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CBO

STUDY

The Future of the Navy's Amphibious and Maritime Prepositioning Forces

November 2004

The Congress of the United States ■ Congressional Budget Office

Notes

Unless otherwise indicated, all years referred to in this study are fiscal years (which run from October 1 to September 30), and all dollar amounts are in 2005 dollars.

Numbers in the text and tables may not add up to totals because of rounding.

The cover shows various Wasp class amphibious assault ships and Maersk-type maritime prepositioning ships.

Preface

Today, the U.S. Navy numbers about 293 battle force ships, including 35 amphibious warfare ships, which are designed to carry marines and their equipment into combat. In addition, the Navy has 16 cargo ships that make up the maritime prepositioning force, which carries equipment and 30 days' worth of supplies for three Marine infantry brigades (though not the marines themselves). The Navy plans to modernize both its amphibious and maritime prepositioning ships over the next 30 years. Its plans include developing a sea-basing capability that would allow the Navy to deploy and sustain Marine Corps units on shore without needing to build up a supply depot on land. Carrying out those plans would require the Navy to spend an average of $2.4 billion a year over the next three decades to buy new amphibious and maritime prepositioning ships—more than twice what it has spent on those categories of ships since 1980. At the same time, the Navy has modernization plans for other types of ships that, if fully implemented, would also require more resources than the Navy now spends on ship construction.

Are there ways to modernize the amphibious and maritime prepositioning forces at a lower cost than what the Navy plans to spend? This Congressional Budget Office (CBO) study—prepared at the request of the Subcommittee on Seapower of the Senate Committee on Armed Services—addresses that question. It examines the Navy's modernizations plans for amphibious and maritime prepositioning ships and their budgetary implications. It also evaluates four lower-cost options for those ships, two of which would cost roughly what the Navy has spent annually since 1980 and two of which would require a spending increase of a little over one-third. Those alternatives would result in smaller, less capable forces than the Navy envisions—or than exist now—but they would provide some of the capabilities that the Navy and Marine Corps desire. In keeping with CBO's mandate to provide objective, impartial analysis, this study makes no recommendations.

Eric J. Labs of CBO's National Security Division wrote the study under the general supervision of J. Michael Gilmore. Raymond Hall of CBO's Budget Analysis Division prepared the cost estimates under the general supervision of Jo Ann Vines. Hannah Robinson provided assistance in preparing some of the figures, and Natalie Fries (a former CBO intern who is now a commissioned naval officer) provided early research for this project. Michael Simpson, Barbara Edwards, Arlene Holen, and Elizabeth Robinson of CBO provided thoughtful comments on an earlier draft of the study. In addition, numerous officials and analysts from the Navy and Marine Corps provided information that improved the analysis, and Robert Work of the Center for Strategic and Budgetary Assessments offered valuable insights and comments. (The assistance of such external participants implies no responsibility for the final product, which rests solely with CBO.)

Christian Spoor edited the study, and Christine Bogusz and Leah Mazade proofread it. Cynthia Cleveland formatted the tables. Maureen Costantino designed the cover, produced the figures, and prepared the study for publication. Lenny Skutnik printed the initial copies, and Annette Kalicki prepared the electronic versions of the report for CBO's Web site (www.cbo.gov).

Douglas Holtz-Eakin
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November 2004

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Summary

The Department of the Navy's vision for military transformation, known as Sea Power 21, rests on three key concepts: Sea Strike, Sea Shield, and Sea Basing. The first two concepts focus on improving the Navy's and Marine Corps's offensive and defensive capabilities, respectively. But the third, Sea Basing, is considered by many in the Department of Defense to be the most transformational of the three ideas. It envisions putting a substantial Marine Corps ground force on shore and sustaining it from ships at sea rather than from a land base. Thus, the Navy and Marine Corps could conduct amphibious assaults (including "forcible-entry" operations, like those conducted on Japanese-held Pacific islands during World War II) without needing to seize enemy territory to build a base or to get permission from a nearby country to use an existing base. Supporters argue that sea basing would therefore allow U.S. forces to operate overseas more independently, flexibly, and quickly.

Although the entire fleet would play a role in the "sea base," the most important vessels for that concept are the Navy's amphibious warfare ships—which carry marines and their equipment—and new prepositioning vessels intended to provide much of the logistics support for Marine Corps units operating on shore.[1] Over the next 30 years, the Navy plans to replace most of its amphibious ships as well as buy the new class of logistics ships, which it calls the Maritime Prepositioning Force (Future), or MPF(F).

Carrying out that plan would cost more than twice as much per year, on average, as the Navy has spent on amphibious ships since 1980, the Congressional Budget Office (CBO) estimates.[2] Such a spending increase may not prove feasible; consequently, this study looks at four ways to modernize the Navy's amphibious and maritime prepositioning forces at lower cost. Some of those alternatives would support sea basing and some would emphasize other capabilities, such as providing overseas (forward) presence.

Organization of the Amphibious and Maritime Prepositioning Forces

Today, amphibious ships make up 12 percent of the Navy's fleet, or 35 out of 293 ships (see Summary Figure 1). Those vessels—referred to collectively as L-class ships—include 12 large amphibious assault ships (known as LHAs or LHDs), 11 amphibious transport docks (LPDs), and 12 dock landing ships (LSDs). All three types of ships carry marines, vehicles, and the landing craft that are used to ferry troops and equipment to shore; some also carry helicopters and fixed-wing aircraft. (For a description of the different types of amphibious warfare ships and the roles they play, see Summary Box 1.) Together, L-class ships provide the lift (transport capacity) to carry 1.9 Marine expeditionary brigades (MEBs), or about 27,000 troops and their equipment—less than the Navy's stated goal of 2.5 MEBs' worth of lift.

In the past, amphibious warfare ships were organized into 12 amphibious ready groups (usually of three ships each), which generally operated independently of other ships in the fleet. Each group carried a Marine expeditionary unit of about 2,200 troops, equivalent to an infantry battalion. Under a plan announced in 2003, however, the Navy is reorganizing its fleet to assign three surface combat ships and one submarine to operate with each amphibious ready group. The resulting task forces are called expeditionary strike groups, which is the term used in this study.

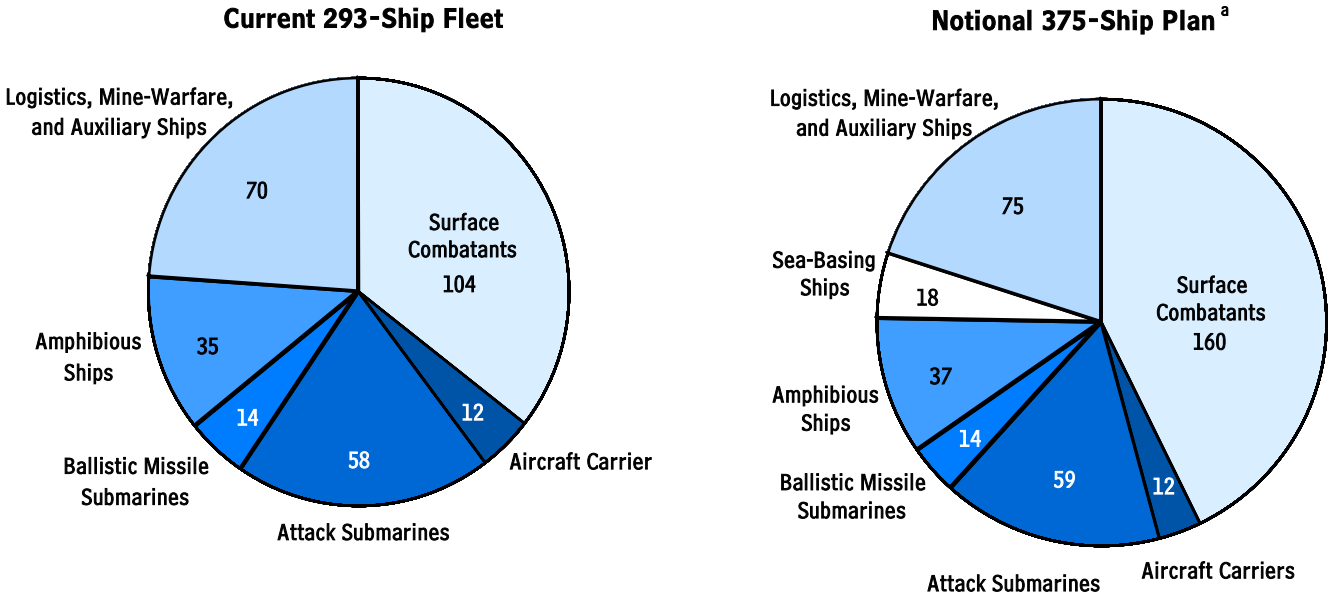
Separate from its main fleet, the Navy has 16 maritime prepositioning ships—conventional cargo vessels oper-

1. In military terms, "prepositioning" refers to the practice of storing equipment on land or at sea in areas near where U.S. forces might be called on to operate overseas.

2. Most of the Navy's current maritime prepositioning ships are leased. The funding for the few that the Navy purchased is included in the historical average.

Summary Figure 1.

Composition of the Current and 375-Ship Battle Force Fleets



Source: Congressional Budget Office based on data from the Navy.

Notes: Current maritime prepositioning ships are not included in the 293-ship fleet because the Navy does not consider them battle force ships. In the 375-ship plan, new, more-capable maritime prepositioning ships are included and are called sea-basing ships.

Attack submarines include four Ohio class ballistic missile submarines that are being converted to carry conventional guided missiles.

a. The Navy's plan for a 375-ship fleet, submitted in May 2003, included 37 amphibious ships and 18 sea-basing ships. CBO's analysis, consistent with more-recent information, assumes that the 375-ship fleet would include 36 amphibious ships and 16 sea-basing ships.

ated by the Military Sealift Command (the organization responsible for providing ocean transportation services to the Department of Defense). Unlike amphibious warfare ships, maritime prepositioning ships do not carry troops, only equipment. They are organized into three squadrons of five or six ships apiece and are based at ports in the Mediterranean Sea, the Indian Ocean, and the western Pacific. Each squadron holds all of the military hardware and supplies needed to equip a Marine expeditionary brigade and sustain it for 30 days. Thus, those ships together provide a total lift capacity of 3.0 MEBs.

Maritime prepositioning vessels are not counted in what the Navy call its ship battle forces and do not have the capability to engage in forcible-entry operations. Instead, they require a secure port for unloading equipment and a secure airfield where troops can fly in from the United States to pick up the equipment and assemble for operations. The Navy and Marine Corps assume, on the basis of various planning factors, that if the Marines needed to forcibly seize a port and airfield first, the first Marine unit getting its equipment from a maritime prepositioning squadron would be ready to operate in eight weeks. If a port and airfield were already available—as was the case in both wars against Iraq—the first such unit could be ready within two weeks.

In March 2003, the Navy sent a report to the Congress that proposed building a fleet of 375 ships, including 37 amphibious ships and 18 new maritime prepositioning ships capable of conducting sea-basing operations (see Summary Figure 1). Under the 375-ship plan, some or all of those new prepositioning ships would be counted as part of the battle fleet by virtue of their combat capability. Together, amphibious and maritime prepositioning ships would make up 15 percent of that fleet. (More-recent information suggests that the 375-ship fleet would include 36 amphibious ships and 16 sea-basing ships.)

Summary Box 1.

The Roles of Different Amphibious Ships in Conducting Amphibious Operations

(Silhouettes not to scale)

Tarawa Class (LHA)

Wasp Class (LHD)

Austin Class (LPD)

San Antonio Class (LPD)

Whidbey Island Class (LSD)

Harpers Ferry Class (LSD)

The two classes of amphibious assault ship, the Tarawa (LHA) and the Wasp (LHD), are the centerpieces of the Navy's expeditionary strike groups. More than twice as big as any other amphibious vessel in the fleet today, each amphibious assault ship carries half of the troops, vehicles, and cargo of a battalion-sized Marine expeditionary unit. These ships are sometimes called helicopter carriers because they provide most of the helicopters and all of the fixed-wing aircraft used in Marine operations. Normally, each ship carries, and serves as an operating platform for, about 30 helicopters and six fixed-wing Harrier jump jets. At times, however, the Navy uses an amphibious assault ship as a small aircraft carrier, putting up to 20 Harriers on board. In addition, each of these ships carries one to three landing craft, which are used to ferry troops, equipment, and materiel to shore. In an expeditionary strike group, one amphibious assault ship operates with one amphibious transport dock and one dock landing ship, as well as with three surface combatants and one submarine.

The amphibious transport dock, or LPD, originated as a larger version of the dock landing ships described below. Like all amphibious ships, transport docks carry some of the troops, vehicles, and material of a Marine expeditionary unit. They carry fewer landing craft than other amphibious vessels, but they have a fixed helicopter deck and can provide hangar space for four to six helicopters. Maintenance and support on those aircraft, however, must be done on an amphibious assault ship. Transport docks of the Austin (LPD-4) class are the oldest amphibious ships still in use. They are scheduled to be replaced gradually by transport docks of the San Antonio (LPD-17) class, the first of which will be commissioned in 2005. Unlike the two classes of amphibious assault ship (LHA and LHD), which are about the same size, the LPD-17 is some 40 percent larger than the LPD-4 class, with twice as much vehicle space and more helicopters and landing craft. The LPD-4 class, by contrast, has far more cargo space than its replacement.

The dock landing ship, or LSD, is a design that had its origins in World War II, when the Navy first developed dedicated amphibious ships. Like amphibious assault ships and transport docks, LSDs carry and (via landing craft) land troops, vehicles, and material for amphibious operations. Dock landing ships have a larger docking well (the area used to transport and deploy landing craft) than other types of amphibious ships do and thus can carry more landing craft. They do not have the capability to house helicopters, although they can support helicopter operations with a removable landing pad that fits over their docking well. The two classes of LSD in the fleet are two variants of the same design. The Harpers Ferry (LSD-49) class has 10 times the cargo capacity and slightly more vehicle space than the Whidbey Island (LSD-41) class. In exchange, the LSD-41 class has a larger docking well that can accommodate more landing craft.

Summary Table 1.

Schedule for Replacing Existing Amphibious and Maritime Prepositioning Ships with New Classes

Existing Ships			Replacement Ships			
Class	Quantity in Service	Year First Ship Retires	Class	Year First Ship Is Authorized	Year First Ship Is Commissioned	Quantity to Be Purchased Through 2035
Amphibious Assault Ships						
Tarawa (LHA-1)	5	2007[a]	LHA(R)	2007	2012[b]	10
Wasp (LHD-1)	7	2027	LHA(R)			
Amphibious Transport Docks						
Austin (LPD-4)	11	2004	San Antonio (LPD-17)	1996	2005	12[c]
Dock Landing Ships						
Whidbey Island (LSD-41)	8	2024	LSD(X)	2020	2024[b]	12
Harpers Ferry (LSD-49)	4	2032	LSD(X)			
Maritime Prepositioning Ships						
MPS Cargo Ships	16	2013[d]	MPF(F)	2009	2013[b]	21[e]

Source: Congressional Budget Office based on data from the Navy.

Note: MPS = maritime prepositioning squadron; MPF(F) = Maritime Prepositioning Force (Future).

a. *Tarawa,* the first LHA to retire, will be replaced by *Makin Island,* the last of the LHDs.

b. Projected.

c. Through 2004, six of the 12 LPD-17s had already been purchased.

d. Most of these ships will be transferred to the Ready Reserve Fleet to replace cargo ships that will be scrapped.

e. CBO assumes that 16 ships will have sea-basing capabilities and five will be replacement cargo ships.

The Navy's Plan to Modernize the Amphibious and Maritime Prepositioning Forces Under the Sea-Basing Vision

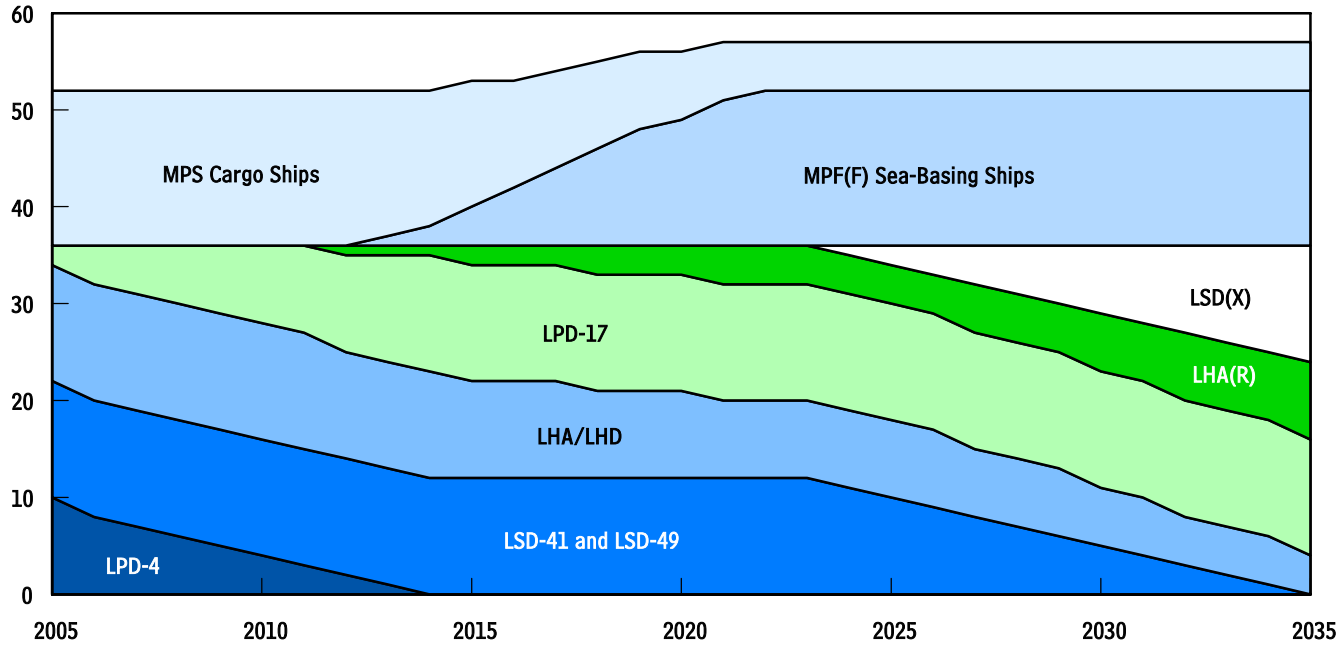
The Navy intends to replace most of its current amphibious and maritime prepositioning ships over the next 30 years (see Summary Table 1). Its plan for those forces includes:

- Completing the purchase of 12 amphibious transport docks of the LPD-17 San Antonio class;
- Buying 10 amphibious assault ships of a new class, designated the LHA(R), which would be similar to the existing LHD class but have the ability to carry and support more aircraft;
- Acquiring 12 dock landing ships of a new class, known as the LSD(X); and
- Buying up to 21 new maritime prepositioning ships, or MPF(F)s, 16 of which would have capabilities far beyond those of today's maritime prepositioning ships in order to support sea basing.

