

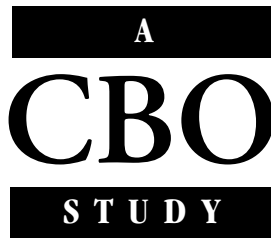
# CBO

## An Analysis of the Navy's Amphibious Warfare Ships for Deploying Marines Overseas



NOVEMBER 2011





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## Notes

Unless otherwise indicated, all years referred to in this study are fiscal years and all dollar amounts are in 2011 dollars.

On the cover—top left: the amphibious assault ship USS *Wasp* and the amphibious transport dock ship USS *San Antonio* during a training exercise (U.S. Navy photo by Mass Communication Specialist 1st Class Arif Patani); top right: sailors aboard the amphibious dock landing ship USS *Whidbey Island* in the Gulf of Aden (U.S. Navy photo by Mass Communication Specialist 1st Class Rachel L. Leslie); bottom: sailors disembark a landing craft utility assigned to the amphibious assault ship USS *Wasp* in Virginia Beach, Va. (U.S. Navy photo by Mass Communication Specialist 2nd Class Paul D. Williams).

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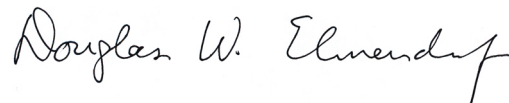


# Preface

**T**oday, the U.S. Navy's fleet numbers 284 ships, including 29 amphibious warfare ships that are designed primarily to carry marines and their equipment into combat but that perform other missions as well. This Congressional Budget Office (CBO) report, requested in the report of the Senate Armed Services Committee on the National Defense Authorization Act for Fiscal Year 2011, reviews the size, missions, and use of the Navy's amphibious warfare ships and related expeditionary forces under the Navy's 2012 shipbuilding plan. In keeping with CBO's mandate to provide objective, impartial analysis, this report makes no recommendations.

Eric J. Labs prepared the report under the general supervision of David Mosher and Matthew Goldberg. Raymond Hall of CBO's Budget Analysis Division prepared the estimates of acquisition costs under the general supervision of Sarah Jennings. Philip Webre and Steven Weinberg of CBO provided comments on the report. Francis Hoffman of the National Defense University also reviewed the report. (The assistance of an external reviewer implies no responsibility for the final product, which rests solely with CBO.)

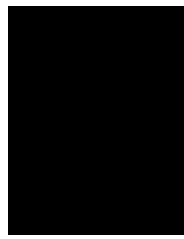
Christine Bogusz edited the report, and Chris Howlett proofread it. Maureen Costantino designed the cover, and Jeanine Rees prepared the report for publication. Monte Ruffin printed the initial copies, and Linda Schimmel coordinated the print distribution. The report is available at CBO's Web site ([www.cbo.gov](http://www.cbo.gov)).



Douglas W. Elmendorf  
Director

November 2011





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# An Analysis of the Navy's Amphibious Warfare Ships for Deploying Marines Overseas

## Summary and Introduction

The Navy's latest 30-year shipbuilding plan (known as the "2012 plan") has a force of 33 amphibious warfare ships as its objective. The primary purpose of those ships in wartime is to carry Marine Corps units overseas and to support and sustain them as they deploy ashore. In peacetime, amphibious ships perform various missions, such as engaging in routine patrols overseas, reassuring allies, responding to crises, and providing humanitarian relief.

Amphibious forces represent a significant investment of taxpayer dollars. Over the next 30 years, the Navy plans to purchase 20 new amphibious ships at a total cost of about \$50 billion (in 2011 dollars), the Congressional Budget Office (CBO) estimates.<sup>1</sup> That total does not include the personnel costs and annual operating costs—for fuel, maintenance, and training—the Navy will face to use its amphibious warfare force.

A force of 33 ships represents a fiscally constrained compromise from the Marine Corps' objective of having 38 amphibious ships.<sup>2</sup> That 38-ship goal represents the number of ships the Navy and Marine Corps would like to have in the fleet in order to execute an opposed

amphibious assault using two Marine expeditionary brigades in the event of war.<sup>3</sup> Under the 2012 plan, the Navy's inventory of amphibious ships would reach at least 33 ships for 15 of the next 30 years—between 2017 and 2031. The rest of the time, from 2012 to 2016 and from 2032 to 2041, the amphibious force would fall below that objective. Over the next 30 years, the force would never reach 38 ships.

The Navy also uses its amphibious force to meet combatant commanders' peacetime goals for overseas presence. (Combatant commanders are the four-star generals or admirals who head the regional commands responsible for all military operations within their geographic areas.) CBO's projections indicate that the Navy's 2012 plan would enable the service to provide overseas presence throughout the next 30 years that would be similar to or exceed the presence it provided in 2007. However, the Navy would not be able to meet the 2010 goals of combatant commanders, which are "fiscally unconstrained," for peacetime amphibious capabilities around the globe.<sup>4</sup> Moreover, CBO's projections indicate that the Navy's 2012 plan would not provide enough amphibious ships for the Marine Corps to prepare and train for all of the missions it might be called on to perform over the next three decades.

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1. See Congressional Budget Office, *An Analysis of the Navy's Fiscal Year 2012 Shipbuilding Plan* (June 2011).

2. See the letter from Chief of Naval Operations Admiral G. Roughead, Commandant of the Marine Corps General James T. Conway, and Secretary of the Navy Donald C. Winter to the Honorable Ike Skelton, Chairman, House Committee on Armed Services, January 7, 2009. See also Department of the Navy, Office of the Chief of Naval Operations, *Report to Congress on Naval Amphibious Force Structure* (December 2008); and Department of the Navy, *Report to Congress on Annual Long-Range Plan for Construction of Naval Vessels for FY 2011* (February 2010).

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3. CBO uses the terms inventory "goal" and inventory "objective" interchangeably.

4. The term "unconstrained" means that the combatant commanders were asked how many amphibious ships they needed on deployment to meet their mission goals, regardless of fiscal resources. In 2007, in contrast, the commanders offered their "constrained" demand, which was based on the number of ships that could be expected to be on routine deployment given the existing fleet.

**Table 1.**  
**Measures of Amphibious Force Size Under the Navy's 2012 Shipbuilding Plan, Selected Years**

	2012	2021	2031	2041	Memorandum	
					Navy's Goal	Marine Corps' Goal
Inventory	30	34	34	30	33	38
Available	27	31	31	27	30	34
Deployable	22	25	25	22	25	26
Deployed	9	10	10	9	10	11

Source: Congressional Budget Office.

Notes: Ship counts represent rounded averages and assume that the Navy does not change its Fleet Response Plan.

Inventory represents the total number of amphibious ships in the fleet. Available ships includes all ships not in long-term maintenance, or about 90 percent of the inventory. Deployable ships are ones whose crews are sufficiently trained to conduct the full range of amphibious missions, or about 74 percent of the inventory. Deployed ships are those that are overseas on routine deployment, or about 30 percent of the inventory.

The inventory goal of 38 ships is the number the Marine Corps says it needs to implement an amphibious assault using two Marine expeditionary brigades. The inventory goal of 33 ships is the number the Navy and Marine Corps have agreed is the minimum needed in light of fiscal constraints. The lower number accepts some risk with respect to the arrival of some support elements to the brigades.

