Force	Non-combatant Evacuations	Recovery Operations	Strikes & Raids	Major Operations
1	1	2	2	3	3	2	2	3	3
1	1	1	3	2	3	2	2	3	3
1	1	1	1	3	3	2	2	3	3
2	3	2	2	2	3	3	1	3	3
6*	6	4	6*	6	6	6	6	6	6
1	4	2	1	1	4	4	1	4	4
1	4	2	1	1	3	1	1	4	4
0	0	0	0	1	1	0	0	1	1
0	2	1	1	1	0	1	0	1	2
2	2	2	2	2	3	3	2	3	3
2	1	1	2	1	3	2	1	3	3
1	3	2	2	2	2	3	2	2	3
1	2	1	1	1	1	2	1	1	3
2	3	2	2	3	3	3	2	3	3

continued

Attribute	Characteristic	Description	Ranking	Humanitarian/ Civic Assistance	Security Force Assistance
Projection	*Intelligence, surveillance, and reconnaissance (ISR) capability*	Required level of ISR support based on communications systems, number and types of analysts, work space, platforms	1= None or minimal; 2= Moderate capability; 3= Highly capable	1	1
	Medical capability	Required level of medical capacity	1= Sick call only, no dedicated staff; 2= ≤ 1 operating room, dedicated staff; 3= ≥ 1 operating room with surgical, intensive care unit, <100 beds; 4= > 1 operating room with surgical, intensive care unit, <200 beds	1	1
	Shore sustainment capability	Amounts of shore delivery of water	1= up to 800 gal/day; 2= 800-5000 gal/day; 3= >5000 gal/day	1	1
	Non-crew berthing	Number of berths (non-surge) for embarked forces (NOT INCLUSIVE OF CREW)	1= <100; 2= 100-454; 3= > 455 (REIN Rifle Co SP-MAGTF)	1	1
	Ship self-protection	Types and capabilities of defenses required (organic to the ship)	1= ship internal security; 2= organic surface defense; 3= organic air and surface defense	1	1
Responsiveness	*Required level of readiness to get underway*	Operating status	1 = low (reduced operating status); 2 = medium (< 5 days); 3 = high (>5 days)	1	1
	On/offload limitations	Maximum sea state level at which mission must be able to be performed	1= Sea state 1-2; 2= Sea state 3; 3= Sea state 4+	1	1
Persistence	*Self-sustainment capabilities*	Capability and capacity to accept supplies under way	1= Able to accept small amounts of supply under way; 2= Able to accept large amounts of supply under way; 3= Able to accept large amounts of supply and fuel underway	1	1
	Habitability	Level of habitability needed for crew effectiveness upon arrival - based on expected transit times, air quality, water refresh rates, workspace, personal space, etc.	1= low; 2= medium; 3= high	2	2
	Days of supply at embarkation	Typical supply levels at deployment	1= <15 days; 2= 15-30 days; 3= >30 days	1	1

Counterdrug	Humanitarian Assistance/ Disaster Relief	Foreign Internal Defense	Maritime Intercept Operations	Combating Terrorism	Show of Force	Non-combatant Evacuations	Recovery Operations	Strikes & Raids	Major Operations
2	1	2	2	2	2	3	2	3	3
1	3	2	1	2	2	3	2	3	4
1	3	1	1	1	1	2	1	1	3
1	2	2	1	1	2	3	1	2	3
1	1	2	2	2	3	3	3	3	3
1	3	1	2	2	2	3	3	3	1
1	2	2	2	3	2	3	3	3	3
1	3	1	1	1	1	3	1	2	3
2	1	3	2	1	2	1	1	1	1
2	3	2	2	2	2	1	1	2	3