Under that plan, the Navy would have 57 amphibious warfare and maritime prepositioning ships by 2035 (see Summary Figure 2), compared with 51 in 2004. Those ships would be organized into 12 expeditionary strike groups and three maritime prepositioning squadrons.

Summary Figure 2.

Inventory of Amphibious and Maritime Prepositioning Ships Under the Navy's Plan



Source: Congressional Budget Office based on data from the Navy.

Note: MPS = maritime prepositioning squadron; MPF(F) = Maritime Prepositioning Force (Future).

By 2035, each expeditionary strike group would comprise one large amphibious assault ship of either the LHD or LHA(R) class, an LPD-17, and an LSD(X). Of the maritime prepositioning squadrons, two would consist of ships with sea-basing capabilities, and one would consist of replacement cargo vessels like those used today. All together, those forces could provide a total lift capacity of 5.5 MEBs (2.5 MEBs on the amphibious warfare ships, 2.0 MEBs on the sea-basing ships, and 1.0 MEB on the conventional cargo ships).

In the Navy's and Marine Corps's vision for sea basing, amphibious ships would continue to carry the "assault echelons"—the first wave of troops—in any expeditionary operation. The MPF(F) ships would carry most of the material needed to sustain that force in the first 20 days of operations. They would also hold all of the equipment for "follow-on assault echelons"—successive waves of troops that would be transported to the theater on aircraft or high-speed surface craft. With sea basing, no land base would be necessary for the follow-on forces to assemble themselves and deploy—all of that would occur on the ships composing the sea base. Nor would there be a large supply depot on land to offer a prime, stationary target for attacks by enemy ballistic missiles, cruise missiles, or aircraft. The MPF(F)s are the linchpin of the sea base; without them, the Navy and Marine Corps would not be able to implement that new approach to amphibious warfare or forcible-entry operations.

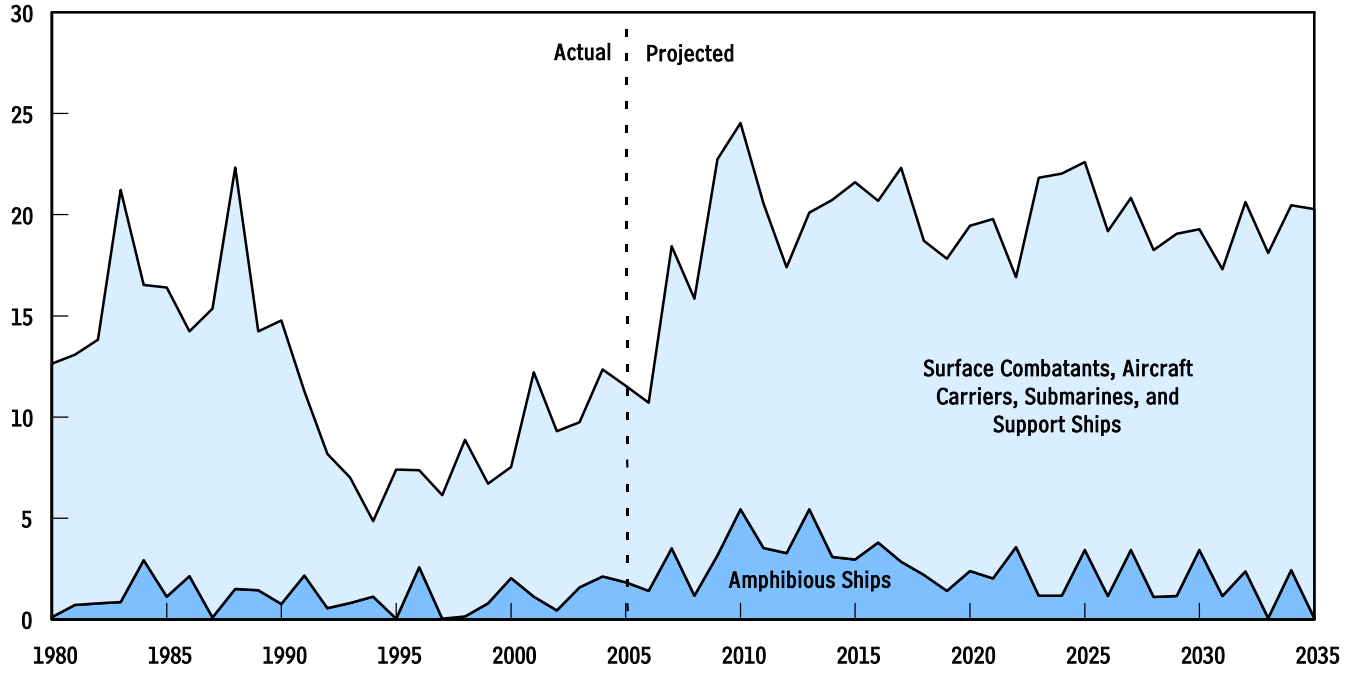
Carrying out the Navy's plan for amphibious and maritime prepositioning forces would require spending an average of $2.4 billion a year (in 2005 dollars) on ship construction between 2005 and 2035, CBO estimates—more than twice the Navy's average annual spending to build amphibious and maritime prepositioning ships between 1980 and 2004. If costs to operate and support those forces were included, the Navy would need to spend an average of $5.4 billion per year over the 2005-2035 period.

That planned increase in spending comes at a time when Navy officials are envisioning other modernization programs—for surface combatants, submarines, aircraft carriers, and support ships—that would also require greater spending on ship construction. Building the proposed

Summary Figure 3.

Projected Funding to Construct a 375-Ship Fleet Compared with Actual Ship Funding

(Billions of 2005 dollars)



Source: Congressional Budget Office.

Note: The data in this figure are roughly analogous to the cost-risk case for ships presented in Congressional Budget Office, *The Long-Term Implications of Current Defense Plans: Summary Update for Fiscal Year 2005* (September 2004).

375-ship fleet would cost an average of about $19 billion annually through 2035, CBO estimates, compared with average funding of less than $12 billion a year since 1980. Spending on amphibious and maritime prepositioning ships would represent about 12 percent of total shipbuilding costs, up from an average of 9 percent between 1980 and 2004 (see Summary Figure 3).

Many questions remain about the future size of the Navy's amphibious forces and the viability of the sea-basing concept. The Navy may find that modernizing its amphibious warfare force and purchasing new MPF(F) vessels are difficult to afford simultaneously. Some Navy officials have suggested reducing the number of L-class ships in order to buy the MPF(F)s. That and other recent proposals for reductions in the force structure suggest that senior Navy leaders do not think the 375-ship goal is viable. If a battle fleet of that size proves too expensive, the Navy's current plans for amphibious and maritime prepositioning ships may change.

In addition, the sea-basing idea is still in its early stages of development. Important conceptual issues and technological problems will have to be solved before that idea can become a reality. Furthermore, a growing number of military leaders and analysts contend that sea basing needs to be joint (in other words, that all of the military services need to be involved in its development and funding). What role the Army and the Air Force would play in that effort, however, is not yet clear.

Lower-Cost Alternatives to the Navy's Plan

CBO constructed four alternative plans for the future of amphibious and maritime prepositioning forces that would lessen the funding challenge the Navy is facing with its shipbuilding budget as a whole and with those forces in particular. All of the alternatives would result in a smaller amphibious force than exists today, and some would result in a smaller prepositioning force as well.

Each option would take a different approach to modernizing amphibious and maritime prepositioning ships:

- Buying fewer, more-capable ships within the historical spending level for construction of those vessels (an average of $1.1 billion per year in 2005 dollars);
- Buying more, less-capable ships within the historical spending level;
- Creating a sea-basing force that was more survivable (better able to withstand attack) than the force envisioned by the Navy, at a cost below that of the Navy's plan but above the historical level; or
- Deemphasizing sea basing in favor of forward presence, at a cost below that of the Navy's plan but above the historical level.

CBO found no alternative that could do more with less. Saving money on the amphibious warfare and maritime prepositioning forces, relative to the Navy's plan, requires buying fewer ships and thus having less capability. Unless the Navy can provide a level of resources equivalent to that required to implement its current plan, choices will have to be made about how to structure those forces in the future. Questions include, What should the balance be between expeditionary strike groups and maritime prepositioning squadrons? Does the Navy need 12 expeditionary strike groups and three maritime prepositioning squadrons? What role should sea basing play in the design of the future maritime prepositioning force? Would the MPF(F) ships be survivable enough to operate in a hostile coastal environment? The options that CBO examined offer different ways to answer those questions.

Option 1A: Buy Fewer, More-Capable Ships Within the Historical Spending Level

Since 1980, the Navy has devoted an average of about $1.1 billion annually to construction of amphibious ships (and the occasional maritime prepositioning ship that it has purchased rather than leased). On the assumption that the average funding level for those vessels will not increase over the next 30 years, this option would buy the new types of ships that the Navy envisions but in much smaller numbers than under the Navy's plan.

This approach would gradually reduce the number of expeditionary strike groups by half (from 12 to six) and the number of maritime prepositioning squadrons by one-third (from three to two). To compensate somewhat for those cuts, one of the maritime prepositioning squadrons would be given sea-basing capabilities. (The other squadron would consist of replacement cargo ships with the same capability as today's maritime prepositioning ships.) Under this option, the Navy would buy four of the new LHA(R) amphibious assault ships through 2035, instead of 10 as under the Navy's plan; five rather than 12 new LSD(X)s that would be larger than today's dock landing ships; and one squadron of eight sea-basing-capable MPF(F) ships instead of 16. This option would also purchase seven LPD-17 dock landing ships rather than 12 and a squadron of five conventional cargo ships. By 2035, the inventory of amphibious and maritime prepositioning ships would total 31 vessels, compared with 57 under the Navy's plan (see Summary Figure 4). Of that total, 26 would be L-class ships and sea-basing-capable maritime prepositioning ships, versus 52 under the Navy's plan.

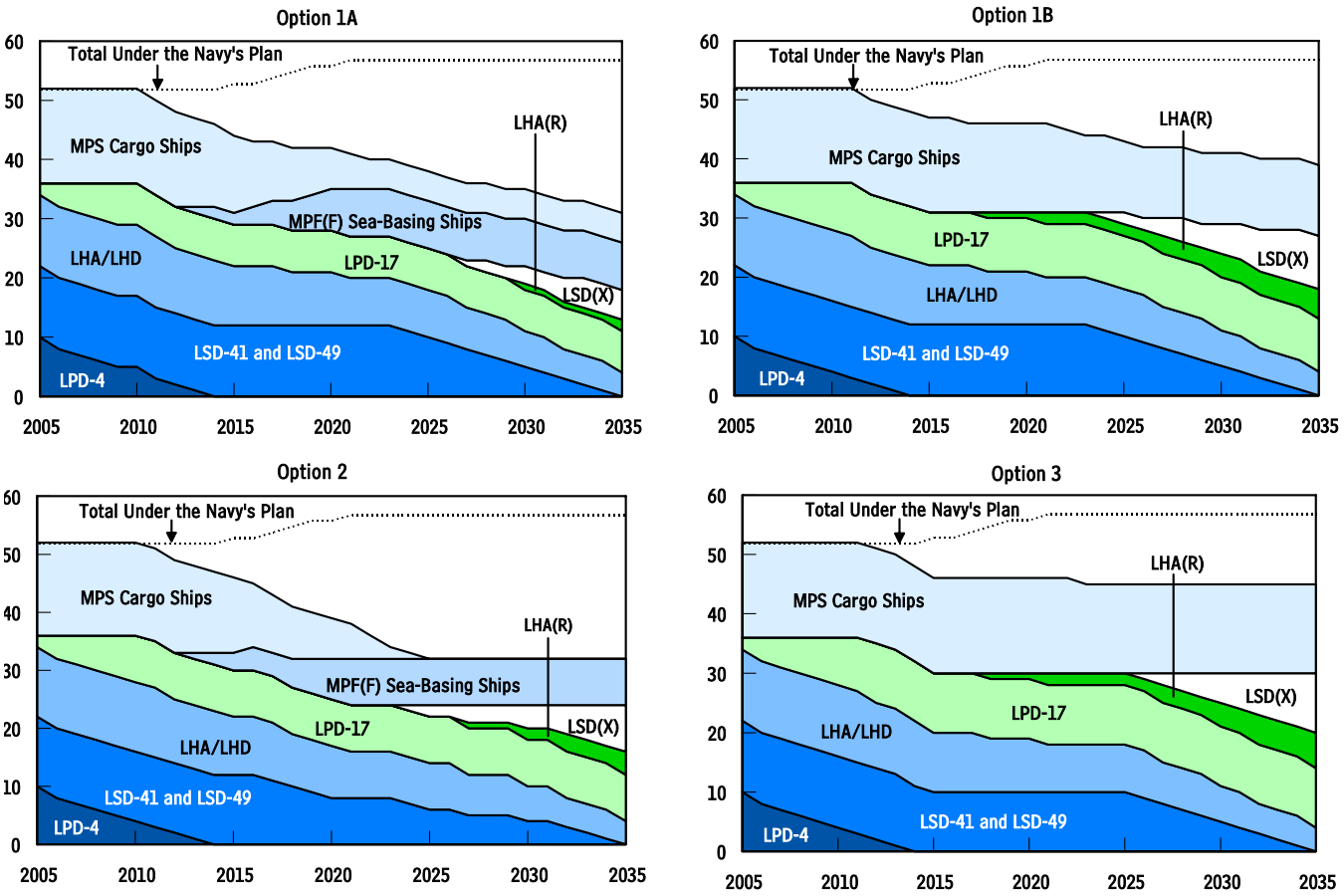
Option 1B: Buy More, Less-Capable Ships Within the Historical Spending Level

If the Navy was forced to fund amphibious and maritime prepositioning ships at the historical level of about $1.1 billion a year but was reluctant to cut the L-class force to the extent envisioned in Option 1A, it could retain a larger number of ships by not investing in new designs. This option illustrates that approach: it would keep the future amphibious warfare and maritime prepositioning forces at a greater size than under Option 1A but would not pursue the enhanced sea-basing capability sought by the Navy and Marine Corps. In other words, for the same amount of money, this approach would emphasize quantity over quality, and Option 1A would do the opposite.

In this alternative, the number of expeditionary strike groups would gradually be cut by one-quarter, from 12 to nine (leaving 50 percent more than in Option 1A). The number of maritime prepositioning ships would be reduced with just over half a squadron rather than by a whole squadron. Amphibious assault ships would be replaced with ships similar in size and capabilities to existing classes, and maritime prepositioning ships would be replaced with modern cargo ships that lacked sea-basing capabilities. Thus, the Navy would purchase six LHA(R)s over the 2005-2035 period, but those vessels would replicate today's amphibious assault ships rather than offer enhanced aviation capabilities, as the Navy plans. The LPD-17 program would end at nine ships instead of 12. Likewise, the Navy would buy nine LSD(X)s rather than

Summary Figure 4.

Inventory of Amphibious and Maritime Prepositioning Ships Under Alternative Force Structures



Source: Congressional Budget Office based in part on data from the Navy.

Note: MPS = maritime prepositioning squadron; MPF(F) = Maritime Prepositioning Force (Future).

12, and those ships would be similar in size and capabilities to existing dock landing ships. By 2035, the total inventory of amphibious and maritime prepositioning vessels would number 39 ships, and the amphibious warfare force would number 27 ships.

Option 2: Create a More Survivable Sea-Basing Force

To save money, senior Navy leaders have proposed cutting the number of expeditionary strike groups from 12 to eight—and thus reducing the number of amphibious warfare ships—and using the savings to buy two squadrons of sea-basing-capable MPF(F)s. This option follows that approach, with one significant difference: it would increase the survivability of the MPF(F) ships. As currently planned, those vessels would be much less survivable than amphibious warfare ships. They would have little or no ability to defend themselves from attack and would have difficulty continuing to operate if they were struck—even though they would be the largest (except for aircraft carriers), the most detectable, and thus the most targetable Navy ships in a theater of operations. To address that issue, this option would build MPF(F)s that were closer, though not equal, in survivability to L-class amphibious ships. Because a more survivable MPF(F) would be more expensive, this option would buy only eight, or one squadron's worth. In all, this approach would spend an average of $1.5 billion a year on ship construction between 2005 and 2035, compared with $2.4 billion under the Navy's plan.

Under this alternative, the LPD-17 program would stop at eight ships instead of 12. The LHA(R) program would be delayed from 2007 until 2022, and six of those ships would be purchased through 2035. The LSD(X) program would begin at the same time as in the Navy's plan (2020), but only eight ships would be bought rather than 12. This option would also purchase eight sea-basing MPF(F) ships with enhanced survivability, starting in 2009. The last of those MPF(F)s would be fully operational by 2021. Under this alternative, the amphibious warfare force would decline fairly rapidly through 2024, at which time it would level off at 24 ships (eight LPDs, eight LSDs, and eight LHA/LHDs). Together, the amphibious and maritime prepositioning forces would total 32 ships.