**Measuring the Size of the Amphibious Force**

In this report, CBO uses four different measures of the size of the Navy's force of amphibious warfare ships in their role as the primary mode of transportation for the Marine Corps expeditionary warfare forces that are deployed ashore. The first measure is the total inventory of amphibious ships. The Navy is projected to have 30 amphibious ships at the end of each of the next four years.<sup>5</sup> Of that total, 26 ships will be based in the United States and 4 will be based in Japan.

5. At any time, the Navy may have more or less than 30 amphibious ships because of the schedule of ship retirements and commissionings. The Navy's 2012 shipbuilding plan projects that there will be 30 amphibious ships in the fleet at the end of each of the next four fiscal years.

The second measure of force size is the number of "available" amphibious ships. That number is calculated by subtracting from the total inventory the number of ships in long-term maintenance, which usually averages about 10 percent of the total. Thus, the Navy aims to have 90 percent of its amphibious force—or 27 ships over the next four years—available at any given time for at least some missions (see Table 1).

The third measure is "deployable" ships—those that are available and in good enough condition, with crews that are sufficiently trained, to deploy for a variety of potential missions for as long as six months. Although all ships not in long-term maintenance are theoretically available, some of them are not considered deployable because their crews are not sufficiently trained. Specifically, ships that are considered available but not deployable could be pressed into service to transport marines and their equipment for an amphibious operation, but their crews would not be sufficiently trained to perform the full range of missions that might normally be required of an amphibious ship if it were ordered to deploy.

In terms of readiness to deploy, there is a difference between the amphibious ships based in the United States and those based in Japan. The Navy's goal under its Fleet Response Plan (the framework for how the Navy maintains and uses its ships and trains the ships' crews) is for amphibious ships based in the United States to be in satisfactory material condition, and their crews sufficiently trained, to deploy 72 percent of the time. That means that about 19 out of the 26 amphibious ships based in the United States should be deployable at any point in time. The Navy's goal for the 4 ships based in Japan is for those ships to be deployable 89 percent of the time—which amounts to about 3 ships. Thus, in a 30-ship amphibious force, about 22 ships would be deployable at any given time.

The last measure of force size used in this report is the number of ships that are actually deployed at any time. That number averages about 9 ships out of 30. The remaining 21 ships may be undergoing maintenance or may be at sea near their home ports conducting training exercises. For ships based in the United States, a deployed ship is one that has been sent overseas for up to six months to perform missions. For ships based in Japan, a deployed ship is one that is not undergoing maintenance; such ships are considered deployed even if they are in

their Japanese home port, because that home port is located overseas.

### Meeting the Demand for Amphibious Ships

In 2007, the combatant commanders generally aligned their reported demand for deployed amphibious ships with the number of ships available for routine deployment. By 2010, the combatant commanders' requests were no longer limited to the number of ships available but were intended to be unconstrained by that consideration. The commanders' reported unconstrained demand for deployed amphibious ships in 2010 was about 18, an 80 percent increase over their constrained 2007 demand.

If policymakers decide to keep the number of amphibious warfare ships at 30 but try to meet the commanders' unconstrained demand for more deployments and overseas presence, then those ships will need to deploy more often. CBO analyzed the implications of a greater frequency of deployment for those ships. The Navy's goal is to have its ships in their home port at least 50 percent of the time (so that crews may spend time with their families and to conduct maintenance, among other purposes). Under the Navy's current plan, the fraction of time that amphibious ships spend in their home port is 58 percent. If average deployment increased from 9.3 ships out of 30 (its currently planned level) to 13.4 ships out of 30 (the average level of deployment based on demand in 2007 through 2010), then the fraction of time that amphibious ships would spend in home port would fall to 47 percent, CBO estimates.<sup>6</sup> If average deployment increased to 17.6 ships out of 30 (the level of demand in 2010), then CBO estimates that amphibious ships would spend only 36 percent of their time in home port—a circumstance that would put enormous strain on those ships and their crews. However, it is unclear how useful an unconstrained measure of demand is for force planning: Without constraints, the desire for any asset usually exceeds its supply.

The rest of this report describes the main missions of the Navy's amphibious warfare ships, their availability for major operations as well as for routine overseas deployments during the 30 years of the 2012 shipbuilding plan, and the ability of the amphibious force to meet the

requests of the nation's combatant commanders. The report does not address the strategic and operational implications of different ship purchases.

### Amphibious Ships Used in Today's Expeditionary Warfare Forces

The purpose of the Navy's expeditionary warfare forces is to transport, deploy, and support Marine Corps units organized into Marine air-ground task forces (known as MAGTFs). Those task forces, which include all of the combat and support units necessary for an operation, can be scaled in size from as little as a few hundred troops to more than 50,000. However, three generic types of MAGTFs are common: Marine expeditionary units (MEUs), which are normally the size of a battalion, or about 2,200 troops; Marine expeditionary brigades (MEBs), with about 14,000 troops; and Marine expeditionary forces (MEFs), with 40,000 to 50,000 troops.

The Navy uses two types of ships to deploy those Marine Corps units: amphibious warfare ships and maritime prepositioning ships. Amphibious warfare ships provide the Navy's capability for opposed amphibious assaults (also known as forcible-entry operations)—the most demanding mission a MAGTF may face—as well as for many lesser types of missions (which are discussed below). If an opposed amphibious assault was required, the first wave of attackers would come from amphibious warfare ships. Equipment and supplies for reinforcements, or what the Marine Corps calls the “follow-on echelon,” would arrive on maritime prepositioning ships (essentially floating warehouses; see Box 1) and would “marry up” with marines for those units who were flown in by transport aircraft. The aviation component (fighter jets and helicopters) also would be flown in from the United States. Not all marines would arrive at their area of operations by amphibious ship, however. Many of the marines involved in the wars in Iraq and Afghanistan over the past 10 years did not arrive via amphibious ship but instead were transported to those countries with their equipment in the same way in which Army troops are deployed.

The Navy has 30 amphibious warfare ships in its main fleet, or battle force: 9 LHA or LHD amphibious assault ships (sometimes called helicopter carriers), 9 LPD amphibious transport docks, and 12 LSD dock landing ships (see Figure 1). Those ships vary in size and

6. An increase in the number of deployed ships does not result in a proportional reduction in the amount of time spent in home port because ships not on deployment still spend some time at sea on training operations.

**Box 1.****The Maritime Prepositioning Force**

In addition to its amphibious warfare ships, the Navy has 16 maritime prepositioning vessels, which are organized into three squadrons of five or six ships apiece. Each squadron carries enough vehicles, equipment, and supplies to equip and sustain a Marine expeditionary brigade for 30 days. The ships are operated by the Navy's Military Sealift Command and are forward deployed at ports in the Mediterranean Sea, the Indian Ocean, and the western Pacific Ocean.

Unlike amphibious warfare ships, maritime prepositioning ships do not have any defensive capabilities, do not carry troops, and do not have a forcible-entry capability. They require a secure port at which to unload and prepare equipment and an airfield where the marines of expeditionary brigades can fly in from the United States, meet up with their equipment, and assemble into a fighting force. In the absence of an

available port, small amounts of light equipment and supplies could be transported to an austere environment with the use of small transport craft, if some operation required it.