Appendix B. Attribute and Characteristic

Attribute	Characteristic	Description	Ranking	LHD 1	LHA 6
Survivability	*Susceptibility*	Ability to avoid or defeat an attack	1= Low (minimal ability to avoid or defeat attack); 2= Medium; 3= High	3	3
	Vulnerability	Required level of ability to withstand damage if hit and continue to perform	1= Low (minimal ability to withstand damage and continue); 2= Medium; 3= High	3	3
	Recoverability	Level of ability to take action to contain and control damage, restore and sustain operations	1= Low (minimal ability to recover and keep fighting); 2= Medium; 3= High	3	3
Breadth	*Surface maneuver capability*	Highest level of launch mechanism	1= no at sea launch capability; 2= small boat launches at sea; 3= large craft launch at sea	3	1
	Air manuever capability	Highest level of aircraft capability	1 = vertical replenishment; 2 = land; 3 = Land and fuel; 4 = land, fuel, and hangar; 5 = land, fuel, hangar, and maintenance; 6 =land, fuel, hangar, maintenance and rearm	6	6
	Offload location capability	Highest level of conditions under which ship can offload cargo	1 = Developed port only; 2 = austere port; 3 = in stream at anchor; 4 = at sea	4	N/A
	Method of in stream offload	Manner in which ship on/offloads cargo	1 = vertical or conventional replenishment; 2 = lift on/lift off; 3 = roll on/roll off; 4 = float on/float off	4	3
	Classified as warship		0 = No; 1 = Yes	1	1
	Ashore water and fuel delivery		0 = no water production; 1 = can produce water but no organic assets to deliver; 2= can produce/deliver water; 3 = bulk prod/delivery of fuel OR water; 4 = bulk production/delivery of fuel AND water	2	2
	Crew capacity	Range of functions crew can support given its size and training	1 = transit only; 2 = support multiple missions sequentially; 3 = support multiple missions simultaneously	3	3
	Crew composition	Legal status of crew	1 = civilian; 2 = civilian/military;3 = military	3	3
Projection	*Air capacity*	Judgment based on numbers and types of air connectors typically deployed on a ship	1 = low; 2 = medium; 3 = high	3	3
	Surface connector capacity	Judgment based on numbers and types of surface connectors typically deployed on a ship	1= none or small boats/AAVs; 2 = lighterage or 1-2 LCACs/1 LCU; 3 = > 2 LCACs/1LCU	3	N/A
	Command and control capability (C2)	C2 spaces, personnel, systems, bandwidth	1= no/few spaces for planning and operating/limited communications capabilities; 2= moderately capable (spaces and communications); 3= highly capable (joint/combined) C2	3	3
	Intelligence, surveillance, and reconnaissance (ISR) capability	Judgment based on comms systems, number and types of analysts, work space, platforms	1= None or minimal; 2= Moderate capability; 3= Highly capable	3	3
	Medical capability	Number and types of work spaces, medical staff	1= Sick call only, no dedicated staff; 2= ≤ 1 operating room, dedicated staff; 3= ≥ 1 operating room with surgical, intensive care unit, <100 beds; 4= > 1 operating room with surgical, intensive care unit, >200 beds	4	2

* = some limitations or caveats; (a) = dissemination of this information is limited for security reasons.

Ratings by Ship

Amphibious Ships				Combat Logistics Force		Maritime Prepositioning Force			Other Ships				
LHA 8	LPD 17	LSD 41	LSD 49	T-AO	T-AOE	T-AKE	T-AK 3008	T-AKR / LMSR	T-AVB	T-AH	JHSV	LCS 1	LCS 2
3	3	3	3									2	2
3	3	3	3				(a)					1	1
3	3	3	3									1	1
3	3	3	3	1	1	2*	2*	2	2*	1	2	2	2
6	6	6*	6*	2	3	4*	3	2	2	5*	3	6*	6*
4	4	4	4	1	1	3	3	3	1	1	2	2	2
4	4	4	4	2	2	2	3	3	3	1	3	4	3*
1	1	1	1	0	0	0	0	0	0	0	0	1	1
2	2	2	2	1	1	1	4	1	2*	1	2	1	1
3	3	2	2	2	2	2	1	1	1	2	3*	2	1
3	3	3	3	1	1	1	1	1	1	1	1	3	3
3	2	1	1	1	2	1	1	1	1	1	1	1	1
2	2	3	2	1	1	1	2	2	1	1	1	1	1
3	2	1	1	1	1	1	1	1	2	1	2	2	2
3	2	1	1	1	1	1	1	1	2*	1	1	2	2
4	3	2	2	1	1	1	1	1	2*	4	1	1	1

continued

Attribute	Characteristic	Description	Ranking	LHD 1	LHA 6
	Shore sustainment capability	Amounts of shore delivery of water	1= up to 800 gal/day; 2= 800-5000 gal/day; 3= >5000 gal/day	3	3
	Non-crew berthing	Number of berths (non-surge) for embarked forces	1= <100; 2= 100-454; 3= ≥ 455 (REIN Rifle Co SP-MAGTF)	3	3
	Ship self-protection	Types and capabilities of defenses organic to the ship	1= ship internal security; 2= organic surface defense; 3= organic air and surface defense	3	3
Responsiveness	*Required level of readiness to get underway*	Planned operating status	1= > 5 days; 2= 2-4 days; 3= 1 day or less	3	3
	On/offload limitations	Sea state limitations of cargo transfer	1= Sea state 1-2; 2= Sea state 3; 3= Sea state 4+	3	3
	Self-sustainment capabilities	Capability and capacity to accept supplies under way	1= Able to accept small amounts of supply under way; 2= Able to accept large amounts of supply underway; 3= Able to accept large amounts of supply and fuel underway	3	3
Persistence	*Habitability*	Level of habitability needed for crew effectiveness upon arrival- based on expected transit times, air quality, water refresh rates, workspace, personal space, etc.	1= Low; 2= Medium; 3= High	3	3
	Days of supply at embarkation	Typical supply levels at deployment	1= <15 days; 2= 15-30 days; 3= >30 days	1	1