Option 3: Deemphasize Sea Basing in Favor of Forward Presence

Just as Option 2 represents a slightly more expensive way than Option 1A to procure sea-basing capability, this alternative is a slightly more expensive way than Option 1B to keep larger amphibious and maritime prepositioning forces. Both this approach and Option 1B would forgo sea-basing capability, but this alternative would allow for greater overseas presence than any of the other options that CBO examined. Under this approach, the number of expeditionary strike groups would be cut by one-sixth (from 12 to 10), and the number of maritime prepositioning squadrons would remain at three, although they would consist of new cargo vessels much like today's rather than sea-basing-capable ships. Once implemented, this option would provide peacetime forward presence and maritime prepositioning capabilities that were similar to but slightly less than those of the current force.

The Navy and Marine Corps have not conducted an opposed amphibious assault since the Korean War, but in the intervening years, the Navy's amphibious ships have responded frequently to crises around the world. Between 1991 and 2000, for example, amphibious and (on occasion) maritime prepositioning ships took part in at least 55 operations, ranging from disaster-relief efforts to military operations in Iraq, Bosnia, Haiti, and the former Yugoslavia. Cutting the crisis-response capability provided by those ships in order to procure the new sea-basing capabilities of the MPF(F) might not make sense, especially given the challenges involved in making the sea-basing concept work. The Navy would need to develop a host of new technologies for MPF(F) ships as well as acquire new fleets of aircraft and small ships to keep the sea base and the troops it is supporting well supplied, at a potential cost of many billions of dollars. As an alternative to investing in sea-basing capabilities, this option would keep the amphibious and maritime prepositioning forces as large as possible—consistent with saving money—to respond to crises.

This approach would end the LPD-17 program at 10 ships instead of 12. It would delay the start of the LHA(R) program from 2007 until 2013 and buy eight ships rather than 10 through 2035. The LSD(X) program would be delayed by two years (from 2020 until 2022), and only 10 ships would be purchased instead of 12. The MPF(F) program would consist of three full squadrons' worth of ships, but they would not have sea-basing capabilities. With those changes, building amphibious and maritime prepositioning ships would cost the Navy an average of $1.5 billion a year between 2005 and 2035. The amphibious warfare force would remain at around 35 ships through 2012 and then quickly level off at 30 ships—10 LPDs, 10 LSDs, and 10 LHA/LHDs, compared with 12 each under the Navy's plan. By 2035, the total inventory of amphibious and maritime prepositioning ships would number 45.

Measures of Capability Under the Options

To evaluate the different alternatives in this study and compare them with the Navy's plan, CBO looked not only at total numbers of ships but also at various measures of peacetime and wartime capability. Those measures include the traditional components of amphibious lift on L-class ships (such as the total space available for carrying troops, landing craft, helicopters, vehicles, and cargo); the total amount of lift by all L-class and maritime prepositioning ships; the number of Joint Strike Fighters carried by amphibious assault ships; the number of expeditionary strike groups that are forward deployed (a measure of peacetime forward presence); and the time needed to deploy Marine infantry battalions in a wartime environment.

Of the approaches analyzed in this study, the Navy's plan would provide the most capability by all of those measures—but at the greatest cost (see Summary Table 2). The less expensive alternatives that CBO examined offer less capability than that plan and, in many cases, less

Summary Table 2.

The Amphibious and Maritime Prepositioning Forces in 2035 Under Alternative Force Structures

Force Structure	Average Annual Procurement Cost (Billions of dollars)	Lift Capacity (Number of MEBs)		Number of Ships		Number of Forward-Deployed ESGs		Number of Marine Infantry Battalions Ashore After		
		All Ships	Amphibious Ships Only[a]	All Ships	Amphibious Ships Only	Using Current Crewing	Using Crew Rotation	Four Weeks	Six Weeks	Ten Weeks
Navy's Plan	2.4	5.5	2.3	57	36	2.7	3.6	8	12	15
Option 1A	1.1	3.3	1.3	31	18	1.8	2.4	4	6	9
Option 1B	1.1	4.3	1.8	39	27	2.2	3.0	2	5	12
Option 2	1.5	2.7	1.7	32	24	2.1	2.8	5	7	7
Option 3	1.5	5.0	2.0	45	30	2.4	3.2	2	5	14
Memorandum:										
Current Force	n.a.	4.9	1.9	51	35	2.7	3.6[b]	2	6	15

Source: Congressional Budget Office.

Note: MEB = Marine expeditionary brigade; ESG = expeditionary strike group; n.a. = not applicable.

a. Space for troops and vehicles is in relatively short supply on amphibious ships. The Navy has excess capacity in other categories of amphibious lift, such as space for cargo, landing craft, and helicopters.

b. The Navy does not employ crew rotation on expeditionary strike groups, although it is planning to experiment with it. This number is shown only for comparability.

capability than today's amphibious and maritime prepositioning forces. However, Options 1A and 2 would provide some of the new sea-basing capability that the Navy and Marine Corps desire, and Option 3 would provide slightly more lift capacity than today's force does.

CBO's analysis suggests that defense officials and lawmakers may have to balance competing priorities. If the operational flexibility of sea basing is considered crucial, the Navy could procure it without an increase from the historical funding level by sharply curtailing the number of amphibious warfare ships (Option 1A). With a 36 percent increase in average funding—less than one-third of the rise needed to carry out current plans—the Navy could achieve some of that capability and also make the ships that possess it less vulnerable to attack (Option 2). Alternatively, if the size of the force and the amount of forward presence it can provide take precedence over sea-basing capability, the Navy could have an amphibious warfare force of about 27 ships by 2035 (compared with 35 today) without a rise in funding (Option 1B). With the same funding increase as in Option 2, it could retain a force of at least 30 L-class ships over the next three decades.

CHAPTER

1

Introduction

The U.S. Navy and Marine Corps have conducted what they call naval expeditionary operations—operations mounted overseas, often in austere environments, from a combination of sea and forward land bases—since the Revolutionary War. One type of expeditionary operation is the amphibious assault, an attack mounted from the sea against a hostile shore, such as the famous D-Day invasion of 1944. Amphibious assaults were perfected during the island-hopping campaign in the Pacific in World War II and continued during the Korean War, when marines stormed ashore at Inchon. However, that war marked the last time that the Navy and Marine Corps conducted an amphibious assault.

More recently, naval expeditionary operations have emphasized using the sea as a high-speed avenue of maneuver to get marines quickly to a potential hotspot—while avoiding defended beaches or coastal approaches—in order to rapidly build up combat power on shore. To accomplish that task, the Navy has maintained a substantial number of ships designed to deliver marines ashore and to support them from the sea.

Today's expeditionary warfare force includes 35 ships of various types known collectively as L-class amphibious warfare ships. Those vessels are special-purpose warships designed to carry Marine Corps units to and across a coastal penetration point, even if it is defended—thus providing the Navy and Marines with a "forcible-entry" capability. Since 1986, amphibious warfare ships have been augmented by a special-purpose maritime prepositioning force. The cargo ships that make up that force are essentially floating warehouses designed to deliver reinforcements and supplies to assault troops quickly once a port and airfield have been seized and secured. The current maritime prepositioning force consists of 16 vessels, bringing the size of the expeditionary warfare force to 51 ships.

Over the next 30 years, the Navy plans to modernize its amphibious warfare fleet with a mix of current and new ship designs. It also intends to completely replace its maritime prepositioning force with a still-undetermined number of new maritime prepositioning ships that have advanced capabilities—a class that the Navy refers to as the Maritime Prepositioning Force (Future), or MPF(F). Carrying out those plans would require more than twice as much annual funding as the Navy has devoted to expeditionary warfare ships since 1980, on average, the Congressional Budget Office (CBO) projects. Moreover, that funding increase would be needed at a time when the Navy wants to expand its overall fleet of battle force ships from 293 to 375 (see Figure 1-1).[1]

This CBO study—the third focusing on the Navy's long-term shipbuilding plans and the resources they could require—examines the composition, missions, and modernization programs of the Navy's amphibious and maritime prepositioning forces.[2] It also analyzes four ways to reduce procurement costs for those forces to relieve pressure on the Navy's future shipbuilding budget.

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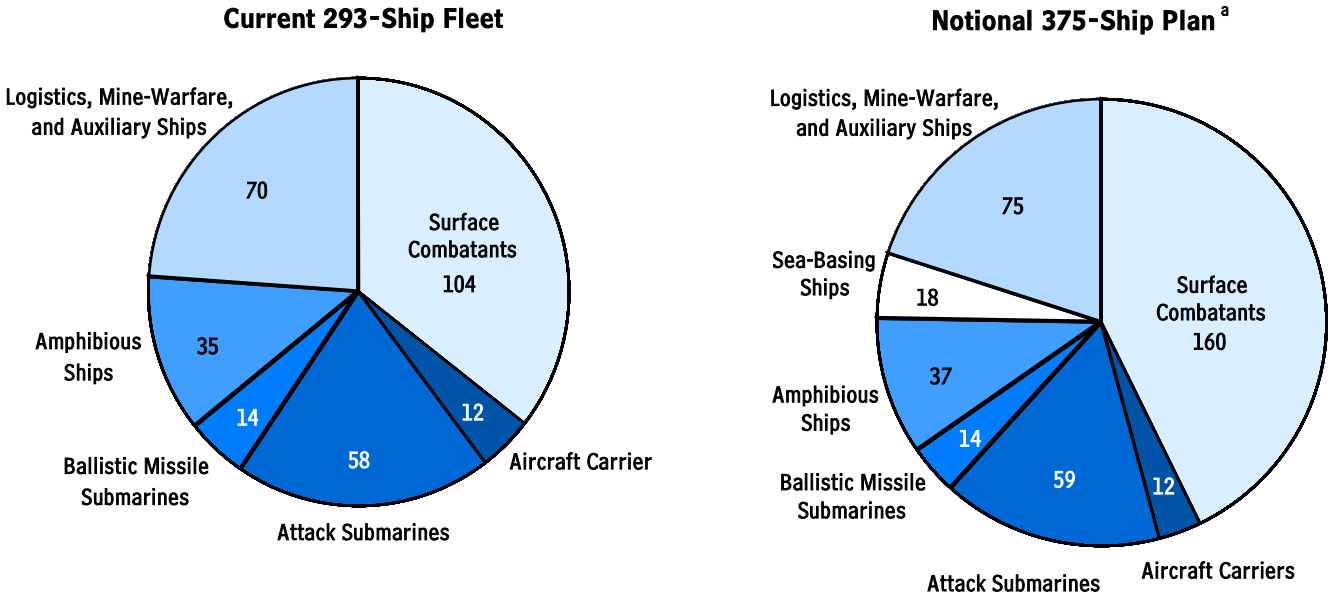
1. See Department of the Navy, *A Report to Congress on Annual Long-Range Plan for the Construction of Naval Vessels* (May 2003). That report, which was mandated by the 2003 defense authorization act, advocated building a 375-ship Navy. The authorization act ordered the Secretary of Defense to prepare and submit a long-term shipbuilding report to the Congress, and that report was presumably sent with the concurrence of the Office of the Secretary of Defense. However, in Congressional hearings in the spring of 2003, Secretary of Defense Donald Rumsfeld pointedly refused to endorse the requirement for 375 ships.

2. The previous studies are Congressional Budget Office, *Transforming the Navy's Surface Combatant Force* (March 2003), and *Increasing the Mission Capability of the Attack Submarine Force* (March 2002).

Figure 1-1.

Composition of the Current and 375-Ship Battle Force Fleets



Source: Congressional Budget Office based on data from the Navy.

Notes: Current maritime prepositioning ships are not included in the 293-ship fleet because the Navy does not consider them battle force ships. In the 375-ship plan, new, more-capable maritime prepositioning ships are included and are called sea-basing ships.

Attack submarines include four Ohio class ballistic missile submarines that are being converted to carry conventional guided missiles.

a. The Navy's plan for a 375-ship fleet, submitted in May 2003, included 37 amphibious ships and 18 sea-basing ships. CBO's analysis, consistent with more-recent information, assumes that the 375-ship fleet would include 36 amphibious ships and 16 sea-basing ships.

Today's Amphibious and Maritime Prepositioning Forces

The ultimate purpose of the Navy's expeditionary warfare force is to transport, insert, 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 MAGTF are common: Marine expeditionary units, which are normally the size of a battalion, or around 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 Marine Corps's entire force is organized into three MEFs.

The Navy uses two types of ship to deploy those Marine units: amphibious warfare ships and maritime prepositioning vessels. Amphibious warfare ships provide the Navy's capability for opposed amphibious assaults (forcible-entry operations). Should an assault be required in the future, the first wave of attackers would come from amphibious warfare ships. Equipment for reinforcements would arrive on maritime prepositioning ships.

The Amphibious Warfare Force

The Navy currently has 35 amphibious warfare ships in its fleet: 12 LHA or LHD large amphibious assault vessels (sometimes called helicopter carriers), 11 LPD amphibious transport docks, and 12 LSD dock landing ships (see Figure 1-2). Those ships vary in size and 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. Some of those ships also carry fixed-wing 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 40,000 tons (see Table 1-1), com-

pared with 4,000 to about 10,000 tons for current surface combat ships.[3]

In the Navy's practice, classes of vessels are known by the name and the letter-and-number designation of the first ship in a class. Today, five classes of amphibious warfare ships are in active service and one is under construction (for more details, see Summary Box 1 on page xi):

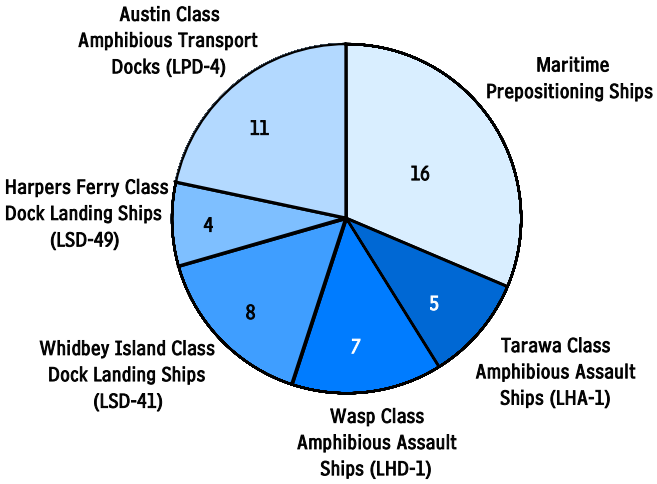
- *Tarawa class (LHA-1) amphibious assault ships* were introduced in the late 1970s, combining the capabilities of several older types of amphibious ships into one. They are among the largest amphibious vessels, with a displacement of about 40,000 tons, and can carry 1,700 troops and large amounts of cargo and vehicles. They also have a docking well—a large opening and ramp to the sea in the back of the ship—to launch landing craft and amphibious vehicles. Each LHA carries an air wing comprising 30 CH-46 Sea Knight and CH-53 Sea Stallion helicopters, as well as six AV-8B Harrier short takeoff and vertical landing jets. In its "sea control" configuration, an LHA can carry up to 20 Harrier aircraft and six helicopters (a more capable force than British aircraft carriers deployed during expeditionary operations in the Falklands War). Tarawa class LHAs are now about 26 years old, on average. Although they have been modernized with new combat systems and other equipment during their service lives, they have gotten heavier. That increased weight threatens to destabilize the ships' center of gravity, making further improvements virtually impossible.

- *Wasp class (LHD-1) amphibious assault ships* are based on a modified design of the Tarawa class LHAs. They carry a similar number of troops but more cargo and fewer vehicles. However, they have more space to support aircraft operations as well as a redesigned docking well that can accommodate more landing craft than the LHAs can. They also have better defensive capabilities than LHAs. The average age of Wasp class LHDs is 9; given their intended service life, those ships will be a core component of the amphibious warfare fleet for the next quarter century. Seven LHDs are operating with the fleet and an eighth is under construction.

3. See Congressional Budget Office, *Transforming the Navy's Surface Combatant Force*, Table 1.

Figure 1-2.

Composition of the Amphibious and Maritime Prepositioning Forces



Source: Congressional Budget Office based on data from the Navy.

That ship (LHD-8) is intended to replace the *Belleau Wood* LHA, which is scheduled for retirement in 2007. Unlike the other ships in its class, the LHD-8 will have gas turbines and a hybrid electric propulsion system instead of being driven by steam.

- *Austin class (LPD-4) amphibious transport docks* are the oldest ships in the amphibious warfare force, with an average age of about 36. They are less than half the size of the Tarawa class LHAs and Wasp class LHDs, displacing about 17,000 tons. Austin class LPDs can carry about 800 troops, a substantial amount of cargo, and a moderate number of vehicles. They also have a docking well to launch landing craft and amphibious vehicles. The principal difference between these amphibious transport docks and the similar dock landing ships (described below) is that the transport docks have a permanent flight deck to support helicopter operations. However, any deployment of helicopters on an Austin class LPD would require the support of an LHA or LHD to provide maintenance and other support for the helicopters on a continuous basis.

- *San Antonio class (LPD-17) amphibious transport docks*, which are under construction, are due to replace Austin class LPDs over the next 10 years. They will be larger than their predecessors and have more space for vehicles and aircraft. (San Antonio class LPDs are discussed in more detail in Chapter 2, along with several

Table 1-1.