Although maritime prepositioning ships participate in various operations, they are intended primarily to provide the follow-on forces that deploy to a theater after the assault troops on amphibious warfare ships have secured an area. Maritime prepositioning ships are not counted as amphibious warfare ships and are not represented in the Navy's inventory objective of 33 ships. However, with two brigades of marines and their equipment transported on amphibious ships and three brigades of equipment shipped by the maritime prepositioning squadrons to support marines who are airlifted to a theater, the Navy is able to muster a total of about 80,000 marines for an amphibious operation.

capability, but they all carry troops, cargo, and vehicles for Marine expeditionary units as well as landing craft to ferry troops and equipment to shore.<sup>7</sup> Some of those ships also carry short take-off and landing aircraft or helicopters for use in expeditionary operations. Amphibious warfare ships are larger than most other Navy vessels. Their displacement (weight) varies from 16,000 to about 45,000 tons, compared with 3,000 to about 10,000 tons for current surface combatants (cruisers, destroyers, frigates, and littoral combat ships). But their displacement is much smaller than that of aircraft carriers, which displace about 100,000 tons.

The Navy's two types of amphibious assault ships—the Tarawa class LHA-1s and Wasp class LHD-1s—are the second-largest ships in the fleet after aircraft carriers. The new LHA-6 America class is replacing the LHA-1s and

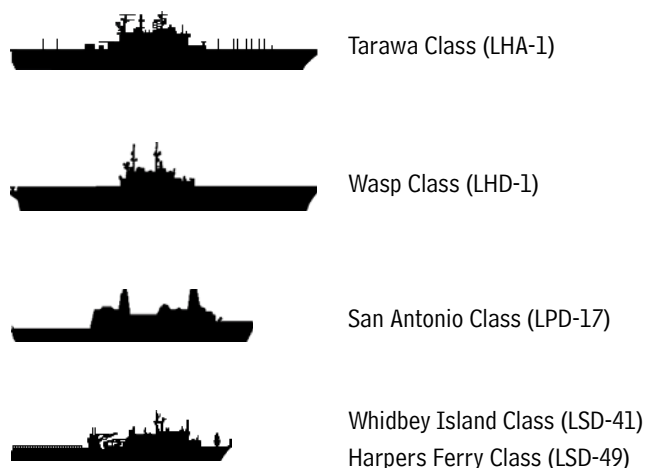
eventually will replace the LHD-1s. The first LHA-6 is still under construction and will displace about 45,000 tons. One amphibious assault ship forms the centerpiece of an amphibious ready group and can carry about half the troops and equipment of a Marine expeditionary unit. It also can carry as many as 30 helicopters and 6 fixed-wing Harrier jump jets, or up to 20 Harriers (which are slated to be replaced by the short take-off and landing version of the Joint Strike Fighter).

The Navy's other four classes of amphibious warfare ships are divided into two types: amphibious transport docks (LPDs) and dock landing ships (LSDs). Two of those ships together provide the remaining transport capacity for a Marine expeditionary unit in an amphibious ready group. Although LPDs and LSDs are quite similar, the LPDs have a hangar (to embark helicopters), whereas the LSDs have a helicopter landing area but no hangar. The Navy's 12 LSDs are divided into two classes—the LSD-41 Whidbey Island and the LSD-49 Harpers Ferry—and displace 16,000 to 17,000 tons each. The LSD-49 has a smaller well deck, so as to carry more troops and equipment than the LSD-41, which has a larger well deck

7. For a recent analysis of the relative costs of using nuclear versus conventional propulsion for amphibious assault ships and amphibious dock landing ships, see Congressional Budget Office, *The Cost-Effectiveness of Nuclear Power for Navy Surface Ships* (May 2011).

**Figure 1.**

## Types of Amphibious Warfare Ships in the Navy's Fleet



Source: Congressional Budget Office.

Note: LHA and LHD = amphibious assault ships; LPD = amphibious transport dock; LSD = dock landing ship.

for conducting amphibious operations. (A well deck is a large opening in the stern of the ship for the egress of amphibious vehicles and craft.) The Navy plans to build one more LPD in 2012 and then a replacement for its LPDs beginning in 2041.<sup>8</sup> The Navy also plans to build a new class of LSDs, designated the LSD(X), beginning in 2017 to replace the existing LSDs as they retire. The design and capabilities of that new class are unknown at this time, although the Navy's 2012 shipbuilding plan implies that they will be similar to those of existing LSDs.

## Missions of Expeditionary Warfare Forces

Marines are the main armament of amphibious ships. Those ships are capable of delivering marines ashore to perform a variety of missions, which can be categorized into five types: assaults, raids, demonstrations, withdrawals, and support to other operations. The missions are listed here in order of importance to the Marine Corps and the Navy. Most activities performed by amphibious

ships fall into the last mission category, however, because combat operations involving those ships (as well as most naval forces) have been relatively rare over the past 30 years. Amphibious ships may also perform activities that do not conform to the Marine Corps doctrine—meaning that Marine Corps forces are not intended to be used ashore in those activities—such as maritime interdiction, mine countermeasures, and strike operations.

Between 1990 and mid-2010, amphibious forces conducted 107 separate operations. Of that total, 4 were categorized as assaults, 1 was a raid, 3 were demonstrations, 1 was a withdrawal, 78 were support to other operations, and 20 did not fit any of the five types of missions conforming to the Marine Corps doctrine.

### Assaults or Forcible-Entry Operations

In this type of operation, made famous by the invasion and conquest of Japanese-held islands in the Pacific during World War II, Marine Corps forces attack a hostile shore. The initial objective is to seize an area of ground—a lodgment—that will enable follow-on forces to arrive in a relatively secure environment and build up a force sufficient to achieve other military or political objectives farther away.

The forces that conduct the invasion usually require intensive preparation and support. Preassault operations include activities such as intelligence gathering, and support on the ground includes activities such as adequate mine detection and clearing, air and gunfire support, and immediate access to supplies and munitions. Preparing for the forcible-entry mission determines the force-structure goals for the amphibious force. A recent example of this type of operation occurred during Operation Iraqi Freedom in 2003, when a Marine expeditionary unit conducted a ship-to-shore assault in the Basra area.

### Raids

In an amphibious raid, forces are swiftly put ashore to destroy a particular objective (such as a structure, port, or airfield) or to temporarily occupy the objective. Forces may also be used to gather information or conduct a rescue. Unlike the forces used for an amphibious assault, the forces used for a raid tend to be much smaller, and they are intended to be withdrawn quickly.

In 1975, when the U.S. freighter *Mayaguez* was seized by Khmer Rouge guerillas, it was retaken by marines in a

8. The first LPD-17 class ship will reach the end of its service life in the late 2040s, so a replacement for that ship will need to be purchased in 2041. The specifications for that replacement class are unknown today.

quick strike; marines were also involved in an unsuccessful landing on the island of Koh Tang off the coast of Cambodia in search of the crew for that ship. In January 1991, during Operation Desert Storm, a Marine expeditionary unit conducted a raid to destroy some Iraqi installations at Umm Al Maridim Island.

**Demonstrations**

An amphibious demonstration is a show of force conducted to deceive an opponent into an unfavorable course of action or, perhaps, to signal presence or an intent to perform an amphibious landing. During the 1990–1991 Gulf War, the Marines mustered a large amphibious force off Kuwait as a decoy to lure forces of Saddam Hussein’s regime away from the main operation, which would come through western Iraq. In addition, during Operation Desert Storm, Marine Corps forces were used to conduct several demonstrations.