Amphibious Ships				Combat Logistics Force		Maritime Prepositioning Force			Other Ships				
LHA 8	LPD 17	LSD 41	LSD 49	T-AO	T-AOE	T-AKE	T-AK 3008	T-AKR / LMSR	T-AVB	T-AH	JHSV	LCS 1	LCS 2
3	3	3	3	3	3	3	3	1	2	1	3*	1	1
3	3	2	2	1	1	2	1	1	2	3	2	1	1
3	3	2	2	1	1	1	1	1	1	1	1	2	2
3	3	3	3	3	3	3	1	3*	3	1	3	3	3
3	3	3	3	3	3	2	2	2	1	***3***	1	3	3
3	3	3	3	3	3	3*	3*	1	3	3*	1	3*	3*
3	3	3	3	3	3	3	2	2	2	2	2	2	2
1	1	1	2	3	3	3	3	3	3	3	1	2	2

Appendix C. Ships' Attribute and

		Amphibious Ships						Combat Logistics Force	
		LHD-1	LHA-6	LHA-8	LPD-17	LSD-41	LSD-49	T-AO	T-AOE
Survivability	Susceptibility	HCA FID NEO SFA MIO CT CD SOF HA/DR RO S&R MO	HCA FID NEO SFA MIO CT CD SOF HA/DR RO S&R MO	HCA FID NEO SFA MIO CT CD SOF HA/DR RO S&R MO	HCA FID NEO SFA MIO CT CD SOF HA/DR RO S&R MO	HCA FID NEO SFA MIO CT CD SOF HA/DR RO S&R MO	HCA FID NEO SFA MIO CT CD SOF HA/DR RO S&R MO	HCA ***FID*** ***NEO*** SFA ***MIO*** ***CT*** CD ***SOF*** HA/DR ***RO*** ***S&R*** ***MO***	HCA ***FID*** ***NEO*** SFA ***MIO*** ***CT*** CD ***SOF*** HA/DR ***RO*** ***S&R*** ***MO***
	Vulnerability	HCA FID NEO SFA MIO CT CD SOF HA/DR RO S&R MO	HCA FID NEO SFA MIO CT CD SOF HA/DR RO S&R MO	HCA FID NEO SFA MIO CT CD SOF HA/DR RO S&R MO	HCA FID NEO SFA MIO CT CD SOF HA/DR RO S&R MO	HCA FID NEO SFA MIO CT CD SOF HA/DR RO S&R MO	HCA FID NEO SFA MIO CT CD SOF HA/DR RO S&R MO	HCA FID ***NEO*** SFA ***MIO*** ***CT*** CD ***SOF*** HA/DR ***RO*** ***S&R*** ***MO***	HCA FID ***NEO*** SFA ***MIO*** ***CT*** CD ***SOF*** HA/DR ***RO*** ***S&R*** ***MO***
Breadth	Surface Capability	HCA FID NEO SFA MIO CT CD SOF HA/DR RO S&R MO	***HCA*** ***FID*** ***NEO*** ***SFA*** ***MIO*** ***CT*** ***CD*** ***SOF*** ***HA/DR*** RO ***S&R*** ***MO***	HCA FID NEO SFA MIO CT CD SOF HA/DR RO S&R MO	HCA FID NEO SFA MIO CT CD SOF HA/DR RO S&R MO	HCA FID NEO SFA MIO CT CD SOF HA/DR RO S&R MO	HCA FID NEO SFA MIO CT CD SOF HA/DR RO S&R MO	***HCA*** ***FID*** ***NEO*** ***SFA*** ***MIO*** ***CT*** ***CD*** ***SOF*** ***HA/DR*** RO ***S&R*** ***MO***	***HCA*** ***FID*** ***NEO*** ***SFA*** ***MIO*** ***CT*** ***CD*** ***SOF*** ***HA/DR*** RO ***S&R*** ***MO***