Characteristics of Current Amphibious Warfare Ships

Class	Type of Ship	Quantity	Displacement[a] (Tons)	Crew Size	Fingerprints of Lift[b]				
					Troops	Vehicle Square	Cargo Cube	Helicopter Spots	LCAC Spots
Current Ships									
LHA-1 Tarawa	Amphibious assault ship	5	40,000	1,160	1,713	25.4	105.9	42	1
LHD-1 Wasp	Amphibious assault ship	7[c]	40,500	1,150	1,686	20.9	125.0	45	3
LPD-4 Austin	Amphibious transport dock	11	17,000	400	788	11.8	38.3	4	1
LSD-41 Whidbey Island	Dock landing ship	8	16,000	310	454	13.5	5.1	0	4
LSD-49 Harpers Ferry	Dock landing ship	4	17,000	330	454	16.9	50.7	0	2
Ships Under Construction									
LPD-17 San Antonio	Amphibious transport dock	12	25,000	420	720	25.0	36.0	6	2

Source: Congressional Budget Office.

a. Displacement at full load (including all of the things the ship normally carries).

b. The five categories (or fingerprints) of amphibious lift are the number of troops a ship can carry; its vehicle storage area, measured in thousands of square feet (or vehicle square); its cargo storage area, measured in thousands of cubic feet (or cargo cube); the number of spots for parking vertical takeoff and landing aircraft (expressed as CH-46 helicopter equivalents); and the number of spots for air-cushion landing craft (known as LCACs).

c. An eighth Wasp class ship is under construction and will be commissioned in 2007.

new types of amphibious warfare ships that the Navy has proposed.)

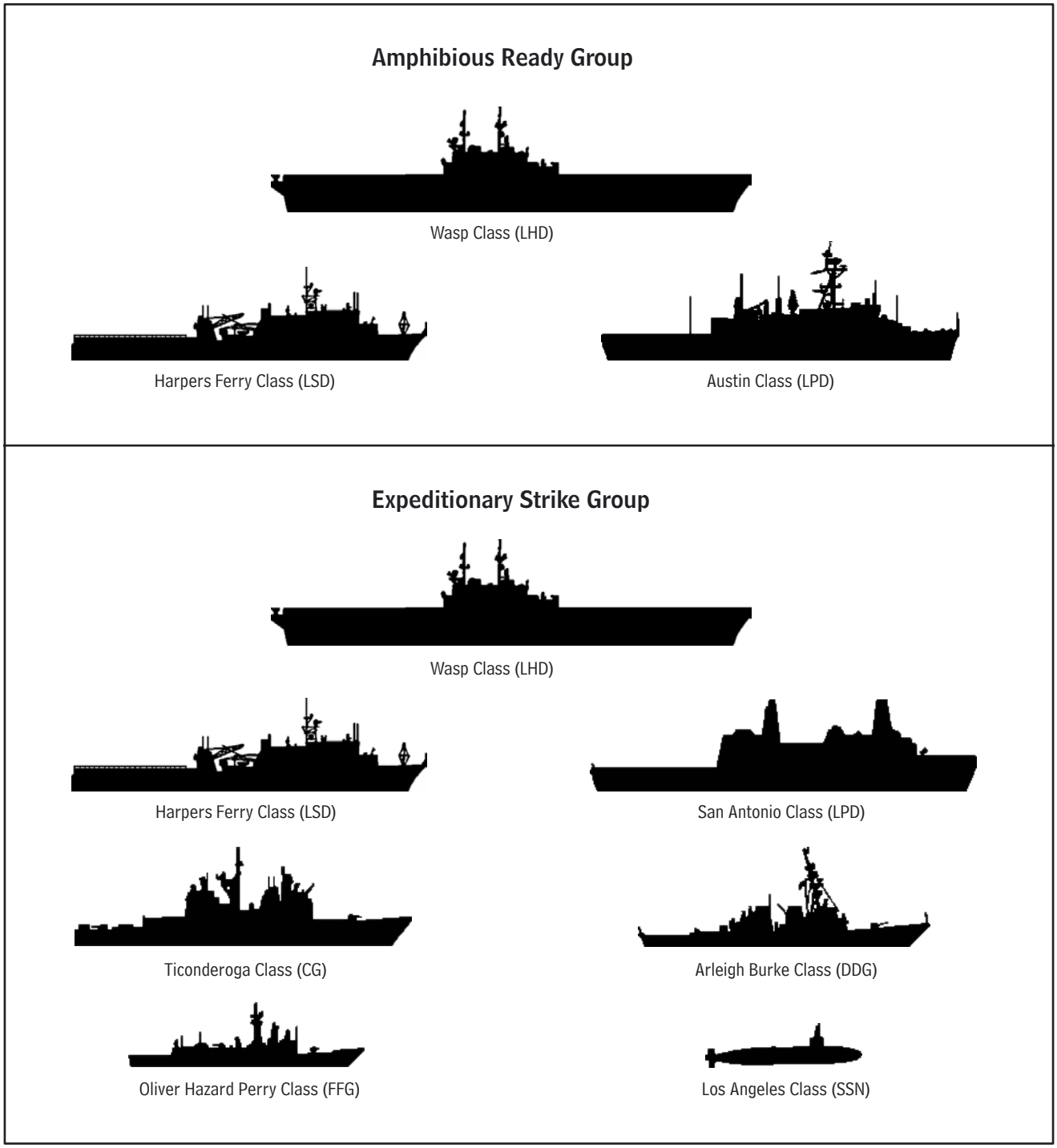
- *Whidbey Island class (LSD-41) and Harpers Ferry class (LSD-49) dock landing ships* are two variants of the same design. Both types of ship can carry about 450 troops apiece. They also have slightly larger vehicle storage areas than the Austin class transport docks do. Harpers Ferry LSDs are considered the cargo variant of dock landing ships: they have 10 times the cargo storage space of the Whidbey Island class but only half the carrying capacity for landing craft in their docking wells. LSDs are relatively young ships. The Harpers Ferry class is about 8 years old, on average, and the Whidbey Island class is about 15 years old.

In the past, amphibious warfare ships were organized into 12 amphibious ready groups—usually of three ships each—that operated independently of other ships in the Navy. Each ready group carried one Marine expeditionary unit. Under a plan announced in 2003, the Navy has begun reorganizing its fleet so that three surface combatants (a cruiser, a destroyer, and a frigate) and one attack submarine operate with each amphibious ready group. The resulting task force is called an expeditionary strike group, or ESG (see Figure 1-3).

The Navy says that a combined force of amphibious warfare ships and surface combatants is far more capable of responding to a variety of low- to mid-level crises than is

Figure 1-3.

Comparison of an Amphibious Ready Group and an Expeditionary Strike Group



Source: Congressional Budget Office based on information from the Navy.

either group of ships alone.[4] Surface combatants offer the ability to strike targets from long range with Tomahawk missiles and the ability to provide air defense for a fleet. Amphibious warfare ships provide the means to go ashore and conduct operations on the ground.

Together, the Navy's amphibious warfare ships can carry about 35,000 troops. However, because at any time some of those ships are in long-term maintenance or the early stages of training cycles, not all of them are available to deploy and conduct military operations. Within a few days, the Navy could respond to a crisis with three to six amphibious warfare ships—the two closest forward-deployed ESGs. In the first six to 10 weeks of a crisis, about half of the Navy's amphibious warfare ships could be mustered for combat operations—about six ESGs, or six battalions, for a total of about 13,000 troops.

The Maritime Prepositioning Force

In addition to its amphibious warfare ships, the Navy has 16 maritime prepositioning vessels, 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, most of which are leased cargo vessels, 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.[5]

Unlike amphibious warfare ships, maritime prepositioning ships do not carry troops and do not have a forcible-entry capability. They require a secure port at which to unload equipment and an airfield where the troops of a MEB can fly in from the United States, meet up with the equipment, and assemble into a fighting force. Thus, maritime prepositioning ships are intended to provide follow-on forces that deploy to a theater after the assault troops on amphibious warfare ships have secured an area.

That capability is designed to allow three large Marine Corps units to be available for combat operations in a relatively short time.[6] The Marine Corps expects that if a port and airfield have to be seized beforehand, the first MEB getting its equipment from a maritime prepositioning squadron will not be ready to operate for eight weeks. But if the port and airfield are already available, such a unit can be ready in two weeks. That was the case early in the first Gulf War: because ports, airfields, and an assembly area all existed in Saudi Arabia before the outbreak of hostilities, the MEB associated with the maritime prepositioning squadron in Diego Garcia was ready to begin military operations within two weeks after the ships of the squadron were ordered to leave their berths.

Conducting an Amphibious Assault Today

Although they have not done so for half a century, the Navy and Marine Corps retain the capability to mount an opposed amphibious assault. Such an operation would be complex, involving aircraft carriers, surface combatants, mine-clearing ships, and support ships as well as amphibious ships. According to the Marine Corps, the minimum force to launch a forcible-entry operation is a Marine expeditionary brigade. To muster a force of that size, the Navy and Marine Corps would bring at least two forward-deployed expeditionary strike groups to the theater of operations, followed by additional ships and marines from ports in the United States. Once assembled, the combined group of ships would be called an amphibious task force, and the troops on board those ships would be considered the "assault echelon."

Before troops were sent ashore, enemy forces in the target area—particularly ships or missiles that could threaten the assault force—would be attacked as much as necessary by the Navy's carrier-based aircraft and by guns and missiles on the surface combatants and submarines.[7] In addition, ships capable of conducting mine-clearing operations would need to cut a path through any minefield that might prevent the marines from landing on shore.

When the marines were ready to conduct their assault, they and their equipment would be transported to the

4. Gidget Fuentes, "Expeditionary Strike Groups: Combining Power, Speed, and Lethality," *Armed Forces Journal* (October 2003), p. 20.

5. Ronald O'Rourke, *Navy-Marine Corps Amphibious and Maritime Prepositioning Ship Programs: Background and Oversight Issues for Congress*, CRS Report for Congress RL32513 (Congressional Research Service, August 5, 2004).

6. However, two maritime prepositioning squadrons were used early in Operation Iraqi Freedom and could require another year or two before they are fully reconstituted and available for further operations.

7. Undoubtedly, the other services would contribute to such an operation as well. The Air Force in particular would provide additional ground-attack capability with its long-range bombers and shorter-range fighter-bombers if those aircraft had a base within the theater from which to operate.

beach with helicopters, air-cushion landing craft (known as LCACs), or amphibious assault vehicles (light tanks able to "swim" ashore). Helicopters would operate from the large flat-deck amphibious assault ships (the LHDs and the LHAs) as well as from the amphibious transport docks (LPDs). Amphibious assault vehicles and LCACs would operate from all types of L-class ships. Although the amphibious assault vehicles would go ashore and stay there, the LCACs would make repeated trips back and forth from the ships to the beach, ferrying whatever needed to be brought in for the operation. In addition, the short takeoff and vertical landing aircraft carried on LHAs and LHDs would provide close air support to the marines on the ground. Carrier-based aircraft could also perform that role unless they were occupied with other tasks.

Current procedures call for the assault echelon of marines carried in L-class amphibious ships to either land on enemy territory and seize a lodgment (a piece of territory taken to set up a base of operations) or land on allied territory and immediately carry the fight to the enemy. In either case, the reinforcements in the "assault follow-on echelon" would require a deepwater port and a nearby airfield to be landed. Maritime prepositioning ships, carrying equipment and supplies for the reinforcing units, would dock at the port and offload their "unit sets" of cargo. The marines associated with those sets would fly into the nearby airfield, move to the port, prepare the equipment coming off the ships, assemble into units, and only then launch offensive operations. That process is referred to as reception, staging, onward movement, and integration.

Once in combat, the reinforcing Marine units would receive supplies from shore-based supply depots at the lodgment that had been built up from the stores located in the ships' holds. Such depots are known colloquially as "iron mountains," referring to the large amount of military equipment, fuel, food, water, ammunition, and supporting services necessary to conduct a military campaign.

Peacetime Missions of Amphibious and Maritime Prepositioning Ships

Because the Navy's amphibious ships are highly versatile, they have been used to respond to a variety of crises, particularly humanitarian operations. Between the end of the first Gulf War in 1991 and 2000, amphibious ships conducted at least 55 operations, such as providing disaster relief, evacuating U.S. citizens or government personnel from unstable countries, and taking part in military operations in Iraq, Bosnia, Haiti, and the former Yugoslavia. Although amphibious ships usually deploy in groups, it is common for the ships of a group to separate once they reach their forward-deployment area and then conduct simultaneous operations or exercises. That practice—as well as the large size of amphibious ships and the supplies and equipment they carry—makes such vessels well suited to respond to low-level crises.

The Navy's maritime prepositioning ships also respond to crises, though much less frequently. Such ships spend most of their time moored at their ports overseas, but they provided support to U.S. troops in Somalia during the early 1990s and have furnished bottled water for several disaster-relief operations around the world. The future size and composition of the maritime prepositioning squadrons are the subject of much debate within the Navy and the Marine Corps. Both services want to expand the capabilities of those squadrons dramatically as part of their vision for sea basing (described later in this chapter). Such enhanced capabilities could make maritime prepositioning ships even more capable of responding to low-level crises, possibly freeing up amphibious warfare ships for other operations.

Requirements for Amphibious and Maritime Prepositioning Forces

Although the number of maritime prepositioning squadrons in the Navy has remained constant since they were introduced in the 1980s, the number of amphibious warfare ships has declined steadily since the end of the Cold War. In the past, the Navy determined the number of L-class ships it required by the amount of amphibious lift (transport capacity on amphibious ships) it considered necessary for wartime. More recently, however, the Navy has also begun to stress the forward presence provided by expeditionary strike groups as the essential measure of capability. That stress appears to reflect, at least in part, the Navy's vision of using its future maritime prepositioning ships to provide more forcible-entry capability in conjunction with L-class ships, thus rendering the amount of forcible-entry capability on L-class ships alone less significant.

Amphibious Lift

The most common measure of the capability of the amphibious force is the amount of lift it provides, expressed

Box 1-1.

The Requirement for Amphibious Lift

Although the Department of the Navy's official requirement for amphibious lift has remained steady since the 1990s, at three Marine expeditionary brigades (MEBs), it changed frequently before then. The war plans of regional combatant commanders call for having the capability to mount amphibious assaults. In the view of Marine Corps leaders, such an assault should be conducted by a force the size of a Marine expeditionary force, or MEF (40,000 to 50,000 troops). Because more than one combatant commander has such a requirement, that capability should exist in both the Atlantic and Pacific Fleets. However, between 1945 and 1990, budgetary pressures forced a continuing reduction in the number of amphibious ships in the Navy; consequently, the requirement for amphibious lift declined as well.

The three-MEB requirement was established in 1990 in the last major study of amphibious-lift needs.[1] Three MEBs of amphibious lift along with three MEBs of prepositioning sealift would in theory create something close to a two-MEF capability.[2] (The marines on amphibious warfare ships would provide the assault echelons in an amphibious assault, and the marines flying in to meet up with equipment from prepositioning ships would provide the follow-on forces.) In the early 1990s, however, the Secretary of the Navy reduced the requirement to 2.5 MEBs, apparently for budgetary reasons, which is why that figure is often referred to as the "fiscally constrained" requirement.

1. That study was Department of the Navy, *Integrated Amphibious Operations and USMC Air Support Requirements* (January 1990), commonly known as DoN Lift 2.

2. Three MEBs together are a bit larger than one MEF in terms of the "fingerprints" of amphibious lift (space for troops, vehicles, cargo, helicopters, and landing craft). Conversely, a MEF contains elements that three MEBs do not, such as headquarters and command-and-control staff. For more details, as well as a brief history of the amphibious-lift requirement, see 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).

in Marine expeditionary brigade equivalents. That measure focuses on how much force can be delivered on the ground in the event of a crisis or conflict. It does not reflect the day-to-day availability of the amphibious force in peacetime or its distribution around the globe.

Maritime prepositioning ships are not considered amphibious lift ships—even though together they carry enough equipment and supplies for three full MEBs—because they do not carry the troops associated with that equipment (except for a small security and maintenance staff) and cannot conduct amphibious assaults. Instead, they are considered sealift ships and are not included in the total expeditionary warfare capabilities of the Navy's battle force, which are measured only in terms of amphibious lift.

The Marine Corps argues today, and has throughout the 1990s, that its requirement for lift by amphibious warfare vessels is 3.0 MEBs. However, resources have not been made available to build enough amphibious warfare ships to reach that level. The Navy and Marine Corps officially say that their "fiscally constrained" goal for amphibious lift is 2.5 MEBs. (For more details, see Box 1-1.)

Amphibious lift capacity is determined by more than just the number of troops that ships can carry. Because those troops operate with trucks, armored vehicles, artillery, helicopters, fixed-wing aircraft, landing craft, and supplies, amphibious lift is measured in five categories, or "fingerprints":

- Number of troops;
- Vehicle storage area (expressed in thousands of square feet, or "vehicle square");
- Cargo storage area (measured in thousands of cubic feet, or "cargo cube");
- Number of places (or spots) on the decks and in the hangars of amphibious ships to park vertical takeoff and landing aircraft, expressed as CH-46 helicopter equivalents;[8] and
- Number of spots inside the ships for LCACs.

Today, the amphibious warfare force has enough cargo cube, helicopter spots, and LCAC spots to meet the Marine Corps's 3.0 MEB requirement. However, it is substantially short with respect to vehicle square. The force can carry enough troops for 2.5 MEBs but only enough vehicles for 1.9 MEBs. Thus, the effective capability of the force is 1.9 MEBs of amphibious lift. That figure is down slightly from the capability in recent years because of the decommissioning of some older amphibious ships and delays in commissioning their replacements. (As noted above, maritime prepositioning ships provide another 3.0 MEBs of sealift, for a total lift capacity of 4.9 MEBs.)

Expeditionary Strike Groups

The other principal measure used to evaluate how many amphibious warfare ships are needed is the number of what used to be called amphibious ready groups but are now called expeditionary strike groups (see Figure 1-3 on page 5). Both the 1997 and 2001 Quadrennial Defense Reviews discussed amphibious ships with respect to the number of ready groups—rather than the overall amount of lift—that they provided. In both reviews, the numerical requirement for amphibious ready groups remained at 12. In 2000, the Navy released a 30-year shipbuilding report that advocated increasing the number of amphibious ships to create 15 ready groups.[9] By contrast, the most recent long-term Navy report, which proposed a 375-ship fleet, did not envision increasing the number of amphibious ships from the current level.[10] However, legislation introduced in the Congress in 2003 would have included 15 amphibious ready groups in the 375-ship fleet.[11]

With its existing force, the Navy can keep about 2.7 ESGs forward deployed at any given time. The group that is based in Japan, which includes four amphibious ships, is considered to provide full-time forward presence by virtue of its being based overseas. The remaining amphibious ships are divided between the Navy's Atlantic and Pacific Fleets into a total of 11 ESGs. Because of the time needed for ship maintenance, crew training, and transit to deployment areas, those remaining amphibious ships are sufficient to keep one ESG forward deployed full time and another deployed for six to eight months of the year.