**Withdrawals**

An amphibious withdrawal is the removal of forces by sea from hostile or potentially hostile shores. Perhaps the most famous amphibious withdrawal is the evacuation of British troops from Dunkirk after the fall of France in World War II. Another example that relates directly to U.S. amphibious forces took place during the Korean War: After the Chinese counteroffensive in 1951, major elements of U.N. forces retreated to the port of Hungnam in eastern North Korea, where 193 Navy ships evacuated more than 200,000 soldiers and civilians and more than 17,000 vehicles. In a more recent example, amphibious ships and marines were used to withdraw U.N. forces from Somalia in 1995.

**Support to Other Operations**

The most common amphibious operation in the post–Cold War era has been providing support to other operations—generally those that contribute to preventing a conflict or alleviating a crisis. Specific activities include responding to humanitarian crises, engaging in security cooperation with other countries, providing support to civil authorities in other countries, and evacuating civilians from areas of conflict. One of the most prominent examples of that type of operation was the disaster relief and humanitarian assistance provided to Indonesia in the wake of the tsunami that struck that country in 2005.

**Table 2.**

**Purchases, Commissionings, and Retirements of Amphibious Warfare Ships Under the Navy’s Plan, 2012 to 2041**

	Purchases	Commissionings	Retirements
LPD-4			2
LSD-41/49			12
LHA-1/LHD-1			8
LPD-17	1	6	
LPD-17 Replacement	1		
LHA-6	7	7	
LSD(X)	11	10	
<b>Total</b>	<b>20</b>	<b>23</b>	<b>22</b>

Source: Congressional Budget Office based on Navy data.

Note: LPD = amphibious transport dock; LSD = dock landing ship; LHA and LHD = amphibious assault ships.

**Amphibious Warfare Ships Under the Navy’s 2012 Shipbuilding Plan**

The size and utility of the Navy’s amphibious warfare force can be measured in four ways: total inventory, available ships, deployable ships, and deployed ships. The inventory is the total number of ships in the fleet. Available ships are all amphibious ships that are not in long-term maintenance; according to current Navy practice, available ships represent about 90 percent of the inventory. Deployable ships form the portion of the force that is sufficiently trained and ready to perform all types of potential missions; according to current practice, deployable ships are about 74 percent of the inventory. Deployed ships are the portion of the force that is on routine peacetime missions; they currently represent about 30 percent of the inventory.

**Inventory**

The Navy’s inventory of amphibious ships is determined by the number of ships purchased, when those ships enter the fleet, and the number of ships retired each year (see Table 2). The Navy plans to purchase 20 amphibious ships between 2012 and 2041 at a total cost of about \$50 billion (in 2011 dollars), according to CBO’s estimates. (See Appendix A for a year-by-year list of ship purchases, retirements, and costs, by class.) That total represents about 10 percent of the \$539 billion CBO



estimates is required to buy all 275 ships the Navy includes in its 2012 shipbuilding plan.<sup>9</sup> The purchases of amphibious ships would comprise:

- 1 LPD-17 amphibious transport dock,
- 1 LPD-17 replacement,
- 7 LHA-6 amphibious assault ships, and
- 11 LSD(X) dock landing ships.

Because the first two LHA-6s, ordered in 2007 and 2011, are optimized for aviation operations, they do not have a well deck. In contrast, all LHA-6s ordered after 2011 would include a well deck to give future military commanders a range of options to maneuver forces via aviation or surface craft. In that way, commanders would have the flexibility to adjust for a range of contingencies (including bad weather) that might limit air assault options, and they could ensure more-efficient transit of heavy equipment and logistics ashore during combat operations by surface means.

The number of amphibious ships the Navy would commission into the fleet under its shipbuilding plan is a bit higher, at 23, and the mix of ships differs slightly:

- 6 LPD-17s,
- 7 LHA-6s, and
- 10 LSD(X)s.

The reason for the discrepancy between purchases and commissionings is that it takes the Navy about five years from the time the Congress authorizes the purchase of a ship to that ship's commissioning into the fleet. Thus, 5 LPD-17s and 1 LHA-6 that were purchased before 2012 will enter the fleet in this decade; but 1 LPD-17 replacement, 1 LHA-6, and 1 LSD(X) scheduled to be

purchased in the late 2030s would not enter the fleet until after 2041.

The third component in projecting the Navy's inventory is the decommissioning, or retirement, from its fleet over the next 30 years of the following ships:

- 2 LPD-4s,
- 8 LSD-41s,
- 4 LSD-49s,
- 1 LHA-1, and
- 7 LHD-1s.

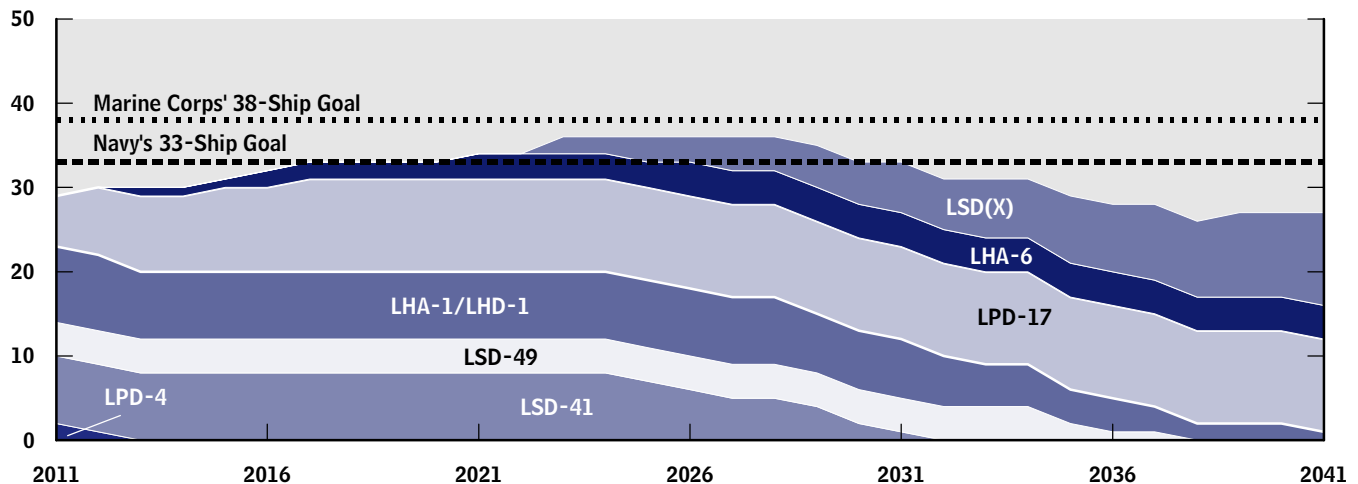
The net result of building new ships and retiring old ones on the Navy's planned schedule would be an amphibious force that would not meet the Navy's objective of 33 ships between 2012 and 2016 and again between 2032 and 2041 (see Figure 2). At no point between 2011 and 2041 would the force reach the Marine Corps' objective of 38 amphibious ships.