	Air Capability	HCA FID NEO SFA MIO CT CD SOF HA/DR RO S&R MO	HCA FID NEO SFA MIO CT CD SOF HA/DR RO S&R MO	HCA FID NEO SFA MIO CT CD SOF HA/DR RO S&R MO	HCA FID NEO SFA MIO CT CD SOF HA/DR RO S&R MO	HCA FID *NEO** SFA MIO *CT** CD *SOF** *HA/DR** *RO** *S&R** *MO**	HCA FID *NEO** SFA MIO *CT** CD *SOF** *HA/DR** *RO** *S&R** *MO**	HCA ***FID*** ***NEO*** ***SFA*** ***MIO*** ***CT*** ***CD*** ***SOF*** ***HA/DR*** ***RO*** ***S&R*** ***MO***	HCA ***FID*** ***NEO*** SFA ***MIO*** ***CT*** ***CD*** ***SOF*** ***HA/DR*** ***RO*** ***S&R*** ***MO***
Projection	Surface Capacity	HCA FID NEO SFA MIO CT CD SOF HA/DR RO S&R MO	HCA FID ***NEO*** SFA MIO CT CD SOF ***HA/DR*** RO S&R ***MO***	HCA FID NEO SFA MIO CT CD SOF HA/DR RO S&R ***MO***	HCA FID NEO SFA MIO CT CD SOF HA/DR RO S&R ***MO***	HCA FID NEO SFA MIO CT CD SOF HA/DR RO S&R MO	HCA FID NEO SFA MIO CT CD SOF HA/DR RO S&R ***MO***	HCA FID ***NEO*** SFA MIO CT CD SOF ***HA/DR*** RO S&R ***MO***	HCA FID ***NEO*** SFA MIO CT CD SOF ***HA/DR*** RO S&R ***MO***
	Air Capacity	HCA FID NEO SFA MIO CT CD SOF HA/DR RO S&R MO	HCA FID NEO SFA MIO CT CD SOF HA/DR RO S&R MO	HCA FID NEO SFA MIO CT CD SOF HA/DR RO S&R MO	HCA FID ***NEO*** SFA MIO CT CD SOF ***HA/DR*** RO S&R ***MO***	HCA ***FID*** ***NEO*** SFA ***MIO*** ***CT*** CD ***SOF*** ***HA/DR*** ***RO*** ***S&R*** ***MO***	HCA ***FID*** ***NEO*** SFA ***MIO*** ***CT*** CD ***SOF*** ***HA/DR*** ***RO*** ***S&R*** ***MO***	HCA ***FID*** ***NEO*** SFA ***MIO*** ***CT*** CD ***SOF*** ***HA/DR*** ***RO*** ***S&R*** ***MO***	HCA FID ***NEO*** SFA MIO CT CD SOF ***HA/DR*** RO S&R ***MO***
	Ashore Water Delivery	HCA FID NEO SFA MIO CT CD SOF HA/DR RO S&R MO	HCA FID NEO SFA MIO CT CD SOF HA/DR RO S&R MO	HCA FID NEO SFA MIO CT CD SOF HA/DR RO S&R MO	HCA FID NEO SFA MIO CT CD SOF HA/DR RO S&R MO	HCA FID NEO SFA MIO CT CD SOF HA/DR RO S&R MO	HCA FID NEO SFA MIO CT CD SOF HA/DR RO S&R MO	HCA FID NEO SFA MIO CT CD SOF ***HA/DR*** RO S&R MO	HCA FID NEO SFA MIO CT CD SOF ***HA/DR*** RO S&R ***MO***
	Command and Control	HCA FID NEO SFA MIO CT CD SOF HA/DR RO S&R MO	HCA FID NEO SFA MIO CT CD SOF HA/DR RO S&R MO	HCA FID NEO SFA MIO CT CD SOF HA/DR RO S&R MO	HCA FID ***NEO*** SFA MIO ***CT*** CD ***SOF*** ***HA/DR*** RO ***S&R*** ***MO***	HCA ***FID*** ***NEO*** SFA ***MIO*** ***CT*** ***CD*** ***SOF*** ***HA/DR*** ***RO*** ***S&R*** ***MO***	HCA ***FID*** ***NEO*** SFA ***MIO*** ***CT*** ***CD*** ***SOF*** ***HA/DR*** ***RO*** ***S&R*** ***MO***	HCA ***FID*** ***NEO*** SFA ***MIO*** ***CT*** ***CD*** ***SOF*** ***HA/DR*** ***RO*** ***S&R*** ***MO***	HCA ***FID*** ***NEO*** SFA ***MIO*** ***CT*** ***CD*** ***SOF*** ***HA/DR*** ***RO*** ***S&R*** ***MO***