Recently, senior Navy officials have discussed reducing the number of ESGs to eight and making up the shortfall in forward presence by employing a form of crew rotation known as Sea Swap. The Navy has experimented with Sea Swap on several types of surface combatants: instead of having one crew deploy and return home with the same ship, the ship remains forward deployed while crews rotate in and out every six months. In between their deployments, the crews train on ships that remain in the United States.[12]

Sea Swap may be more difficult to apply to amphibious ships than to surface combatants, however, because of the logistical challenges of coordinating predeployment training between the Navy crews and the marines who serve

8. The number of aircraft that a ship can carry (helicopter spots) differs from the number of aircraft that can operate from that ship (operating spots).

9. Department of the Navy, *Report on Naval Vessel Force Structure Requirements* (June 2000).

10. Department of the Navy, *A Report to Congress on Annual Long-Range Plan for the Construction of Naval Vessels*.

11. The National Naval Force Structure Policy Act (H.R. 375 and S. 902) asserted that it is "the policy of the United States to rebuild as soon as possible the size of the fleet of the United States Navy to no fewer than 375 vessels in active service, to include 15 carrier battle groups and 15 amphibious ready groups." That legislation was introduced in the House on January 27, 2003, and in the Senate on April 11, 2003, and was referred to the House and Senate Armed Services Committees, which had not passed it when this study was written.

12. For more information, see Congressional Budget Office, *Transforming the Navy's Surface Combatant Force*; and Ronald O'Rourke, *Navy Ship Deployments: New Approaches—Background Issues for Congress*, Report for Congress RL21338 (Congressional Research Service, August 3, 2004).

on board an amphibious ship.[13] Nevertheless, the Chief of Naval Operations, Admiral Vern Clark, has ordered Navy analysts to study the issue, and some experimentation is likely to follow.[14]

If the Navy adapted Sea Swap to its amphibious ships and then reduced the number of expeditionary strike groups, it would be setting aside the importance of overall amphibious lift on L-class vessels—the traditional measure of amphibious capability. (Because amphibious lift is a wartime measure, it is determined by the overall number of L-class vessels in the fleet, not by whether the Navy employs a rotational crewing policy.) No decision has yet been made, so in this analysis, CBO did not assume that the Navy's ESGs would use crew rotation to increase forward presence. However, one of the measures discussed in Chapter 4 shows what effect Sea Swap would have on the forward presence provided by ESGs if the concept was applied to amphibious ships.

The Navy's and Marine Corps's Vision for Sea Basing

The impetus behind the Navy's desire to increase its battle force to 375 ships and to expand the capabilities of its expeditionary warfare fleet is its "transformation vision," called Sea Power 21.[15] That vision rests on three key concepts: Sea Strike, Sea Shield, and Sea Basing. Sea Strike represents the Navy's efforts to support joint campaigns by projecting offensive power from and through the world's littoral (coastal) areas. That power could take the form of strikes from carrier-based aircraft, from naval guns, or from missiles launched from surface combatants and submarines; information or electronic attack warfare (such as disrupting an enemy's communications); or landings or assaults by Marine Corps ground units.

Sea Shield is the defensive counterpart to Sea Strike. It encompasses the capabilities that defend or screen Navy ships at sea from attack, protect joint and allied forces operating on shore from air or missile attack, and protect the United States from both conventional and unconventional threats. As now conceived, Sea Shield would eventually include theater and perhaps national missile defense systems.

Sea Basing is considered by many defense officials to be the most transformational of the three concepts: it envisions that future landings of Marine units ashore will be conducted, supported, *and* sustained from ships at sea. Today, such an operation would be supported primarily from supply depots on land, located either at an existing base provided by a host nation or in a lodgment seized during the assault. Future sea-based operations would forgo putting "iron mountains" of supplies, fuel, and ammunition ashore and instead keep them at sea, rearming and replenishing Marine forces operating on shore only when needed. Although the entire fleet would play a role in the "sea base," the most important platforms would be the Navy's amphibious warfare ships and future maritime prepositioning vessels.[16]

Navy and Marine Corps planners hope that under this concept, Marine units in the follow-on echelon could conduct the major portion of the reception, staging, onward movement, and integration process on board ships at sea and thus become operational more quickly. Marine units would fly directly to the sea base, assemble into combat units, prepare their equipment for combat while on board the ships, and launch attacks directly at inland targets from the sea base, which would operate over the horizon, out of sight of land. No port and airfield would need to be taken to support the introduction of either the assault or follow-on assault echelons, at least during the

13. Christopher Munsey, "Sea Swapping Marines is 'Daunting,'" *Navy Times*, September 20, 2004.

14. Malina Brown, "Expeditionary Strike Groups to Join Naval Sea Swap Experiment," *Inside the Navy,* March 22, 2004; David Brown, "ESGs Could Expand Sea Swap Concept," *Navy Times*, March 29, 2004; Ron Laurenzo, "Sea Swap Could Become the Norm," *Defense Today*, April 1, 2004; Lorenzo Cortes, "Navy Surface Chief Would Eventually Like to Swap an Entire ESG," *Defense Daily,* April 1, 2004; Malina Brown, "LaFleur: Navy Working on Applying Sea Swap to an Entire ESG," *Inside the Navy,* April 5, 2004; Andrew Koch, "U.S. Considers Overhaul of Amphibious Forces," *Jane's Defence Weekly*, May 5, 2004; and Jason Ma, "LaFleur: Sea Swap Could Keep Amphibious Ship at Sea for 12 Months," *Inside the Navy*, July 19, 2004.

15. Admiral Vern Clark, "Sea Power 21: Projecting Decisive Joint Capabilities," *Proceedings*, U.S. Naval Institute (October 2002), pp. 32-41, available at www.chinfo.navy.mil/navpalib/cno/proceedings.html.

16. Officially, the Department of Defense regards sea basing as a joint capability. The Army has an interest in developing a sea-basing capability, and Air Force bombers and other assets would have to be involved to make a forcible-entry operation work. This discussion, however, focuses on the Navy and Marine Corps because their conceptual and programmatic efforts to develop a sea-basing capability are much farther along than those of the other services.

initial "seize the initiative" phase of an attack on enemy territory or a defense of allied territory. (Further follow-on forces would still require an airfield and port.) Moreover, forces ashore could withdraw back to their ships and reorganize to attack a new target, again operating solely from the amphibious warfare and maritime prepositioning ships of the sea base.

Potential Advantages of Sea Basing

The Marines refer to that new style of naval expeditionary warfare as "operational maneuver from the sea" (OMFTS) and "ship-to-objective maneuver" (STOM). Those two key concepts implement the Marine Corps's vision of fast and flexible forces. The Marines argue that OMFTS and STOM will afford a landing force significant advantages at the operational and tactical levels of war, such as:

- Faster deployment and operations;
- More maneuver space and thus greater unpredictability about where U.S. forces might be;
- More uncertainty on the part of the enemy and therefore more disruption to its strategy and operations; and
- Faster destruction of enemy forces, either because they disperse to cover the wide area where U.S. forces could land (and thereby allow themselves to be defeated piecemeal by arriving ground forces) or because they try to concentrate against U.S. forces (and thus become vulnerable to U.S. air and missile strikes).

The Marine Corps believes that none of those advantages are possible without sea basing. The increased speed of operations, the greater maneuver space, and the confusion of the enemy are facilitated by keeping the logistics support for Marine ground forces at sea. No time is wasted in seizing a lodgment and setting up a supply depot. Ground operations against tactical, operational, or strategic objectives can proceed almost immediately once the sea base has assembled.

In addition to the operational and tactical advantages associated with conducting OMFTS and STOM from ships, sea basing has two other significant benefits. First, it eliminates the need to ask a host nation for permission to use a base, thereby giving U.S. combatant commanders greater freedom of action and allowing more-independent operations that do not depend on the politics of other countries. Proponents of sea basing argue that such independence will be critical in the future because the United States will be less and less likely to gain access to overseas bases if it must conduct a military operation.[17] Those proponents cite several recent examples: Turkey's denial of access to the Army's 4th Mechanized Infantry Division for a northern front against Iraq, and Saudi Arabia's refusal to let U.S. forces use facilities in that country during Operation Enduring Freedom in Afghanistan.[18] If that trend continues, they argue, sea basing will allow the United States to bypass such requests for permission by having everything it needs in terms of support at the sea base, which (unlike a land base in a foreign country) is "sovereign U.S. territory." The Marine Corps Commandant, General Michael Hagee, has described a sea base that would have permitted the military to launch the war against Iraq without using Kuwait: "We come into the [Persian] Gulf, we do the arrival and assembly, we do the reception, staging, onward movement and integration at sea."[19]

Second, proponents argue that a sea base is less vulnerable than a land base to attack from cruise and ballistic missiles. Because ships at sea are constantly on the move, detecting, tracking, and targeting them is inherently more difficult than targeting a fixed land base. As cruise and ballistic missiles proliferate among potential U.S. adversaries, that advantage of sea basing becomes increasingly apparent, supporters say.

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17. Richard Mullen, "Seabasing Yields Big Military Advantages: Officers," *Defense Today*, April 8, 2004, p. 4; Christian Lowe, "Attack Platform: Sea Basing Could Render Reluctant Allies Irrelevant," *Armed Forces Journal* (April 2004), pp. 36-38; and Nathan Hodge, "Iraq War Seen as Test of Sea Basing," *Defense Week*, April 21, 2003, p. 6.
18. Many supporters of sea basing have argued that if the United States had had such a capability, it would not have needed to offer Turkey a substantial aid package in exchange for allowing the U.S. military to launch a division-sized attack on Iraq from the north. However, the sea-basing capability being discussed today would not be large enough to launch a division-sized attack. Moreover, northern Iraq (the part that borders Turkey) is more than 450 nautical miles from the sea, which would be too far for sea basing.
19. John T. Bennet, "Marine Corps Commandant, DSB Describe Visions of Sea Basing Concept," *Inside the Pentagon*, October 30, 2003, p. 16. See also the interview with Rear Admiral John M. Kelly, "Kelly: Sea Basing Presents Infinite Number of Problems for the Enemy," *Sea Power* (June 2004), p. 22.

Potential Drawbacks of Sea Basing

Four counterarguments exist to the points in favor of sea basing that proponents cite. First, although supporting relatively small military operations from a sea base may prove feasible in time, military operations such as the division-sized or larger attack on Iraq from Turkey planned for Operation Iraqi Freedom may be too big to be launched and sustained from a sea base. The Defense Science Board, which endorses the sea-basing concept, stated in a 2003 report: "Forcible entry from modern sea-bases . . . represents a substantially greater challenge than the amphibious operations of World War II and Korea."[20]

Second, although today land bases appear more vulnerable than sea bases to ballistic and cruise missiles, that may not always be the case. New short-range ballistic missiles with maneuvering reentry vehicles and radar and infrared seekers could be accurate enough to attack ships at sea.[21] Arguably, sea bases might be at greater risk than land bases from ballistic and cruise missiles because they are more concentrated, meaning that a missile strike could disable or destroy a vastly greater proportion of material and capability for a military operation than would be the case with a land base. (During the Falklands War, for example, the sinking of the *Atlantic Conveyor,* which carried 14 helicopters and all of the tentage for Britain's landing force, "was a crippling blow to British strategic plans for the campaign.")[22]

As described in the next chapter, current designs for the new ships necessary to support the sea-basing concept would make those vessels some of the largest and most detectable ships in a theater of operations as well as the least survivable if hit by enemy fire. The Government Accountability Office (formerly the General Accounting Office) has also reported that the Navy may be underestimating the threat posed by cruise missiles and may be overly optimistic about its ability to defend against that threat.[23] In addition, if an enemy is sophisticated enough to have cruise and ballistic missiles in sufficient quantities to threaten a land base, it is also likely to have the weapons and ability to severely disrupt the continuous airlift of supplies from a sea base to troops on land.

Third, opponents of sea basing might question the likelihood that the U.S. military would attempt an amphibious assault in the future when it has not done so since the Korean War. Although maintaining current amphibious capabilities—which can be used for various purposes other than opposed amphibious assaults—may be advantageous, it is less clear that all of the Navy's amphibious forces should be prepared to fight from a sea base.

Finally, sea basing might prove to be too expensive for what in the end could be a modest capability. The total amount of resources needed to carry out the sea-basing concept is highly uncertain. Because that concept has not been fully fleshed out, CBO has not attempted to estimate the total cost of building a sea-based amphibious force. However, implementing that concept would involve developing a variety of new technologies, ships, and aircraft, some of which would require technological advances whose feasibility is not yet clear (see Box 1-2). The Defense Science Board has stated that fully realizing the sea-basing vision could potentially cost tens of billions of dollars.[24]

The Possible Scope of Sea Basing

Some supporters of the overall concept of sea basing argue for more-modest capabilities. They state that rather than try to conduct multiple battalion- or brigade-sized operations from a sea base, the military could use such a base for seizing a lodgment that would serve as a base for more forces brought ashore to conduct larger operations. One or two battalions could be deployed by air behind an enemy's shore defenses and then move toward the sea in conjunction with supporting operations from U.S. forces at sea. That approach differs from a more traditional amphibious operation in which marines assault a beach directly and try to seize a lodgment head-on. The more modest approach to sea basing would simply enhance the traditional amphibious assault capability in which the

20. Department of Defense, Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics, *Defense Science Board Task Force on Sea Basing* (August 2003), p. iv, available at www.acq.osd.mil/dsb/reports/seabasing.pdf.

21. Office of Naval Intelligence, *Worldwide Maritime Challenges* (2004), p. 22. That may be especially true of China's growing arsenal of ballistic missiles.

22. Max Hastings and Simon Jenkins, *The Battle for the Falklands* (New York: W.W. Norton, 1983), p. 229.

23. General Accounting Office, *Defense Acquisitions: Comprehensive Strategy Needed to Improve Ship Cruise Missile Defense,* NSIAD-00-149 (July 11, 2000).

24. Department of Defense, *Defense Science Board Task Force on Sea Basing*, p. 85.

Box 1-2.

Sea and Air Connectors for the Sea Base

One of the most important examples of the new technologies and equipment necessary to make sea basing a reality involves what are called the sea and air connectors. To put troops ashore and sustain them requires having the means to get troops from the continental United States to a theater of operations quickly. The Navy and Marine Corps are still studying the best way to do that. One option would be to purchase fast sealift ships capable of ferrying troops from the United States directly to the sea base at high speeds. Such a ship does not exist in the Navy's inventory or even on the drawing boards; at the moment, it is just a "concept ship." Another alternative for getting troops to the sea base would be to fly them to an advanced base some 200 to 2,000 nautical miles away from the theater of operations and then ferry them to the sea base using shorter-range high-speed vessels. Ships of that type do exist, and the Navy, Marine Corps, and Army have been experimenting with commercial off-the-shelf variants. Using such ships as sea connectors would require scaling up their designs to make them bigger and then funding their construction, but the Navy does not believe those to be insurmountable obstacles. The distance from the advanced base to the theater will in part drive the requirements for those high-speed ferries.

The Navy and Marine Corps may need other types of vessels to help deploy troops and equipment. A larger air-cushion landing craft than now exists in the inventory may be necessary to get everything ashore within the timelines that the Marine Corps desires. To speed up the assault, the Navy and Marine Corps are looking at buying a small number of flow-on/flow-off (flo/flo) ships to bring four or five landing craft at a time near the shore. (Existing flo/flo ships, such as the one chartered to bring the *U.S.S. Cole* back to the United States after it was attacked by terrorists in Yemen, are very large. The flo/flo ships that the Navy and Marine Corps have in mind would be much smaller.) Such ships would not be difficult to design and build, but they would require additional funding.

The Marine Corps has stated that it will need to replace its large CH-53 helicopters to provide the heavy lift necessary to support troops operating from a sea base. Joint requirements may envision developing and procuring an even larger heavy-lift aircraft than the CH-53's replacement, such as a quad-tilt rotor, capable of carrying 20 tons at a time as far as 110 nautical miles.[1] Such an aircraft is only in the early design stages and could prove costly if bought in significant numbers.

The Navy and Marine Corps are still refining their sea-basing concepts. Ideally, one outcome of a clearer vision of sea basing would be a tally of what kinds of sea and air connectors would be required to make the concept work, how many would be necessary, and how much they would cost. So far, those issues have not yet been resolved.

1. The Marine Corps Commandant, Michael Hagee, has endorsed the need for such an aircraft. See Jason Sherman, "U.S. Seeks Ship-Based Airlifter," *Defense News,* April 26, 2004, p. 16.

Marine Corps specializes. It would not try to fundamentally change the way Marine forces operate and fight.

As described by many senior Navy leaders, the sea base would comprise the entire fleet. For example, Admiral Clark has written that "sea bases will consist of numerous platforms, including nuclear-powered aircraft carriers, multi-mission destroyers, submarines with Special Forces, and maritime pre-positioned ships."[25] That would be true inasmuch as carriers, destroyers, and submarines would continue to perform many of the missions that they do today, such as projecting power ashore from the sea through the use of carrier-based aircraft, Tomahawk missiles, naval gunfire, and the insertion of special-operations forces. But, as discussed above, the transfor-

25. Clark, "Sea Power 21," p. 37.

mational character of sea basing lies in how it would change the way the Marine Corps assembles and projects forces from the sea and the way the Navy supports and sustains those forces. The most important ships involved in those changes would be existing and future amphibious warfare ships and especially the proposed Maritime Prepositioning Force (Future) ships.[26]

At the moment, proponents of the more expansive view of sea basing hold sway, primarily because of the strong advocacy of that concept by senior Marine Corps and Navy leaders. The strength of that advocacy is reflected in the Navy's future plans for its amphibious warfare and maritime prepositioning forces.