### Available Amphibious Ships

The number of amphibious ships in the Navy's inventory is not the number available for operational use. At any given time, approximately 10 percent of the amphibious force would not be able to be deployed because those ships would be undergoing extensive maintenance. The other 90 percent of the force could deploy, although some ships would be ready to go more quickly than others when called for by commanders and some ships would be able to perform only a few limited tasks. (See Box 2 on page 10 for a more detailed discussion of the operating cycle for the Navy's amphibious ships.) The Navy characterizes that situation as a 90 percent availability rate. Thus, a force of 30 amphibious warfare ships provides an average of 27 that are available. Likewise, the inventory objective of 38 amphibious ships preferred by the Marine Corps would yield a force of 34 available ships, and the Navy's fiscally constrained inventory objective of 33 ships would yield 30 available amphibious ships.

The availability rate is lower—at 83 percent—for the new class of LPD-17 amphibious transport docks (5 of which have already been commissioned, 5 of which are

9. The Navy's 2012 shipbuilding plan comprises a set of tables the service provided to the Congress that update the Navy's written 2011 shipbuilding plan. For the 2012 plan, see Department of the Navy, *Report to Congress on Annual Long-Range Plan for Construction of Naval Vessels for FY 2011* (February 2010). See also Congressional Budget Office, *An Analysis of the Navy's Fiscal Year 2012 Shipbuilding Plan* (June 2011).

**Figure 2.****Inventory of Amphibious Warfare Ships**

Source: Congressional Budget Office.

Note: LPD = amphibious transport dock; LSD = dock landing ship; LHA and LHD = amphibious assault ships.

under construction or have been ordered, and 1 of which will be purchased in 2012). That lower rate stems from the many problems in the construction and design of the ship that have proved difficult for the Navy to fix.<sup>10</sup> Navy officials expect to resolve the problems with the LPD-17 class so that it will ultimately achieve the same average 90 percent availability rate as the rest of the amphibious force.

The Marine Corps' objective of having 34 available amphibious warfare ships would not be met in any year under the Navy's 30-year shipbuilding plan. If all current and future amphibious ships achieved a 90 percent availability rate, then success in achieving the goal of having 30 amphibious ships would mirror success in achieving the overall inventory objective: The Navy could essentially meet the objective from 2017 through 2031 but would fall short in other years. If, however, the LPD-17 class was unable to achieve a higher rate of availability than the current 83 percent, then the Navy would meet its 30-ship objective only from 2021 to 2029 (see Figure 3).

### Deployable and Deployed Amphibious Ships

The Navy maintains about 74 percent of its amphibious warfare force as deployable (22 ships out of a total of 30),

and it deploys roughly 30 percent of its amphibious force (9 ships out of 30) on routine peacetime missions. There is a difference in deployment rates between ships based in the United States and ships based in Japan (see Box 2). For ships based in the United States, the Navy aims to have the ships and their crews sufficiently trained to perform the full range of amphibious missions and ready to deploy 72 percent of the time. Given the current inventory of 26 amphibious ships based in the United States, that means having an average of about 19 ships deployable. For ships based in Japan, the Navy aims to have the ships and their crews sufficiently trained and ready to deploy 89 percent of the time. Given the current inventory of 4 amphibious ships based in Japan, that means having an average of about 3 ships deployable.

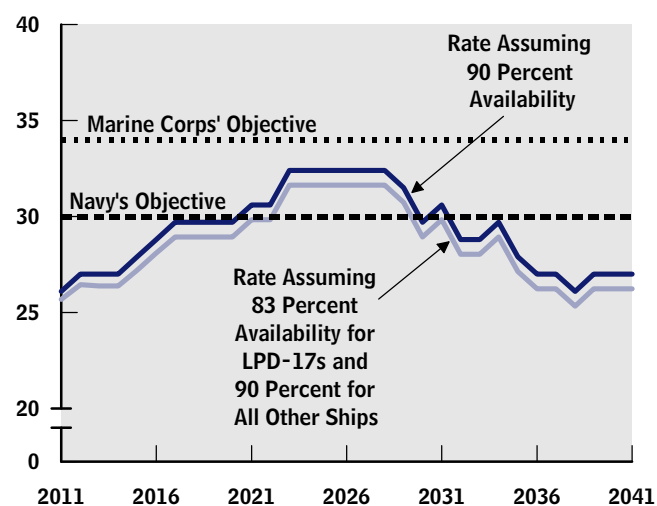
For U.S.-based ships, the Navy computes statistics that measure the stress on the ships and their crews; those statistics are determined by the Navy's rules governing operations tempo (optempo) and personnel tempo (perstempo). Optempo refers to the amount of overseas presence a ship provides during its 117-week (or 27-month) operating cycle. Perstempo assesses the stress on a ship's crew using three measures:<sup>11</sup>

10. See Ronald O'Rourke, *Navy LPD-17 Amphibious Ship Procurement: Background, Issues, and Options for Congress*, RL34476 (October 28, 2010).

11. Technically, these measures indicate the tempo of ship operations, not the tempo of the personnel on board. Ship operations may overstate to some degree the tempo of the personnel because some of the crew may leave the ship during its 27-month cycle to attend school or begin a job on shore.



**Figure 3.**  
**Available Amphibious Warfare Ships**



Source: Congressional Budget Office.

Notes: The Marine Corps' objective represents the inventory goal of 38 ships minus 10 percent in long-term maintenance. The Navy's objective represents the inventory goal of 33 ships minus 10 percent in long-term maintenance.

LPD = amphibious transport dock.

- *The length of the ship's overseas deployment.* The Navy aims to keep deployments to six months or less.
- *The amount of time the ship spends in its home port.* The Navy wants a ship to spend a minimum of 50 percent of its time in its home port. Time spent away from a home port would include overseas deployments as well as relatively short training exercises if the ship was out to sea overnight.
- *The amount of dwell time,* which the Navy defines as the ratio of the number of days since a ship was last deployed to the number of days in the last deployment. The Navy's goal for this measure is 2:1 or higher—in other words, for every day spent on a deployment, the ship would spend at least two days in nondeployed status before being deployed again.

Under the Navy's Fleet Response Plan, amphibious ships based in the United States would deploy for 26 weeks at a time; their dwell-time ratio would be 3.5:1. Those ships would spend 58 percent of their time in home port and the remaining 42 percent either deployed or undergoing

at-sea training. Those statistics all meet or exceed the Navy's goals outlined above.

## Meeting the Demand for Amphibious Ships

Since 2007, the stated demand for amphibious ships on routine peacetime deployments by the major overseas commands of the U.S. military has increased by more than 80 percent. According to the Navy, that increase has more to do with the way demand is calculated than with an underlying change in demand. The demand for amphibious ships—which is CBO's characterization of what the Marine Corps reports as its force-in-readiness requirements—is a sum of the assignment of existing forces under the Global Force Management Allocation Plan and the requests for additional forces by the combatant commanders. (The Global Force Management Allocation Plan is a document prepared by the Chairman of the Joint Chiefs of Staff and approved by the Secretary of Defense that authorizes force allocations and deployment of forces in support of the regular—peacetime—rotational force requirements of the combatant commanders.) In 2007, that demand indicated a desire for the overseas deployment of about 10 amphibious ships. By 2010, that number had nearly doubled (see the upper line in Figure 4 on page 12).