	Intelligence, Reconaissance, and Surveillance	HCA FID NEO SFA MIO CT CD SOF HA/DR RO S&R MO	HCA FID NEO SFA MIO CT CD SOF HA/DR RO S&R MO	HCA FID NEO SFA MIO CT CD SOF HA/DR RO S&R MO	HCA FID ***NEO*** SFA MIO CT CD SOF HA/DR RO ***S&R*** ***MO***	HCA ***FID*** ***NEO*** SFA ***MIO*** ***CT*** ***CD*** ***SOF*** HA/DR ***RO*** ***S&R*** ***MO***	HCA ***FID*** ***NEO*** SFA ***MIO*** ***CT*** ***CD*** ***SOF*** HA/DR ***RO*** ***S&R*** ***MO***	HCA ***FID*** ***NEO*** SFA ***MIO*** ***CT*** ***CD*** ***SOF*** HA/DR ***RO*** ***S&R*** ***MO***	HCA ***FID*** ***NEO*** SFA ***MIO*** ***CT*** ***CD*** ***SOF*** HA/DR ***RO*** ***S&R*** ***MO***
	Medical Capability	HCA FID NEO SFA MIO CT CD SOF HA/DR RO S&R MO	HCA FID ***NEO*** SFA MIO CT CD SOF ***HA/DR*** RO ***S&R*** ***MO***	HCA FID NEO SFA MIO CT CD SOF HA/DR RO S&R MO	HCA FID NEO SFA MIO CT CD SOF HA/DR RO S&R ***MO***	HCA FID ***NEO*** SFA MIO CT CD SOF ***HA/DR*** RO ***S&R*** ***MO***	HCA FID ***NEO*** SFA MIO CT CD SOF ***HA/DR*** RO ***S&R*** ***MO***	HCA ***FID*** ***NEO*** SFA MIO ***CT*** CD ***SOF*** ***HA/DR*** ***RO*** ***S&R*** ***MO***	HCA ***FID*** ***NEO*** SFA MIO ***CT*** CD ***SOF*** ***HA/DR*** ***RO*** ***S&R*** ***MO***
	Non-Crew Berthing Space	HCA FID NEO SFA MIO CT CD SOF HA/DR RO S&R MO	HCA FID NEO SFA MIO CT CD SOF HA/DR RO S&R MO	HCA FID NEO SFA MIO CT CD SOF HA/DR RO S&R MO	HCA FID NEO SFA MIO CT CD SOF HA/DR RO S&R MO	HCA FID ***NEO*** SFA MIO CT CD SOF HA/DR RO S&R ***MO***	HCA FID ***NEO*** SFA MIO CT CD SOF HA/DR RO S&R ***MO***	HCA ***FID*** ***NEO*** SFA MIO CT CD ***SOF*** ***HA/DR*** RO ***S&R*** ***MO***	HCA ***FID*** ***NEO*** SFA MIO CT CD ***SOF*** ***HA/DR*** RO ***S&R*** ***MO***
	Crew Capability and Capacity	HCA FID NEO SFA MIO CT CD SOF HA/DR RO S&R MO	HCA FID NEO SFA MIO CT CD SOF HA/DR RO S&R MO	HCA FID NEO SFA MIO CT CD SOF HA/DR RO S&R MO	HCA FID NEO SFA MIO CT CD SOF HA/DR RO S&R MO	HCA FID ***NEO*** SFA MIO CT CD ***SOF*** HA/DR RO ***S&R*** ***MO***	HCA FID ***NEO*** SFA MIO CT CD ***SOF*** HA/DR RO ***S&R*** ***MO***	HCA FID ***NEO*** SFA ***MIO*** CT ***CD*** ***SOF*** HA/DR RO ***S&R*** ***MO***	HCA FID ***NEO*** SFA ***MIO*** CT ***CD*** ***SOF*** HA/DR RO ***S&R*** ***MO***