26. Colonel Art Corbett and Colonel Vince Goulding (ret.), "Sea Basing: What's New?" *Proceedings*, U.S. Naval Institute (November 2003), pp. 34-39.

CHAPTER

2

The Navy's Plan for Modernizing the Amphibious and Maritime Prepositioning Forces

Impelled by the Sea Power 21 vision in general and the sea-basing concept in particular, the Navy intends to replace most of its amphibious warfare ships and all of its maritime prepositioning ships over the next 30 years. Specifically, the Navy plans to replace all of its current amphibious transport docks with the LPD-17 class now under construction; begin a new class of amphibious assault ship, the LHA(R); and replace all of its dock landing ships with the still-conceptual LSD(X) (see Table 2-1). That modernization program would keep the size of the L-class force at 36 ships through 2035 (see Figure 2-1), at which point the force would be slightly younger, on average, and slightly more capable than it is today. More dramatically, the Navy plans to replace its mostly chartered maritime prepositioning ships with new Maritime Prepositioning Force (Future) ships, which would substantially alter the way the Navy and the Marine Corps conduct operations on shore.

Under those plans, the Navy's amphibious lift capability would slowly increase. It would rise from 1.9 Marine expeditionary brigade equivalents now to 2.1 MEBs by the end of 2005, with the arrival of the first LPD-17 in the fleet, and reach the fiscally constrained goal of 2.5 MEBs in 2015, when the Navy commissioned the last LPD-17. (As noted in Chapter 1, the amount of amphibious-lift capability is determined by the size of the smallest category of amphibious lift, which is currently square footage for vehicles; see Figure 2-2 on page 18). However, the Marine Corps's 3.0-MEB requirement would never be met under the Navy's long-term shipbuilding plans.

Overall, that modernization program would keep the goal for the total lift capability of the amphibious and maritime prepositioning forces the same as it is now—5.5 MEBs—but would change its distribution. Instead of the current goal of approximately 2.5 MEBs of *amphibious* lift and 3.0 MEBs of *sealift*, the Navy would have 2.5 MEBs of amphibious lift on L-class ships, 2.0 MEBs of *sea-based* lift on sea-basing-capable MPF(F) ships, and another 1.0 MEB of sealift on replacement prepositioning cargo ships. Because MPF(F) sea-basing ships would be able to equip and support full Marine combat units, they would be considered operational fleet assets and would be counted along with amphibious warfare ships in the Navy's overall battle force.

Much uncertainty surrounds what capabilities—and thus what costs—future amphibious and maritime prepositioning ships would have. Even allowing for that uncertainty, however, the Congressional Budget Office estimates that the Navy's modernization plan will require much higher funding than the service has devoted to the amphibious and maritime prepositioning forces in the past 20 years.

The quantities and timing of ship purchases discussed in this chapter are based on the long-term shipbuilding report that the Navy issued in May 2003—*A Report to Congress on Annual Long-Range Plan for the Construction of Naval Vessels*—updated from various selected acquisition reports (documents on major procurement programs that the services are required to submit regularly to the Congress). That combination of sources represents the most authoritative statement of the Navy's long-term shipbuilding plans available to CBO. Overall, the Navy intends to buy 28 amphibious ships and, CBO assumes, 21 maritime prepositioning ships over the next 30 years.

Table 2-1.

Schedule for Replacing Existing Amphibious and Maritime Prepositioning Ships with New Classes

Existing Ships			Replacement Ships			
Class	Quantity in Service	Year First Ship Retires	Class	Year First Ship Is Authorized	Year First Ship Is Commissioned	Quantity to Be Purchased Through 2035
Amphibious Assault Ships						
Tarawa (LHA-1)	5	2007[a]	LHA(R)	2007	2012[b]	10
Wasp (LHD-1)	7	2027	LHA(R)			
Amphibious Transport Docks						
Austin (LPD-4)	11	2004	San Antonio (LPD-17)	1996	2005	12[c]
Dock Landing Ships						
Whidbey Island (LSD-41)	8	2024	LSD(X)	2020	2024[b]	12
Harpers Ferry (LSD-49)	4	2032	LSD(X)			
Maritime Prepositioning Ships						
MPS Cargo Ships	16	2013[d]	MPF(F)	2009	2013[b]	21[e]

Source: Congressional Budget Office based on data from the Navy.

Note: MPS = maritime prepositioning squadron; MPF(F) = Maritime Prepositioning Force (Future).

a. *Tarawa,* the first LHA to retire, will be replaced by *Makin Island,* the last of the LHDs.

b. Projected.

c. Through 2004, six of the 12 LPD-17s had already been purchased.

d. Most of these ships will be transferred to the Ready Reserve Fleet to replace cargo ships that will be scrapped.

e. CBO assumes that 16 ships will have sea-basing capabilities and five will be replacement cargo ships.

The LPD-17 Amphibious Transport Dock

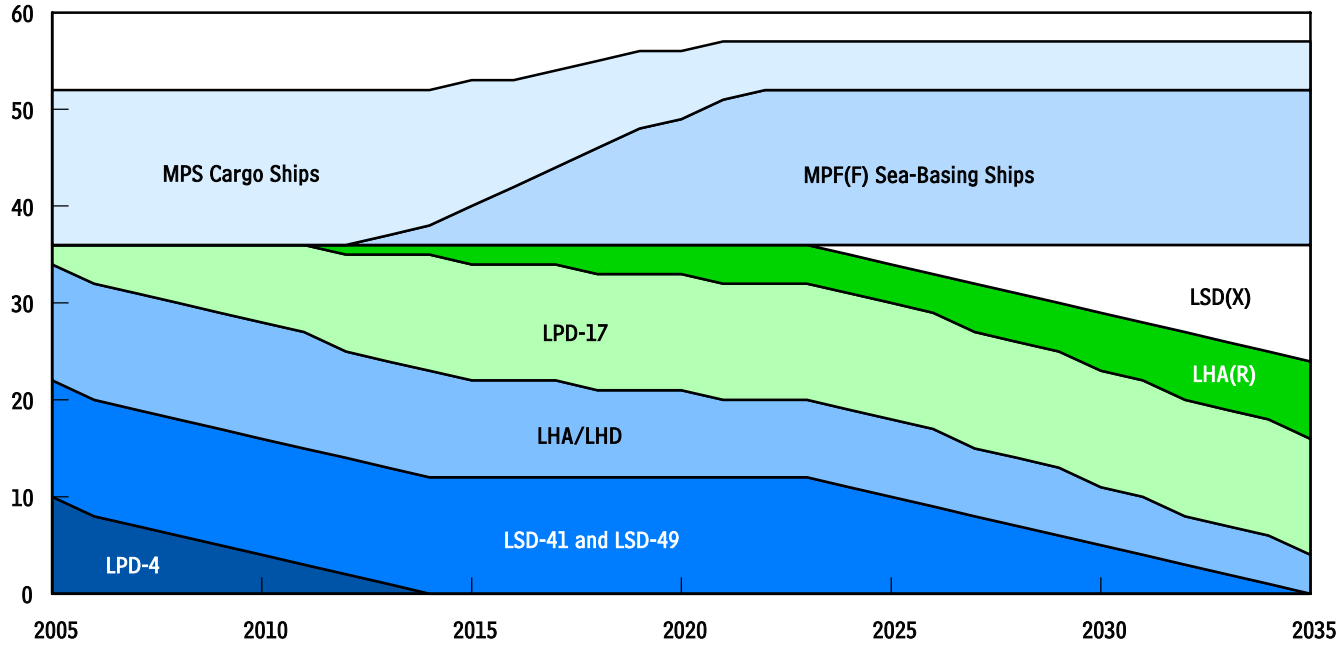
The program to develop the San Antonio class amphibious transport dock began in 1990, and construction of the first ship was authorized in 1996. These ships are intended to replace the Austin class LPD-4 transport docks, which will reach the end of their notional 40-year service lives in the next 10 years.[1] The Navy plans to procure 12 LPD-17s—one for each of the 12 expeditionary strike groups. So far (through fiscal year 2004), it has ordered six of those ships. Thus, the Navy plans to buy six more between 2005 and 2010, at a rate of one per year (see Figure 2-3 on page 19).

The LPD-17 class is designed to be a substantial improvement over the LPD-4 class in terms of lift capacity, accommodations for personnel, electronics, and self-defense capabilities. The ship will be more than 45 percent larger than its predecessor, displacing about 25,000 tons at full load, compared with almost 17,000 tons for

1. The Navy describes the LPD-17 class as the replacement for 41 older ships: 11 LPD-4s, five LSD-36 dock landing ships, 20 tank landing ships (LSTs), and five amphibious cargo ships (LKAs). However, three of the LSDs and all of the LSTs and LKAs have already been retired.

Figure 2-1.

Inventory of Amphibious and Maritime Prepositioning Ships Under the Navy's Plan



Source: Congressional Budget Office based on data from the Navy.

Note: MPS = maritime prepositioning squadron; MPF(F) = Maritime Prepositioning Force (Future).

the LPD-4 class (see Table 2-2 on page 20).[2] It will carry fewer troops and less cargo than the LPD-4 class but have twice as much space for vehicles and landing craft as well as two additional spots for helicopters. The crew and marines aboard the new ship will have more-spacious bunks than those found on previous classes of amphibious ships. The LPD-17 will also be equipped with computers and systems for cooperative engagement capability, part of the Navy's effort to integrate the electronics and computers on its ships into one fleetwide warfare system. Finally, the LPD-17 will carry two rolling air-frame missile launchers with 42 ship-defense missiles. (Space and weight have also been reserved to install vertical launch system cells for the Evolved Sea Sparrow Missile defensive system, although those cells were eliminated from the design early on to save money.)

2. A ship's light load reflects the displacement of the ship itself, not including its weapons (such as aircraft), fuel, personnel, or other types of cargo. The full load refers to a ship's displacement including all of the things it normally carries.

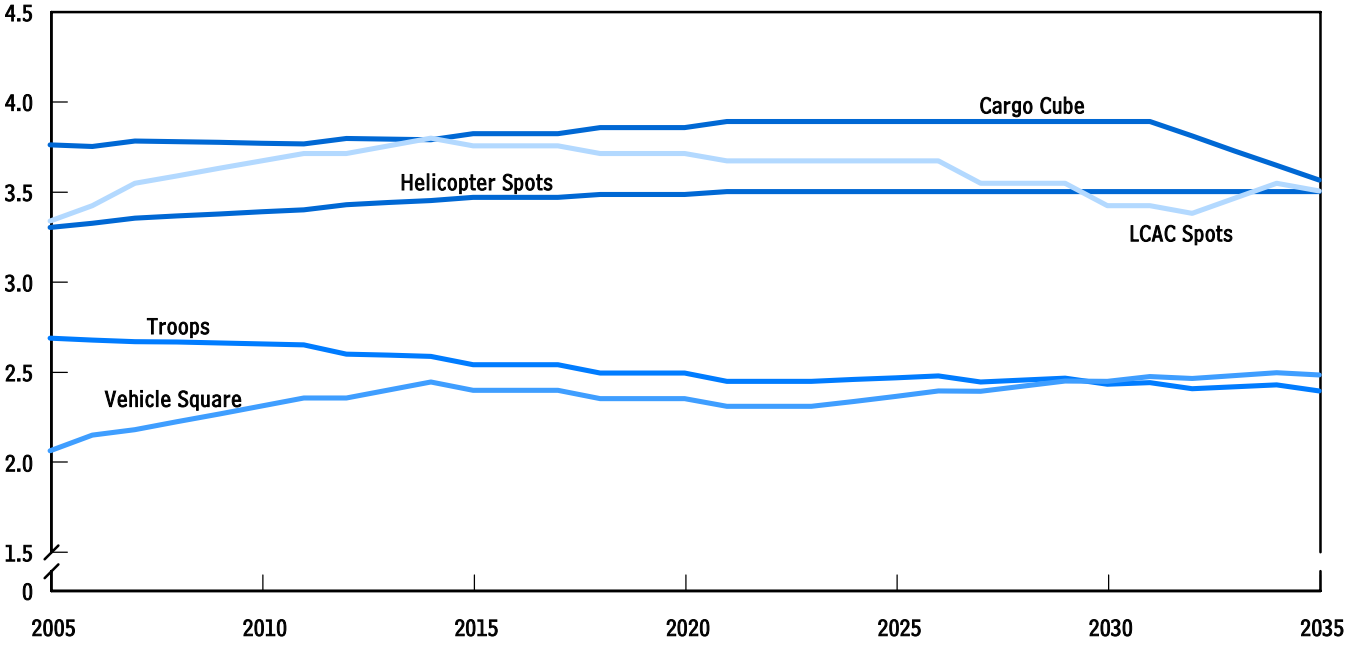
The construction program for the LPD-17 has been a troubled one. The 1996 selected acquisition report estimated that a 12-ship program would cost an average of about $830 million per ship. Eight years later, that cost had grown by more than 50 percent—to an average of about $1.3 billion per ship, CBO estimates. (The Navy's 2004 selected acquisition report estimated that a 12-ship program would cost about $1.2 billion per ship, on average.)

Although CBO does not provide an explanation for the cost growth, the Navy attributes it in part to mistakes by the service and by the contractor, Avondale Industries (now owned by Northrop Grumman). Those mistakes included computer design tools that initially were not up to the complex task of designing a Navy warship, insufficient research and development spending to design a complicated weapon system, and a lack of understanding of the costs of many new features that the Navy wanted the ship to have. As a consequence, the program suffered substantial delays, which themselves led to higher costs, including additional years of inflation in material and labor costs. Costs for labor and materials also proved

Figure 2-2.

Amphibious Lift, by Category, Under the Navy's Plan

(Marine expeditionary brigade equivalents)



Source: Congressional Budget Office based on data from the Navy.

Note: The five categories (or fingerprints) of amphibious lift are the number of troops a ship can carry; its vehicle storage area, measured in thousands of square feet (or vehicle square); its cargo storage area, measured in thousands of cubic feet (or cargo cube); the number of spots for parking vertical takeoff and landing aircraft (expressed as CH-46 helicopter equivalents); and the number of spots for air-cushion landing craft (known as LCACs).

greater than originally estimated apart from the effects of inflation. Overall, the Navy attributes 14 percent of the cost growth to additional inflation, 28 percent to the restructuring of the procurement schedule, 29 percent to the complexity of the design and to higher labor and overhead rates, 25 percent to the challenges of integrating the ship's systems and the materials used, and 4 percent to additional outfitting costs.

The LHA(R) Amphibious Assault Ship

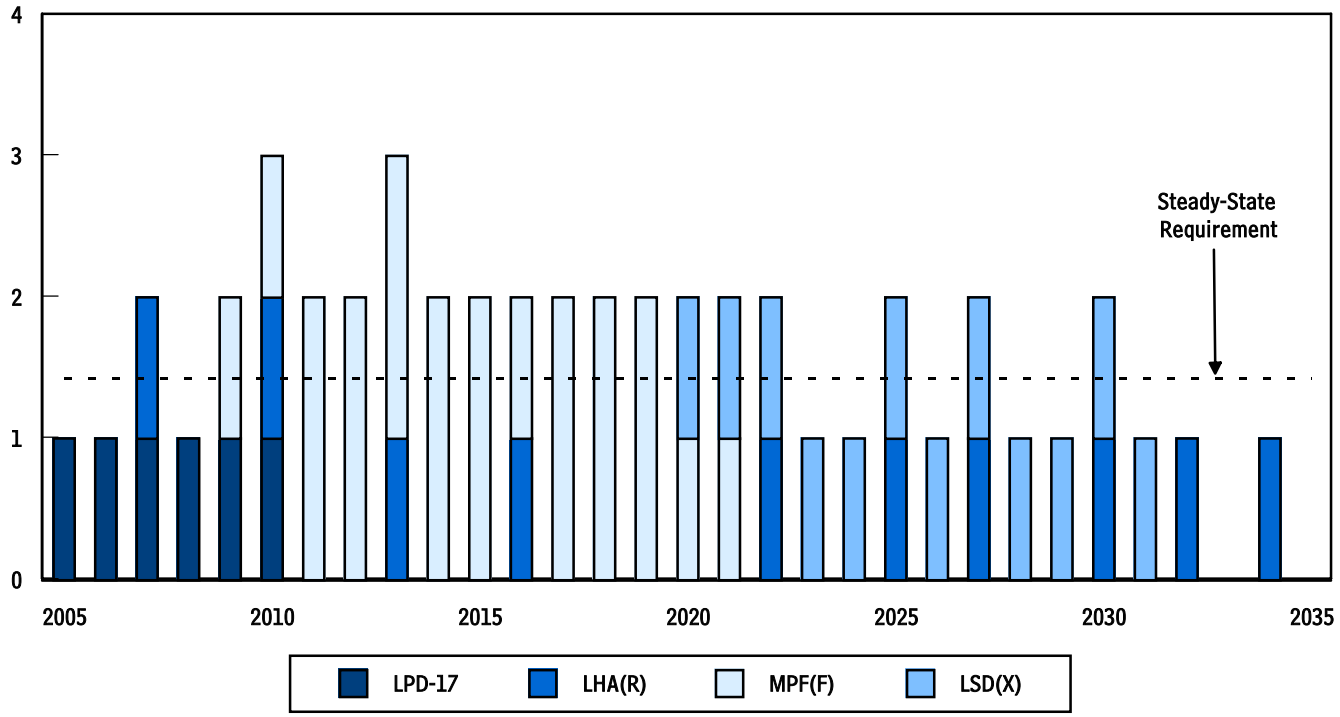
The LHA(R) class of amphibious assault ship is intended to replace the current aging LHA Tarawa class. It may eventually replace the LHD Wasp class as well. Officially, the Navy has selected a design for only the first LHA(R), called Flight 0; the design for subsequent ships is still to be determined. According to the 2005 Future Years Defense Program, the first LHA(R) will be authorized in 2007, with all others of the class coming after 2009. The ship will displace 45,000 tons at full load or 30,000 tons at light load—12 percent more than the latest amphibious assault ship, the LHD-8, which is now under construction.