In a briefing to CBO, officials from the Navy stated that the apparent increase in the “demand signal” for amphibious ships over the past four years was not an increase as such but a redefinition of what constitutes the demand for amphibious ship deployments. Through 2007, the combatant commanders aligned their demand for amphibious ships closely with the number of available ships—in other words, they submitted a resource-constrained demand. After 2007, however, guidance from the Department of Defense changed, and the combatant commanders were asked to submit their full demand for amphibious ships based on mission need (an unconstrained demand), which raised the desired number of deployed amphibious ships from about 10 in 2007 to 18 in 2010.<sup>12</sup> Although the specific reasons why the combatant commanders would use amphibious ships are classified, they fall into the categories of providing humanitarian relief, responding to crises, and engaging in exercises with the naval forces of other countries.

12. Navy briefing to CBO staff, February 10, 2011.

**Box 2.**

**The Operating Cycle for Amphibious Warfare Ships**

The number of amphibious ships available for operations is not the same as the number of ships in the Navy's fleet. At any given time, some ships will be deployed, while others will be in various stages of maintenance or training. Under the Navy's Fleet Response Plan—the service's road map for maintaining many of the Navy's ships in a condition to deploy quickly, if needed—an amphibious ship based in the United States operates according to a planned 117-week (27-month) cycle. That cycle is divided into five phases: a maintenance period, basic training, integrated training, deployment, and sustainment (see the table below). After those five phases are complete, the cycle repeats throughout the life of the ship. The actual amount of time spent in each phase may vary depending on the condition of the ship, the state of the crew's training, and the mission for which the ship deploys.

During the maintenance phase, the crew or a repair yard (or both) make the physical condition of the ship ready for training and deployment. Basic training prepares the crew to operate the ship. Integrated training engages the ship in training exercises with other ships to prepare it to deploy in an amphibious ready group or, possibly, a carrier strike group. On deployment, ships overseas come under the purview of the combatant commanders, who assign them various tasks and responsibilities. During the sustainment phase, the ship has returned from deployment, but its physical condition and the crew's readiness are maintained at a relatively high level, in case the ship is needed to deploy again. (The ranges in the categories of maintenance and sustainment occur because some ship classes require more maintenance than others. The ships that require more maintenance spend less time in the sustainment phase, so all U.S.-based amphibious ships have a 117-week operating cycle.)

**117-Week Operating Cycle of Amphibious Ships Based in the United States**

Maintenance	Basic	Integrated	Deployment	Sustainment
10–17 weeks	20 weeks	14 weeks	26 weeks	40–47 weeks

Source: Congressional Budget Office.

Continued

The Navy's ability to meet the demand for amphibious ships fluctuates slightly from year to year depending on how many ships are available for deployment. The Navy provided an average of 9.2 ships per year from 2007 to 2010—approximately 30 percent of its amphibious force—to the regional commanders (see the lower line in Figure 4 on page 12).

By the mid-2020s, assuming the Navy does not alter the way it trains, maintains, and deploys its amphibious forces, the Navy's 30-year shipbuilding plan would lead to a larger inventory of amphibious ships, which would permit the deployment of an average of 10.5 ships to overseas commands each year. However, by the 2030s, the number would fall back to about where it is today.<sup>13</sup> According to CBO's projections, the Navy would be

able to meet 90 percent or more of the combatant commanders' constrained demand for deployed ships throughout the 30-year period (based on the demand reported in 2007) but a much smaller share of the commanders' unconstrained demand (based on the demand reported in 2010) (see Figure 5 on page 13).

13. The Navy's inability to meet the demand for amphibious ship deployments overseas is mirrored by a similar shortfall in meeting the Marine Corps' desired amount of time for training aboard those ships. In 2010, the Navy's amphibious forces were able to meet 57 percent of the days requested for training in shipboard operations. Furthermore, the Marine Corps has not been able to conduct a large amphibious exercise in more than 10 years because of the difficulty in assembling a sufficiently large number of ships for a credible exercise.

**Box 2.**

**Continued**

**The Operating Cycle for Amphibious Warfare Ships**

The operating cycle for the four amphibious ships based in Japan is 104 weeks, or 24 months. Those ships spend 11 to 15 weeks performing maintenance and the remaining 89 to 93 weeks on deployment or ready to deploy (see the table below). The Japan-based ships have a less specific training regimen because they are expected to maintain a high state of readiness at all times. Even during the maintenance phase, the physical condition of the ship must be maintained so that the ship could get under way within 30 days, if necessary.

Under the Fleet Response Plan, an amphibious force composed of 30 ships would have about 9 ships deployed, 10 ships ready to deploy within 30 days, and about 3 ships capable of deploying within

90 days. Another 5 ships could emerge from their basic training period and, with a substantial investment of resources, be made ready within 90 days to perform the limited mission of amphibious lift. Those 5 ships would not be qualified to deploy to perform the full range of missions conducted by amphibious ships, but in a moment of great need, they could be used to carry marines overseas to contribute to a forcible-entry operation. In short, at any given time, about 30 percent of the amphibious force is on routine deployment, 74 percent of the force could be mustered within 90 days to respond to a variety of crises (and thus is considered deployable), and 90 percent of the force could be mobilized and made available to provide amphibious lift.

**104-Week Operating Cycle of Amphibious Ships Based in Japan**

Maintenance	Deployment
11–15 weeks	89–93 weeks

Source: Congressional Budget Office.

The unconstrained demand articulated by the combatant commanders for any asset usually exceeds the supply of that asset, sometimes to a much greater degree than for amphibious ships. For example, the demand for unmanned aircraft systems greatly exceeds the available supply.<sup>14</sup> The combatant commanders do not have responsibility for budgeting or long-term planning for future military forces. Nor do they have to consider the demands for military forces in other theaters. It is the responsibility of the services and, ultimately, of lawmakers to decide which military systems and activities should be funded.

In the event of a crisis, amphibious ships (along with other naval and military forces) might be deployed for a larger percentage of the time than they are today. Longer

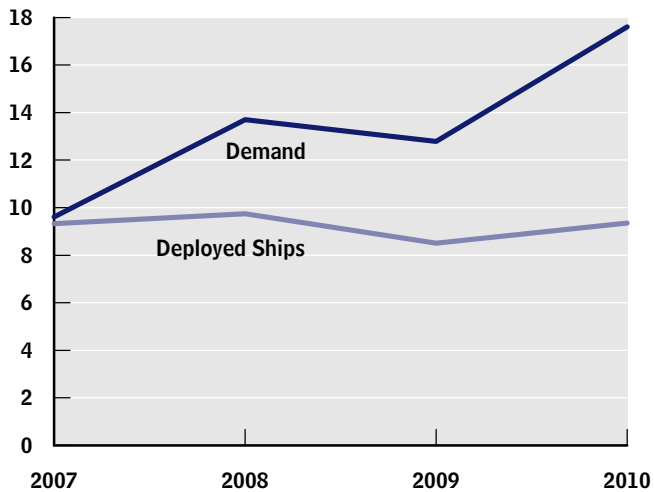
deployments, less time in home port, and less dwell time would typically be required if, for example, the United States were to fight a war that included the extended use of naval forces. Over the past eight years, the Army and Marine Corps have maintained much higher perstempo rates than peacetime doctrine would dictate because of their heavy involvement in the land wars in Iraq and Afghanistan. A desire for greater routine presence overseas with amphibious ships would require either revisions to the Navy's optempo and perstempo goals or an increase in the size of the amphibious force. Using the existing force, the Navy could provide greater presence—but only at a higher cost, including greater stress on the force.