Note: Normal (that is, roman, no italic, no bold) font indicates there is no capability shortfall. Italic font with an asterisk (*) indicates the ship meets the minimum required capability with some limitations. Bold italic font indicates a capability shortfall; these cells are also shaded.

Characteristic Gaps by Mission

Characteristic	Category	Maritime Prepositioning Force			Other Ships				
		T-AKE	T-AK	T-AKR/ LMSR	T-AVB	T-AH	JHSV	LCS-1	LCS-2
Susceptibility	Survivability	HCA SFA CD HA/DR **FID** **MIO** **NEO** **CT** **SOF** **RO** **S&R** **MO**	HCA SFA CD HA/DR **FID** **MIO** **NEO** **CT** **SOF** **RO** **S&R** **MO**	HCA SFA CD HA/DR **FID** **MIO** **NEO** **CT** **SOF** **RO** **S&R** **MO**	HCA SFA CD HA/DR **FID** **MIO** **NEO** **CT** **SOF** **RO** **S&R** **MO**	HCA SFA CD HA/DR **FID** **MIO** **NEO** **CT** **SOF** **RO** **S&R** **MO**	HCA SFA CD HA/DR **FID** **MIO** **NEO** **CT** **SOF** **RO** **S&R** **MO**	HCA SFA CD HA/DR FID MIO NEO **CT** **SOF** RO **S&R** **MO**	HCA SFA CD HA/DR FID MIO NEO **CT** **SOF** RO **S&R** **MO**
Vulnerability	Survivability	HCA SFA CD HA/DR FID **MIO** **NEO** **CT** **SOF** **RO** **S&R** **MO**	HCA SFA CD HA/DR FID **MIO** **NEO** **CT** **SOF** **RO** **S&R** **MO**	HCA SFA CD HA/DR FID **MIO** **NEO** **CT** **SOF** **RO** **S&R** **MO**	HCA SFA CD HA/DR FID **MIO** **NEO** CT **SOF** RO **S&R** **MO**	HCA SFA CD HA/DR FID **MIO** **NEO** **CT** **SOF** **RO** **S&R** **MO**	HCA SFA CD HA/DR FID **MIO** **NEO** **CT** **SOF** **RO** **S&R** **MO**	HCA SFA CD HA/DR FID **MIO** **NEO** **CT** **SOF** **RO** **S&R** **MO**	HCA SFA CD HA/DR FID **MIO** **NEO** **CT** **SOF** **RO** **S&R** **MO**
Surface Capability	Breadth	HCA* **SFA** CD* **HA/DR** FID* MIO* **NEO** CT* **SOF** RO **S&R** **MO**	HCA* **SFA** CD* **HA/DR** FID* MIO* **NEO** CT* **SOF** RO **S&R** **MO**	HCA **SFA** CD **HA/DR** FID MIO **NEO** CT **SOF** RO **S&R** **MO**	HCA* **SFA** CD* **HA/DR** FID* MIO* **NEO** CT* **SOF** RO **S&R** **MO**	**HCA** **SFA** **CD** **HA/DR** **FID** **MIO** **NEO** **CT** **SOF** RO **S&R** **MO**	HCA **SFA** CD **HA/DR** FID MIO **NEO** CT **SOF** RO **S&R** **MO**	HCA **SFA** CD **HA/DR** FID MIO **NEO** CT **SOF** RO **S&R** **MO**	HCA **SFA** CD **HA/DR** FID MIO **NEO** CT **SOF** RO **S&R** **MO**
Air Capability	Breadth	HCA SFA **CD** **HA/DR** FID* **MIO** **NEO** **CT** **SOF** **RO** **S&R** **MO**	HCA SFA **CD** **HA/DR** **FID** **MIO** **NEO** **CT** **SOF** **RO** **S&R** **MO**	HCA **SFA** **CD** **HA/DR** **FID** **MIO** **NEO** **CT** **SOF** **RO** **S&R** **MO**	HCA **SFA** **CD** **HA/DR** **FID** **MIO** **NEO** **CT** **SOF** **RO** **S&R** **MO**	HCA SFA **CD** **HA/DR** FID **MIO** **NEO** **CT** **SOF** **RO** **S&R** **MO**	HCA SFA **CD** **HA/DR** **FID** **MIO** **NEO** **CT** **SOF** **RO** **S&R** **MO**	HCA SFA CD HA/DR* FID MIO NEO* CT* SOF* RO* S&R* MO*	HCA SFA CD HA/DR* FID MIO NEO* CT* SOF* RO* S&R* MO*
Surface Capacity	Projection	HCA SFA CD **HA/DR** FID MIO **NEO** CT SOF RO S&R **MO**	HCA SFA CD HA/DR NEO CT SOF RO S&R **MO**	HCA SFA CD HA/DR FID MIO NEO CT SOF RO S&R **MO**	HCA SFA CD **HA/DR** FID MIO **NEO** CT SOF RO S&R **MO**	HCA SFA CD **HA/DR** FID MIO **NEO** CT SOF RO S&R **MO**	HCA SFA CD **HA/DR** FID MIO **NEO** CT SOF RO S&R **MO**	HCA SFA CD **HA/DR** FID MIO **NEO** CT SOF RO S&R **MO**	HCA SFA CD **HA/DR** FID MIO **NEO** CT SOF RO S&R **MO**
Air Capacity	Projection	HCA SFA CD **HA/DR** **FID** **MIO** **NEO** **CT** **SOF** **RO** **S&R** **MO**	HCA SFA CD **HA/DR** **FID** **MIO** **NEO** **CT** **SOF** **RO** **S&R** **MO**	HCA SFA CD **HA/DR** **FID** **MIO** **NEO** **CT** **SOF** **RO** **S&R** **MO**	HCA SFA CD **HA/DR** **FID** **MIO** **NEO** **CT** **SOF** **RO** **S&R** **MO**	HCA SFA CD **HA/DR** **FID** **MIO** **NEO** **CT** **SOF** **RO** **S&R** **MO**	HCA SFA CD **HA/DR** **FID** **MIO** **NEO** **CT** **SOF** **RO** **S&R** **MO**	HCA SFA CD **HA/DR** **FID** **MIO** **NEO** **CT** **SOF** **RO** **S&R** **MO**	HCA SFA CD **HA/DR** **FID** **MIO** **NEO** **CT** **SOF** **RO** **S&R** **MO**