The design of the LHA(R) remains the subject of considerable controversy within the Department of the Navy. The department conducted an analysis of alternatives for the ship, considering six different designs—ranging from one that would be essentially the same as the LHD-8 to one (called the Dual Tram) that, among other things, would weigh 70 percent more than existing amphibious assault ships and have two separate flight decks so that fixed-wing and rotary-wing aircraft could operate simultaneously (something that cannot be done on LHAs and LHDs).[3] The President's budget for 2005, submitted

3. According to the Navy's analysis of alternatives, the Dual Tram design would have a displacement of 69,000 tons (as large as the Navy's former Midway class aircraft carriers) and cost an average of about $3 billion apiece. CBO estimates the cost of those ships at closer to $4 billion apiece.

Figure 2-3.

Annual Purchases of Amphibious and Maritime Prepositioning Ships Under the Navy's Plan



Source: Congressional Budget Office based on data from the Navy.

Note: The steady-state requirement is the annual purchases needed to keep the amphibious and maritime prepositioning forces at the Navy's planned level of 57 ships indefinitely. MPF(F) = Maritime Prepositioning Force (Future).

in February 2004, indicated that the Navy had selected a design for the first LHA(R) called the "LHD plus plug," which would have a somewhat longer and wider hull than the LHD class and displace about 50,000 tons. That design was a slight modification of one of the midrange designs in the analysis of alternatives and was intended to balance cost and capability. The first LHA(R) was estimated to cost $3.7 billion to procure, including $800 million for design and engineering.[4]

Since the 2005 budget was submitted, however, concerns about the affordability of that LHA(R) have caused the Navy to change the design to one that is essentially a repeat of the LHD-8—except that it would have enhanced aviation capabilities. However, it would not have a docking well to transport and deploy the landing craft that move large equipment ashore. That design was not one considered in the analysis of alternatives.

If constructed as currently proposed, the "LHA(R) aviation variant" would be the first amphibious ship in decades built without a docking well. Eliminating the docking well allows more space and weight to be devoted to the hangar area and to facilities that support aviation. For example, the LHA(R) would carry 600 fewer troops and have 9,000 fewer square feet of vehicle space than the LHD-8, but it could carry two to three times as much aviation fuel as well as more and larger aircraft—including helicopters and Harrier aircraft today, or V-22 tilt-rotor aircraft and Joint Strike Fighters (JSFs) when those are fielded in coming years.

The Navy has budgeted about $3 billion for the first LHA(R), or about $800 million more than for the

4. Ronald O'Rourke, *Navy-Marine Corps Amphibious and Maritime Prepositioning Ship Programs: Background and Oversight Issues for Congress*, CRS Report RL32513 (Congressional Research Service, August 5, 2004), pp. 7-8.

Table 2-2.

Characteristics of Current and Proposed Amphibious and Maritime Prepositioning Ships

					Fingerprints of Lift[b]				
Class	Type of Ship	Quantity	Displacement[a] (Tons)	Crew Size	Troops	Vehicle Square	Cargo Cube	Helicopter Spots	LCAC Spots
				Current Ships					
LHA-1 Tarawa	Amphibious assault ship	5	40,000	1,160	1,713	25.4	105.9	42	1
LHD-1 Wasp	Amphibious assault ship	7[c]	40,500	1,150	1,686	20.9	125.0	45	3
LPD-4 Austin	Amphibious transport dock	11	17,000	400	788	11.8	38.3	4	1
LSD-41 Whidbey Island	Dock landing ship	8	16,000	310	454	13.5	5.1	0	4
LSD-49 Harpers Ferry	Dock landing ship	4	17,000	330	454	16.9	50.7	0	2
				Ships Under Construction					
LPD-17 San Antonio	Amphibious transport dock	12	25,000	420	720	25.0	36.0	6	2
				Proposed Ships[d]					
LHA(R)	Amphibious assault ship	12[e]	45,000	1,852	1,102	12.0	125.0	45	0
LSD(X)	Dock landing ship	12	22,000	~350	590	22.0	5.1	0	4
MPF(F)	Maritime prepositioning ship	21[f]	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.

Source: Congressional Budget Office.

Note: MPF(F) = Maritime Prepositioning Force (Future); n.a. = not available.

a. Displacement at full load (including all of the things the ship normally carries).

b. The five categories (or fingerprints) of amphibious lift are the number of troops a ship can carry; its vehicle storage area, measured in thousands of square feet (or vehicle square); its cargo storage area, measured in thousands of cubic feet (or cargo cube); the number of spots for parking vertical takeoff and landing aircraft (expressed as CH-46 helicopter equivalents); and the number of spots for air-cushion landing craft (known as LCACs).

c. An eighth Wasp class ship is under construction and will be commissioned in 2007.

d. Many of the characteristics of these ships are estimates published in Navy briefings or CBO's assumptions based on conversations with Navy officials.

e. Officially, the program quantity is four ships. However, CBO assumes that the LHA(R) will also replace the LHD-1 class as those ships reach their retirement age of 40 years. In CBO's analysis, only 10 of the 12 ships are bought through 2035.

f. Depending on the final design of these ships, the Navy could buy as few as 15 (three squadrons of five conventional cargo ships) or 24 (three squadrons of eight sea-basing ships). CBO's analysis assumes that the Navy will buy 21 (one squadron of five conventional cargo ships and two squadrons of eight sea-basing ships).

Box 2-1.

Developing Cost Estimates for Amphibious and Maritime Prepositioning Ships

In estimating the costs of various amphibious and maritime prepositioning ships for this analysis, the Congressional Budget Office (CBO) relied mainly on a cost-per-thousand-tons methodology. Using data on the Navy's costs to build the LPD-17 class of amphibious transport docks and the LHD-8 amphibious assault ship, CBO estimated that the Navy pays about $80 million per thousand tons to construct an amphibious warship. That number is based on the ships' light loads (the displacement of the vessels themselves without their crew, materiel, weapons, and fuel).

For new amphibious warfare ships, CBO's cost estimates were consistent with that approach. New ship designs tend to be more expensive on a per-ton basis than older designs because of higher labor and materials costs and the costs of incorporating new technology. However, the similarity between existing ships and the proposed designs for new amphibious ships suggests that extrapolating from the cost per thousand tons of amphibious ships now under construction provides the most likely predictor of the cost of those future ships.

For prepositioning and sea-basing ships, CBO used the initial cost estimates that the Center for Naval Analyses (CNA) developed in its analysis of alternatives for the Maritime Prepositioning Force (Future), or MPF(F), program. CNA estimated that replacement cargo ships for that force would cost about $20 million per thousand tons, which is consistent with the cost of the T-AKE combat logistics ships that the Navy is building today. Consequently, CBO used that $20 million per thousand tons estimate for all of the MPF(F) replacement cargo ships in this analysis.

CNA estimated that the first MPF(F) sea-basing ship would cost $1.6 billion, or about $40 million per thousand tons, but that successive ships would cost less. Those estimates suggest that the average price tag for a squadron of eight sea-basing ships would be about $1.3 billion per ship. In this analysis, CBO used the $40 million per thousand tons estimate for the first sea-basing ship because it did not have enough information about that vessel or an appropriate historical analogy to produce a completely independent estimate. For succeeding ships of the class, however, recent experience suggests that optimism about reducing costs may not be warranted. For example, the Navy's experience with cost growth in its Virginia class submarine and LPD-17 programs suggests that sea-basing ships could actually cost substantially more than CNA estimates. Thus, CBO estimated that eight sea-basing ships would have an average cost of $1.6 billion apiece, which is consistent with a cost of $40 million per thousand tons. Conversely, some Navy officials hope that competition among potential shipbuilders can reduce the cost of the MPF(F) ships below what CNA estimated.

LHD-8. That estimate, however, is based on the larger LHD-plus-plug design. Ten LHA(R)s of the aviation-variant design would cost an average of about $2.4 billion each, CBO estimates. That figure is consistent with the costs of both the LPD-17 and the LHD-8 when measured per thousand tons. (For more details about how CBO calculated its cost estimates for individual ships, see Box 2-1.) The Navy has not yet decided on the configuration of future LHA(R) ships. Various designs are still under consideration, with one candidate being a ship similar to the first LHA(R) but somewhat larger and capable of carrying more aircraft.

The Navy's decision to build a smaller amphibious assault ship than it had originally planned (or than other designs that it had considered) has been criticized as not adequately supporting future Marine Corps warfighting requirements, including the new sea-basing strategy. A larger design is needed to support that strategy, some critics argue.[5] Other Marine Corps officials have maintained

5. See, for example, Department of Defense, Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics, *Defense Science Board Task Force on Sea Basing* (August 2003), available at www.acq.osd.mil/dsb/reports/seabasing.pdf.

that the Navy needs an expeditionary strike ship, though it is not clear what such a ship would entail in terms of size, capabilities, or cost.[6]

Conversely, other officials, including many in the Marine Corps, have argued that very large designs for the new amphibious assault ship are unnecessary. In their view, the LHA(R) aviation variant is the right ship because, when operating in conjunction with new maritime prepositioning ships, its helicopters would fly off and operate from the prepositioning ships. At the same time, additional fixed-wing aircraft (Joint Strike Fighters) would be flown in and operated from the LHA(R), making that ship in effect a small aircraft carrier. Reportedly, as many as 23 JSFs could operate from the first LHA(R). The Navy hopes that subsequent versions of that ship will accommodate up to 30 JSFs, but for this analysis, CBO assumed that all members of the LHA(R) class bought by the Navy would have the same capabilities as the first one. CBO has few details about what a future LHA(R) might look like or cost.

The LSD(X) Dock Landing Ship

Little is known about the LSD(X) other than that it is intended to replace the LSD-41 Whidbey Island and LSD-49 Harpers Ferry classes of dock landing ships. The first LSD(X) will not be authorized until 2020, with an expected commissioning date of 2024, when the first LSD-41 will reach the end of its notional 40-year service life. Development and procurement of the LSD(X) are too far in the future for the Navy to have considered in any detail what characteristics and capabilities it wants the ship to have. The Navy's long-term shipbuilding report envisioned procuring 12 of the ships between 2020 and 2031 at an average cost of about $750 million. CBO does not know what characteristics, such as dimensions or displacement, were used in making that estimate.

For the purposes of this analysis, CBO assumed that the LSD(X) would reflect the growth in size that new amphibious ships have exhibited over the past several years relative to previous classes. A weighted average of the growth in ship displacement from the LHD-8 to the LHA(R) and from the LPD-4 class to the LPD-17 suggests that the LSD(X) would be about 30 percent larger than the LSD-41 and LSD-49 classes. Thus, CBO assumed that the LSD(X) would displace about 15,000 tons at light load and 22,000 tons at full load (versus 12,000 tons at light load and 16,000 to 17,000 tons at full load for the LSD-41 and LSD-49 classes).

CBO assumed that the Navy would use the additional space in the LSD(X) to carry 30 percent more troops and vehicles than on the LSD-41 class, to compensate for the Navy's shortages of lift in those categories relative to the amphibious-lift goal. The LSD(X) would carry the same amount of cargo and the same number of landing craft as the LSD-41 class. (In comparison, the LPD-17's displacement is more than 45 percent greater than that of the LPD-4 class and results in twice the vehicle square and LCAC spots as well as in six air spots instead of four.) The average cost for 12 LSD(X)s would be about $1.2 billion each, CBO estimates, based on the cost per thousand tons of the LHD-8 and the LPD-17 class.

One of the difficulties, however, in determining the Navy's and Marine Corps's plans for dock landing ships is that the services are still developing concepts for the future composition and employment of amphibious forces. For example, current plans would have each expeditionary strike group include a large amphibious assault ship (such as an LHD or LHA(R)), an LPD-17, and an LSD class ship. But the Navy is also considering a formation in which each expeditionary strike group would include an LHD, an LHA(R), and an LPD-17. In that case, the LSD(X) program would never be started, and existing LSDs would be retired without replacement. The Navy and Marine Corps are still debating the merits of that formation. One problem is that unless the Navy cut the number of expeditionary strike groups, using such a formation would cost more than the Navy's existing plan.

The Future Maritime Prepositioning Ship

The MPF(F) represents the greatest departure from past practice in the Navy's plan for amphibious and maritime prepositioning vessels. It is an important ship in the service's vision of the future of expeditionary warfare, but it is also the ship about which the Navy has released the fewest details. The prospective fleet of MPF(F) ships would, at a minimum, carry all of the equipment and material necessary for three Marine expeditionary brigades to operate for 20 days. Beyond that, the ships would have various sea-basing capabilities that current prepositioning cargo ships lack, such as the ability to:

6. Malina Brown, "Naval Services May Develop New Class of 'Expeditionary Strike Ships,'" *Inside the Navy,* April 12, 2004, p. 14.

- Operate and support rotary-wing aircraft;
- Have equipment and supplies off-loaded selectively, depending on what a military operation required, without the entire ship needing to be unpacked; and
- Transfer troops, military equipment, fuel, and supplies to aircraft and smaller surface craft at sea—rather than at a pier in a port—in conditions at least equal to "sea state three" (waves four feet high and wind speeds of 15 knots). Those aircraft and surface craft would then transport the troops and equipment to shore.

Because the Navy has not yet spelled out its requirements for MPF(F) ships in much detail, the capabilities—and costs—of the ships could vary widely.

Possible Designs for MPF(F) Ships

The Center for Naval Analyses, a federally funded research and development center that serves as the Navy's research arm, has conducted an analysis of alternatives for the design of the future maritime prepositioning ship. The three main MPF(F) options in the analysis are:

- A modified large, medium-speed roll-on/roll-off (LMSR) cargo ship, which would essentially replicate the capabilities of today's maritime prepositioning ships, with no sea-basing features. Five ships—at an average cost of $700 million each, CBO estimates—would constitute a squadron capable of supporting a Marine expeditionary brigade.
- A "constrained design" sea-basing ship, capable of operating rotary-wing and tilt-rotary-wing aircraft. The design is constrained in the sense that the ship's size is limited so it could be built in several of the private shipyards that construct Navy vessels.[7] The Center for Naval Analyses estimated that eight of these ships would make up a squadron and that the lead ship of the class would cost about $1.6 billion.
- An "unconstrained design" sea-basing ship, capable of operating Joint Strike Fighters. This ship would be very large (displacing 83,000 tons at full load) and could only be built by Ingalls or Newport News Shipbuilding, both of which are owned by Northrop Grumman. Six ships would be needed to form a squadron and the first one would cost about $2.2 billion, according to the Center for Naval Analyses.

The last two alternatives would be logistical and aviation support ships, capable of conducting a variety of sea-basing operations in support of different military objectives. In addition, the analysis of alternatives looked at families of specialized ships that would perform different functions in support of the sea-basing concept.

The analysis of alternatives suggested that total procurement costs for the MPF(F) program could range from $9 billion to $30 billion. If history is a guide, the Navy's cost estimates for those ships could prove too low. A RAND study found that, on average, costs for Navy ship programs grew by 11 percent from the original estimates.[8] Moreover, during the past five years, the Navy's Virginia class attack submarine program and LPD-17 class amphibious ship program have experienced cost growth of 20 percent and 40 percent, respectively.

The Navy has not yet decided which design or designs for the MPF(F) it wants to buy. Over a year ago, Navy officials seemed to indicate that they would like to have three maritime prepositioning squadrons equipped with sea-basing capabilities. More recently, the Chief of Naval Operations appeared to imply that he wanted only two sea-basing squadrons, neither of which would use the large unconstrained design. (The fate of the third squadron was not clear.)

On the basis of that information, CBO assumed for this study that the Navy would buy two squadrons—or a total of 16—of the smaller constrained-design sea-basing-capable ships. A third squadron would be composed of

7. The most likely yards that could build this ship would be National Steel and Shipbuilding Company in San Diego and Bath Iron Works in Maine (although it has no recent experience in constructing support ships), which are owned by General Dynamics, and Avondale Industries in Louisiana and Ingalls Shipbuilding in Mississippi, which are owned by Northrop Grumman.

8. See J.M. Jarvaise, J.A. Drezner, and D. Norton, *The Defense System Cost Performance Database: Cost Growth Analysis Using Selected Acquisition Reports*, MR-625-OSD (Santa Monica, Calif.: RAND, 1996).

five LMSRs to replace existing cargo ships.[9] Thus, CBO assumed that the Navy would buy a total of 21 MPF(F) ships, out of a possible 15 to 24 depending on the design that could be selected.

Press reports indicate that the ongoing debate within the Department of Defense about the capabilities of the MPF(F) has superseded the results of the analysis of alternatives.[10] Partly in response to the continuing uncertainty about the proposed ship, the conference report accompanying the 2005 defense appropriation act states that "none of the funds provided for the MPF(F) may be obligated or expended until the Secretary of the Navy submits to the congressional defense committees a detailed report on the MPF(F) mission, operational requirements, analysis of alternatives, expenditure plans, and overall program congruence with ongoing forcible entry studies."[11] Nevertheless, CBO used the information in the MPF(F) analysis of alternatives to establish a baseline for this study. Even if the final design is not identical to one of those considered here, CBO's analysis illustrates the force-structure and budgetary issues associated with decisions about the future of the maritime prepositioning force.

Survivability of MPF(F) Ships

Besides the ship's capabilities, quantity, and cost, another critical characteristic of the MPF(F) that has not been finalized is its survivability in the event of attack. Navy ships are built to one of three levels of survivability: Level I is for ships, such as ammunition resupply vessels, that operate in the least demanding wartime environment, whereas Level III is for ships, such as major surface combatants, that operate in the most demanding environment. Amphibious warfare ships are built to Level II, which falls between the other two standards. (For more information about the concepts underlying the Navy's survivability levels, see Box 2-2.) Thus far, the design specifications for the MPF(F) ships appear to require only an "enhanced commercial standard," which is something less than a Level I survivability standard. That means the ships would have little, if any, capability to defend themselves from attack and no ability to "fight hurt" if they were attacked.