CBO considered two cases—a medium-stress case and a high-stress case—to illustrate the effects on the amphibious force if the Navy attempted to meet more of the unconstrained peacetime demand signaled by the combatant commanders with a fixed inventory of deployable

14. For a discussion of those systems, see Congressional Budget Office, *Policy Options for Unmanned Aircraft Systems* (June 2011).

**Figure 4.**

### Demand for Amphibious Warfare Ships by U.S. Military Commanders Compared with the Number Deployed



Source: Congressional Budget Office based on Navy data.

Note: As discussed in the text, the Department of Defense's definition of demand changed over this period, such that constraints on ship availability became less important.

ships. The medium-stress case would increase the number of deployed amphibious ships from the current average of about 9.3 under the Fleet Response Plan to 13.4, the average unconstrained demand for those ships from 2007 through 2010. To achieve that objective with the 30-ship fleet that the Navy will have in 2012, deployment time for ships based in the United States would increase from 26 to 44 weeks over a 117-week cycle (see Figure 6). Deployment time for ships based in Japan would remain the same. That longer period of deployment for U.S.-based ships would not have to be one long deployment, however; two shorter deployments would be equally effective. Dwell time would be determined by whichever deployment plan was selected. With one long deployment, the dwell-time ratio would be 1.66:1, below the Navy's goal of 2:1. With two shorter deployments,

the dwell-time ratio would be slightly lower still, because ships would spend more time transiting back to their home ports. In addition, the share of time spent in home ports under either scenario would fall to 47 percent, just below the Navy's goal of 50 percent.<sup>15</sup>

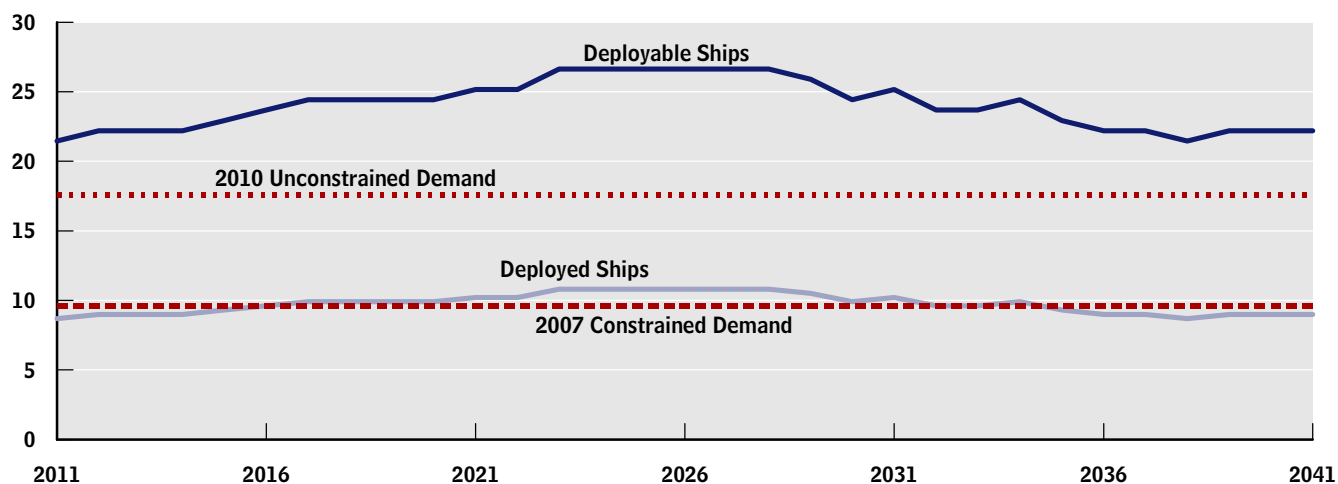
The high-stress case would meet the unconstrained demand for 17.6 ships in 2010 (with a 30-ship force) only by generating even more unfavorable perstempo measures. Deployment time for U.S.-based ships would increase to about 62 weeks, or more than half of the 117-week operating cycle for amphibious ships. The ratio for dwell time would be 0.88:1, less than half of the Navy's goal. Also, the share of time spent in home ports would fall to 36 percent over the 117-week period. (A 33-ship force would improve those numbers, but the effect of trying to meet the unconstrained demand would still be severe.) As those statistics show, this scenario could not be achieved without putting enormous strain on the crews of the ships as well as on the physical condition of the ships. Although that pace might be possible to sustain for a short period during a crisis, it would be difficult to sustain for many months or years.

Operating costs under the medium- and high-stress cases would be higher than costs under the Fleet Response Plan, although the size of the increase would depend on how long the stress persisted. As the ships and crews were used more aggressively, costs for ship maintenance, fuel, and sea pay would all rise. In addition, if the ships wore out faster because they were operating more often, that could lead to a shorter service life. In that case, the ships would require replacement on a schedule faster than what the Navy assumed under its 2012 shipbuilding plan.

15. If the Navy had 33 amphibious warfare ships, as its shipbuilding plan calls for, then under the medium-stress and high-stress scenarios, the deployment time for the average amphibious ship would be about 10 percent shorter, and the time spent in home port about 10 percent longer, than for the average ship that is part of a 30-ship force.