Ashore Water Delivery	Projection	HCA SFA CD **HA/DR** FID MIO NEO CT SOF RO S&R **MO**	HCA SFA CD HA/DR FID MIO NEO CT SOF RO S&R MO	HCA SFA CD **HA/DR** FID MIO NEO CT SOF RO S&R **MO**	HCA SFA CD HA/DR* FID MIO NEO CT SOF RO S&R MO*	HCA SFA CD **HA/DR** FID MIO NEO CT SOF RO S&R **MO**	HCA SFA CD HA/DR FID MIO NEO CT SOF RO S&R MO	HCA SFA CD **HA/DR** FID MIO NEO CT SOF RO S&R **MO**	HCA SFA CD **HA/DR** FID MIO NEO CT SOF RO S&R **MO**
Command and Control	Projection	HCA SFA **CD** **HA/DR** **FID** **MIO** **NEO** **CT** **SOF** **RO** **S&R** **MO**	HCA SFA **CD** **HA/DR** **FID** **MIO** **NEO** **CT** **SOF** **RO** **S&R** **MO**	HCA SFA **CD** **HA/DR** **FID** **MIO** **NEO** **CT** **SOF** **RO** **S&R** **MO**	HCA SFA CD **HA/DR** FID MIO **NEO** **CT** **SOF** RO **S&R** **MO**	HCA SFA **CD** **HA/DR** **FID** **MIO** **NEO** **CT** **SOF** **RO** **S&R** **MO**	HCA SFA CD **HA/DR** FID MIO **NEO** **CT** **SOF** RO **S&R** **MO**	HCA SFA CD **HA/DR** FID MIO **NEO** **CT** **SOF** RO **S&R** **MO**	HCA SFA CD **HA/DR** FID MIO **NEO** **CT** **SOF** RO **S&R** **MO**
Intelligence, Reconaissance, and Surveillance	Projection	HCA SFA **CD** HA/DR **FID** **MIO** **NEO** **CT** **SOF** **RO** **S&R** **MO**	HCA SFA **CD** HA/DR **FID** **MIO** **NEO** **CT** **SOF** **RO** **S&R** **MO**	HCA SFA **CD** HA/DR **FID** **MIO** **NEO** **CT** **SOF** **RO** **S&R** **MO**	HCA SFA CD HA/DR FID* MIO* NEO CT* SOF RO* **S&R** **MO**	HCA SFA **CD** HA/DR **FID** **MIO** **NEO** **CT** **SOF** **RO** **S&R** **MO**	HCA SFA **CD** HA/DR **FID** **MIO** **NEO** **CT** **SOF** **RO** **S&R** **MO**	HCA SFA CD HA/DR FID MIO **NEO** CT SOF RO **S&R** **MO**	HCA SFA CD HA/DR FID MIO **NEO** CT SOF RO **S&R** **MO**
Medical Capability	Projection	HCA SFA CD **HA/DR** **FID** MIO **NEO** **CT** **SOF** **RO** **S&R** **MO**	HCA SFA CD HA/DR **FID** MIO **NEO** **CT** **SOF** **RO** **S&R** **MO**	HCA SFA CD HA/DR **FID** MIO **NEO** **CT** **SOF** **RO** **S&R** **MO**	HCA SFA CD **HA/DR** FID* MIO NEO CT* SOF* RO* **S&R** **MO**	HCA SFA CD HA/DR FID MIO NEO CT SOF RO S&R MO	HCA SFA CD **HA/DR** **FID** MIO **NEO** **CT** **SOF** **RO** **S&R** **MO**	HCA SFA CD **HA/DR** **FID** MIO **NEO** **CT** **SOF** **RO** **S&R** **MO**	HCA SFA CD **HA/DR** **FID** MIO **NEO** **CT** **SOF** **RO** **S&R** **MO**
Non-Crew Berthing Space	Projection	HCA SFA CD **HA/DR** **FID** MIO **NEO** CT SOF RO S&R **MO**	HCA SFA CD HA/DR FID MIO **NEO** CT **SOF** RO **S&R** **MO**	HCA SFA CD HA/DR FID MIO **NEO** CT **SOF** RO **S&R** **MO**	HCA SFA CD HA/DR FID MIO **NEO** CT SOF RO S&R **MO**	HCA SFA CD HA/DR FID MIO NEO CT SOF RO S&R MO	HCA SFA CD HA/DR FID MIO **NEO** CT SOF RO S&R **MO**	HCA SFA CD **HA/DR** **FID** MIO **NEO** CT **SOF** RO **S&R** **MO**	HCA SFA CD **HA/DR** **FID** MIO **NEO** CT **SOF** RO **S&R** **MO**
Crew Capability and Capacity	Projection	HCA SFA **CD** HA/DR FID **MIO** **NEO** CT **SOF** RO **S&R** **MO**	HCA SFA **CD** **HA/DR** **FID** **MIO** **NEO** **CT** **SOF** **RO** **S&R** **MO**	HCA SFA **CD** **HA/DR** **FID** **MIO** **NEO** **CT** **SOF** **RO** **S&R** **MO**	HCA SFA **CD** **HA/DR** **FID** **MIO** **NEO** **CT** **SOF** **RO** **S&R** **MO**	HCA SFA **CD** HA/DR FID **MIO** **NEO** CT **SOF** RO **S&R** **MO**	HCA SFA **CD** HA/DR FID **MIO** **NEO** CT **SOF** RO **S&R** **MO**	HCA SFA CD HA/DR FID MIO **NEO** CT **SOF** RO **S&R** **MO**	HCA SFA **CD** **HA/DR** FID **MIO** **NEO** **CT** **SOF** **RO** **S&R** **MO**