**Figure 5.**

## Deployable and Deployed Amphibious Warfare Ships and Demand for Them by U.S. Military Commanders



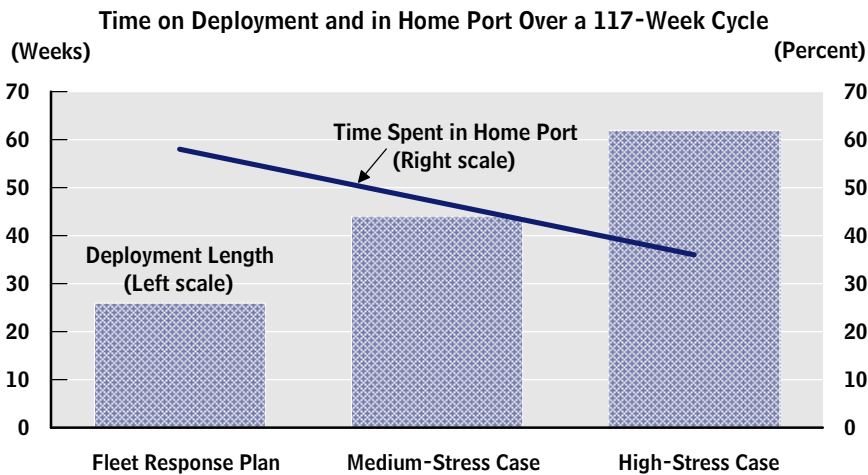
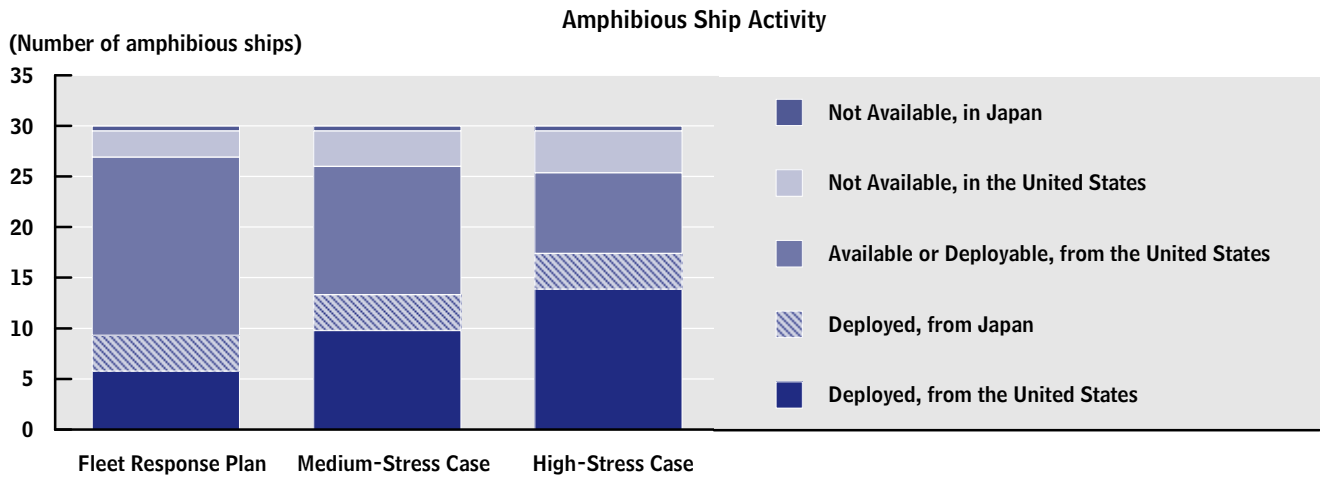
Source: Congressional Budget Office.

Notes: CBO projected the number of deployed ships using the normal peacetime deployment rate of about 30 percent of the amphibious ship inventory. Crises could cause an increase in the number of deployed ships for short periods of time.

Deployable ships are ones that are in good enough material condition and whose crews are sufficiently trained to perform any of the amphibious missions that may be needed. Deployed ships are the subset of deployable ships that are actually overseas performing missions. Constrained demand refers to the relatively close alignment between the number of ships requested by U.S. military commanders for routine deployment overseas and the number of ships available to go on routine deployment. Unconstrained demand is the number of ships requested for routine deployment overseas without reference to the number of ships that might actually be provided.

**Figure 6.**

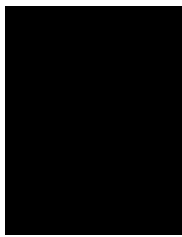
**The Amphibious Warfare Force Under Different Peacetime Deployment Scenarios**



Source: Congressional Budget Office based on Navy data.

Notes: The medium-stress case represents the 2007–2010 average unconstrained demand for routine overseas presence of amphibious ships by U.S. military commanders. The high-stress case represents the 2010 unconstrained demand for those ships.

If the Navy had 33 amphibious warfare ships, as its shipbuilding plan calls for, then under the medium-stress and high-stress scenarios, the deployment time for the average amphibious ship would be about 10 percent shorter, and the time spent in home port about 10 percent longer, than for the average ship that is part of a 30-ship force.



# Appendix: Annual Purchases, Retirements, and Costs for Amphibious Ships Under the Navy's 2012 Shipbuilding Plan

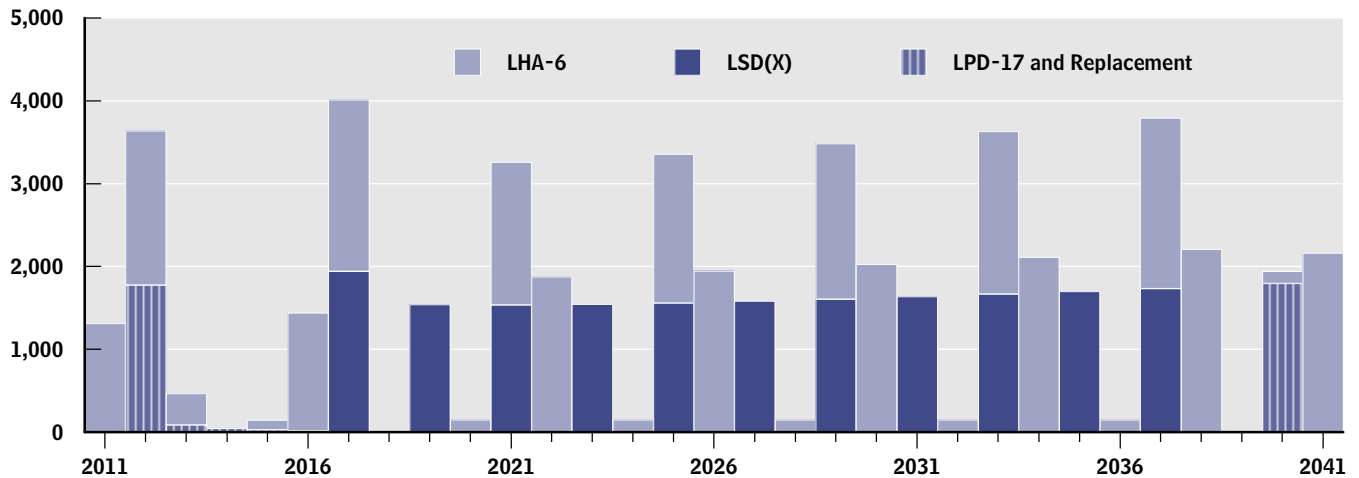
The figure and table in this appendix provide year-by-year data for the Navy's plan for the amphibious force. Figure A-1 shows the costs of buying new ships over the

next 30 years. Table A-1 lists the ship purchases and retirements planned for that period.

**Figure A-1.**

## Annual Procurement Costs of Amphibious Warfare Ships, by Class

(Millions of 2011 dollars)



Source: Congressional Budget Office.

Notes: Navy ships are authorized in a given year, but they may be paid for over several years. Some money may be spent before a ship is authorized, in order to acquire items that need long lead times to build or have ready.

LHA = amphibious assault ship; LSD = dock landing ship; LPD = amphibious transport dock.

**Table A-1.**

**Purchases and Retirements of Amphibious Warfare Ships Under the Navy's 2012 Shipbuiding Plan**

	Ship Purchases			Ship Retirements		
	LPD-17 and Replacement	LHA-6	LSD(X)	LPD-4	LHA-1/LHD-1	LSD-41/49
2012	1			1		
2013				1		
2014					1	
2015						
2016		1				
2017			1			
2018						
2019			1			
2020						
2021		1	1			
2022						
2023			1			
2024						
2025		1	1			1
2026						1
2027			1			1
2028						
2029		1	1		1	1
2030						2
2031			1			1
2032					1	1
2033		1	1		1	
2034						
2035			1		1	2
2036						1
2037		1	1		1	
2038					1	1
2039						
2040	1					
2041		1			1	
<b>Total</b>	<b>2</b>	<b>7</b>	<b>11</b>	<b>2</b>	<b>8</b>	<b>12</b>

Source: Congressional Budget Office based on Navy data.

Note: LPD = amphibious transport dock; LHA and LHD = amphibious assault ships; LSD = dock landing ship.









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