Appendix D. Ship Designations and Acronyms

Ship Designations (from Naval Vessels Register)

JHSV	Joint High Speed Vessel
LCAC	Landing Craft Air Cushion
LCS	Littoral Combat Ship
LCU	Landing Craft Utility
LHA	Amphibious Assault Ship (General Purpose)
LHD	Amphibious Assault Ship (Multi-Purpose)
LPD	Amphibious Transport Dock
LSD	Dock Landing Ship
LX(R)	Dock Landing Ship, Replacement
MLP	Mobile Landing Platform
T-AH	Hospital Ship
T-AK	Cargo Ship
T-AKE	Dry Cargo /Ammunition Ship
T-AKR	Vehicle Cargo Ship
T-AO	Oiler
T-AOE	Fast Combat Support Ship
T-AVB	Aviation Logistics Support Ship

Acronyms

A2/AD	anti-access/area denial
AAV	amphibious assault vehicle
AE	assault echelon
AFSB	afloat forward staging base
AOR	area of responsibility

ARG	Amphibious Ready Group
C2	command and control
CBO	Congressional Budget Office
CLF	Combat Logistics Force
COCOM	combatant command
CRFP	crisis response force package
DENTCAP	dental civic assistance program
DOD	Department of Defense
DON	Department of the Navy
FDNF	Forward Deployed Naval Force
FID	foreign internal defense
FRP	Fleet Response Plan
FY	fiscal year
HA/DR	humanitarian assistance and disaster relief
HCA	humanitarian and civic assistance
ISR	intelligence, surveillance, and reconnaissance
MEB	Marine Expeditionary Brigade
MEDCAP	medical civic assistance program
MEDEVAC	medical evacuation
MEF	Marine Expeditionary Force
MEU	Marine Expeditionary Unit
MIO	maritime intercept operation
MPF	Maritime Prepositioning Force
MPF(F)	Maritime Prepositioning Force-Future
MPSRON	Maritime Prepositioning Squadron
MSC	Military Sealift Command
NDAA	National Defense Authorization Act
OFRP	Optimized Fleet Response Plan
RFF	request for forces
SCN	Shipbuilding and Conversion, Navy (account)
SFA	security force assistance
SP MAGTF-CR	Special Purpose Marine Air Ground Task Forces-Crisis Response
TSC	theater security cooperation
UHF	ultra high frequency
VHF	very high frequency

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