Nevertheless, the Navy and the Marine Corps envision having the MPF(F) operate along with, and in proximity to, L-class amphibious warfare ships. That could include operating in environments where it was subject to attack from cruise missiles, submarines, mines, small boats, or aircraft—the full array of littoral threats that concern Navy officials. Further, to perform its mission of providing continuous logistics support to troops on shore, the MPF(F) would probably have to operate far closer to the shore (within 25 nautical miles) than would an aircraft carrier, for example. In that environment, surface combatants protecting an MPF(F) would have only about a minute to detect, track, target, and destroy an antiship cruise missile traveling at twice the speed of sound. Moreover, since the MPF(F)s would probably be the largest ships in the littoral environment and the most visible to sensors, they would be the most likely target within a group of ships for ballistic or antiship cruise missiles.[12]

Building the MPF(F) ships to Level II survivability specifications could mitigate those concerns, but it would also substantially increase the cost of the ships. It might also lessen the ability of the MPF(F) to perform the sea-basing mission as the Navy and Marine Corps would like. To allow for selective off-loading of cargo, a substantial portion of the MPF(F)'s internal capacity would need to operate like a modern, floating warehouse with large, open spaces. But making the MPF(F) more survivable would involve, among other things, increasing the compartmentalization of its design. (Notably, in discussions during the late 1980s about the specifications of what was to become the LPD-17, alternative designs similar to the ones being considered for the MPF(F) were proposed. Those designs were rejected, however, because of concerns about

9. In a few years, the Navy must decide whether to exercise an option to buy its existing leased maritime prepositioning ships. If it does not buy them, it will need to sign new leases so those ships can remain in the maritime prepositioning force until the new MPF(F)s are deployed. When that happens, the existing maritime prepositioning ships will be transferred to the Ready Reserve Fleet to replace sealift ships that will be scrapped.

10. Christopher J. Castelli, "Meeting of Top Naval Officials Sheds Light on Prepositioning Ships," *Inside the Navy*, September 6, 2004, p. 1.

11. House of Representatives, *Making Appropriations for the Department of Defense for the Fiscal Year Ending September 30, 2005, and for Other Purposes*, Conference Report 108-622 (July 20, 2004), p. 360.

12. For a similar discussion, see Robert Work, "The Department of the Navy and Assured Access: A Critical Risk Assessment," in Andrew Krepinevich, Barry Watts, and Robert Work, *Meeting the Anti-Access and Area-Denial Challenge* (Washington, D.C.: Center for Strategic and Budgetary Assessments, 2003), pp. 52-56.

Box 2-2.

The Survivability of Surface Ships in the Navy

The concept of survivability as it relates to Navy ships rests on three features: susceptibility, vulnerability, and recoverability.[1] Susceptibility is a ship's ability to avoid an enemy strike, or its probability of being hit. Vulnerability is the ship's ability to withstand the strike, or its probability of being destroyed if hit. Recoverability is the ability of the crew to restore a ship's systems so the ship can carry out its missions while damaged. Key determinants of survivability include, among other things, a ship's defensive systems, the way it is constructed, and the resources on board the ship to redress damage.

In designing and building ships, all three of those concepts must be balanced. For example, a vessel that had zero susceptibility when its defensive systems were engaged but that had had little attention paid to reducing its vulnerability would be subject to crippling attack when its defenses were down, such as when it was on a nonalert status in a foreign port. Conversely, a ship that was built to withstand almost any kind of attack would most likely be too heavy, costly, and slow to be effective in combat situations.

The Navy divides its surface ships into three broad survivability categories that reflect the environments in which they are expected to function: Level I, Level II, and Level III. Ships built to Level I are expected to operate in the least severe environment, away from the area where a battle group is operating or the general war-at-sea region. Those vessels should be able to maintain good handling in bad weather and should have systems for fighting fires on board the ships, hardening against electromagnetic pulses, and protection against chemical, biological, or radiological contamination. However, they are not expected to "fight hurt," as the Navy puts it. Such ships include material support ships, mine-warfare vessels, and patrol combatants.

Ships built to Level II are expected to operate in a more severe environment, such as in support of a battle group in the war-at-sea region. Level II survivability should include the capacity to continue fighting even if the ship is hit by enemy weapons. Such ships would have all of the features of Level I but more redundancy in their primary and support systems, better structural integrity and compartmentalization (such as being built with numerous watertight sections), protection against conventional and nuclear blasts, and a smaller signature (meaning they have a smaller radar cross-section, make less noise when passing through the water, and are less susceptible to mines). Ships built to Level II include the logistics support ships that supply materials, fuel, and ammunition to carrier battle groups and amphibious warfare ships during combat.

Level III is the most severe environment envisioned for surface warships. Vessels designed to withstand that environment should have all of the features of ships designed to Level II as well as better defensive systems and more ability to deal with the degrading effects of hits from antiship cruise missiles, torpedoes, and mines (through better damage-control systems and greater structural integrity). Ships built to Level III specifications include aircraft carriers and major surface combatants, such as Aegis-capable cruisers and destroyers.

1. This discussion comes almost entirely from Department of the Navy, Chief of Naval Operations, Ship Safety and Survivability Office, *Survivability Design Handbook for Surface Ships* (September 2000).

the ship's survivability and therefore about the risk to the marines it would carry.)

How MPF(F) Ships Might Be Used

Another source of uncertainty about the design and capabilities of sea-basing maritime prepositioning ships is the fact that the Navy envisions using them in four different ways—individually, in an MPF(F) squadron, in conjunction with one expeditionary strike group, or in conjunction with two. MPF(F) ships would be capable of some independent operations, although the environment would have to be fairly benign, given the low level of survivability those ships are likely to have.

Designing MPF(F) ships so they bring the optimal mix of capabilities to an operation when used in any of those ways is the central issue that the Navy and Marine Corps are examining today. For example, this study assumes—on the basis of the analysis of alternatives—that an MPF(F) squadron will be composed of eight similarly designed ships. But the Navy is now looking at whether a squadron should be composed of nine ships plus an additional conventional cargo ship. If such a squadron became the choice of the Navy and Marine Corps, it could be more expensive than the estimates that CBO reports in this study—depending on the final design of the MPF(F) ship itself. Moreover, the Navy is considering other compositions for MPF(F) squadrons, such as using nine to 10 vessels per squadron, with two or three different types of ship. A squadron in which all of the ships were more or less the same would allow more flexibility in the ships' use. Conversely, a squadron in which the ships were more specialized could be less expensive because not every vessel would need to have aviation capabilities.

Budgetary Implications of the Navy's Plan

Assessing the resources necessary to implement the Navy's plan for modernizing amphibious and maritime prepositioning forces requires dealing with uncertainty about the design of the MPF(F), the LSD(X), and even to some degree the LHA(R). But even allowing for that uncertainty, CBO's analysis indicates that the Navy's plan will cost substantially more than what the service has spent on amphibious and maritime prepositioning ships over the past 20 years.

Between 1980 and 2004, the amphibious warfare force received an average of about $1.1 billion a year (in 2005 dollars) for ship construction, or about 9 percent of the Navy's total shipbuilding budget.[13] With that funding, the Navy built an average of slightly less than 0.9 ships a year—almost enough annual production to keep the amphibious warfare force at 36 ships indefinitely.[14]

In all, modernizing the amphibious warfare force as the Navy plans to do and acquiring 21 new maritime prepositioning ships would cost an average of $2.4 billion a year between 2005 and 2035, CBO estimates—more than twice the average historical funding level (see Table 2-3). Even if the MPF(F) was excluded, costs would still average $1.5 billion per year. Moreover, the highest spending would occur in the next 10 years, when costs for amphibious and maritime prepositioning ships would average $3.1 billion a year. Although annual costs would be substantially smaller in succeeding decades, at no point in CBO's projection would they be at or below the historical average level.

Senior Navy leaders appear to recognize the funding challenge posed by that modernization program. Because of the high value those leaders place on acquiring a sea-basing capability, they want to free resources to pay for the MPF(F) program.[15] Consequently, they are considering reducing the number of expeditionary strike groups to eight, in conjunction with employing crew rotation for ships in those groups. If such a reduction occurred—and led the Navy to cut the number of LPD-17s to eight, delay the first LHA(R) by 15 years, and buy only eight LSD(X)s in the 2020s—the result would be substantial savings relative to the current plan. Construction costs for both L-class and maritime prepositioning ships would average $1.8 billion a year between 2005 and 2035 instead of $2.4 billion (see the section labeled "Reduced Navy Plan" in Table 2-3). Over the next 10 years, construction costs would average $2.0 billion annually instead of $3.1 billion.

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13. Even during the 1980s, a decade that included the Reagan Administration's defense buildup, the Navy still spent an average of $1.1 billion a year on amphibious ships.

14. That steady-state production level is calculated by dividing the total number of ships by their service life. In this case, 36 amphibious ships divided by a 40-year service life equals a production rate of 0.9 per year.

15. Christopher J. Castelli, "Navy Wants to Cut Number of Strike Groups, Slash LPD-17 Shipbuilding," *Inside the Navy*, April 26, 2004, and "Navy May Cut Number of Expeditionary Strike Groups to Fund MPF(F)," *Inside the Navy*, July 12, 2004.

Table 2-3.

Average Annual Construction Spending and Procurement for Amphibious and Maritime Prepositioning Ships, 2005 to 2035

	Historical Average, 1980-2004	Projected Average			
		2005-2014	2015-2024	2025-2035	2005-2035
		Navy Plan			
Construction Spending (Billions of 2005 dollars)					
Amphibious warfare ships	1.1	1.5	1.2	1.8	1.5
Maritime prepositioning ships	n.a.	1.6	1.2	0	0.9
Total	**1.1**	**3.1**	**2.3**	**1.8**	**2.4**
Procurement Quantity					
Amphibious warfare ships	0.9	0.9	0.7	1.1	0.9
Maritime prepositioning ships	n.a.	1.0	0.9	0	0.6
Total	**0.9**	**1.9**	**1.6**	**1.1**	**1.5**
		Reduced Navy Plan[a]			
Construction Spending (Billions of 2005 dollars)					
Amphibious warfare ships	1.1	0.3	0.7	1.6	0.9
Maritime prepositioning ships	n.a.	1.6	1.2	0	0.9
Total	**1.1**	**2.0**	**1.9**	**1.6**	**1.8**
Procurement Quantity					
Amphibious warfare ships	0.9	0.2	0.4	0.9	0.5
Maritime prepositioning ships	n.a.	1.0	0.9	0	0.6
Total	**0.9**	**1.2**	**1.3**	**0.9**	**1.1**

Source: Congressional Budget Office.

Note: n.a. = not applicable (because most current maritime prepositioning ships are leased by the Navy from private firms).

a. CBO assumed that if the Navy reduced the number of expeditionary strike groups to eight, it would end the LPD-17 program at eight ships instead of 12, delay the LHA(R) program until 2022, and buy eight LSD(X)s instead of 12.

Although the increases in spending discussed above may seem modest relative to the Navy's entire budget of $120 billion, they should be considered in the context of other shipbuilding needs. To maintain today's 293-ship fleet in a steady state, the Navy would have to spend an average of about $12.8 billion annually on ship construction, CBO estimates. However, between 1990 and 2004, the Navy spent an average of about $8.9 billion a year on shipbuilding (see Table 2-4), including conversions and nuclear-refueling overhauls of existing ships as well as construction of new ones. As a consequence, it built up a cumulative shortfall of about $58 billion and 16 ships relative to the amounts needed to keep the fleet at the current size. Thus, if the Navy wants to have at least 293 ships at the end of the 35-year period that began in 1990—because the average service life of the entire fleet is about 35 years—it must make up that shortfall in ship construction over the next two decades.

Average spending on ship construction has risen in recent years, to about $9.3 billion a year from 2001 to 2005 (excluding overhaul and conversion programs), although it remains far below the steady-state requirement. If that level of spending continued for the next two decades, the Navy would face an additional shortfall of $58 billion, for a total of $116 billion over the 1990-2025 period. That shortfall would result in 44 fewer ships' being bought

Table 2-4.

Shortfalls in Sustaining a 293-Ship Navy, 1990 to 2025

Type of Ship	Annual Average, 1990-2004	Steady-State Requirement[a]	Historical Cumulative Surplus or Shortfall (-) Relative to Steady-State Requirement, 1990-2004	Projected Cumulative Surplus or Shortfall (-) Relative to Recent Shipbuilding Plans, 2005-2025[b]	Total Cumulative Surplus or Shortfall (-), 1990-2025
			Construction Spending (Billions of 2005 dollars)[c]		
Surface Combatants	3.7	3.4	4.7	2.8	7.5
Attack Submarines	1.9	4.0	-39.9	-31.9	-71.9
Ballistic Missile Submarines	0.3	1.0	-8.6	-19.0	-27.6
Aircraft Carriers	1.4	2.3	-15.2	-6.9	-22.1
Amphibious Ships	1.1	1.3	-0.2	0.7	-0.5
Other	0.5	0.7	-0.8	-3.6	-2.8
Total	**8.9**	**12.8**	**-58.3**	**-57.9**	**-116.3**
			Quantity[d]		
Surface Combatants	3.4	3.1	4.3	-2.6	6.8
Attack Submarines	0.6	1.8	-17.4	-13.9	-31.2
Ballistic Missile Submarines	0.1	0.3	-3.0	-6.7	-9.7
Aircraft Carriers	0.1	0.2	-1.6	-1.0	-2.6
Amphibious Ships	0.9	0.9	-0.1	0.4	0.3
Other	2.1	2.0	2.2	-10.0	-7.9
Total	**7.3**	**8.3**	**-15.6**	**-28.5**	**-44.2**

Source: Congressional Budget Office.

a. The annual purchases and spending required to maintain the fleet at a certain size (in this case, the current size, 293 battle force ships). To determine steady-state purchases, CBO divided the Navy's inventory of ships by the service life of each type of ship. To determine steady-state spending, CBO multiplied those annual purchases by its estimate of the unit (per-item) cost of each type of ship.

b. "Recent plans" refers to average construction spending and purchases between 2001 and 2005.

c. Money spent for construction of new ships and for major conversions and nuclear-refueling overhauls of existing ships.

d. The Navy does not buy fractional ships, of course, but showing the data to one decimal place provides greater understanding of historical and future trends.

during that period than the number needed to maintain the fleet at 293—implying that the Navy's battle force would total around 250 ships by 2025, far short of the 375-ship goal espoused in recent years.

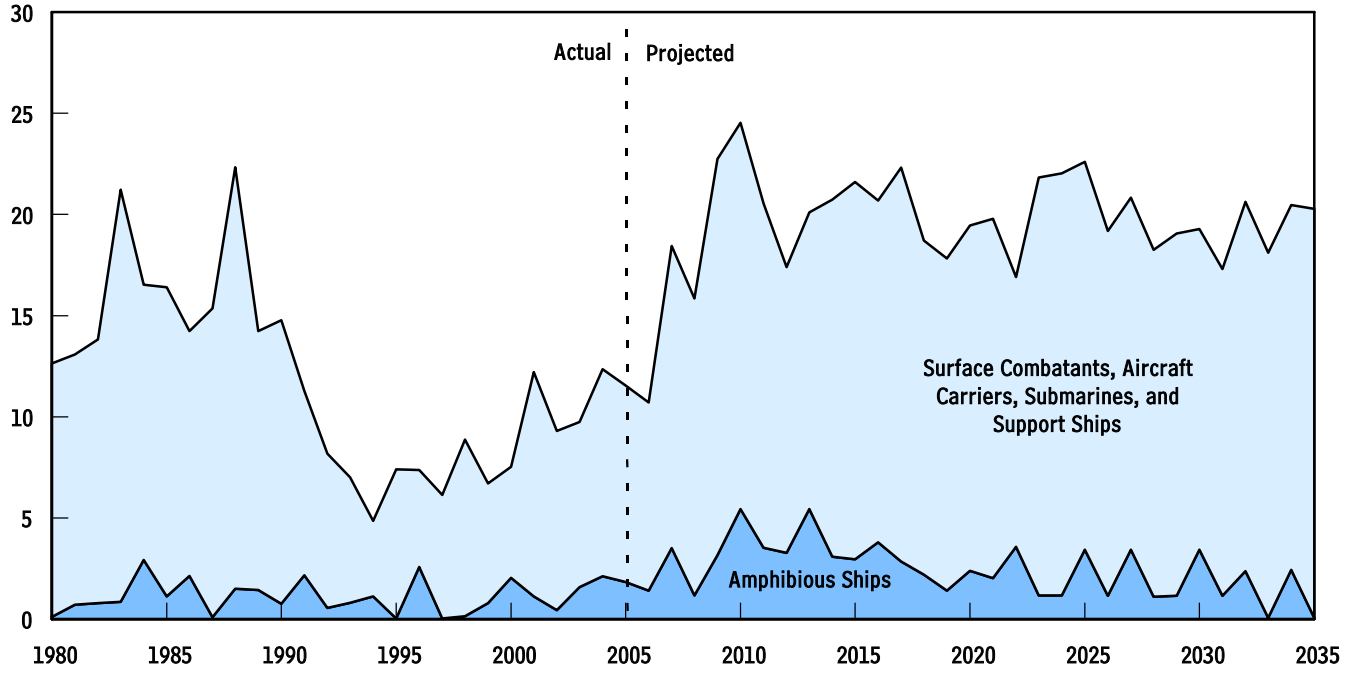
Thus, in the context of past funding levels, the Navy's plans for amphibious and maritime prepositioning ships and for a larger overall force appear daunting. The Navy's proposal to build a 375-ship fleet would cost an average of about $19 billion a year through 2035, CBO estimates (see Figure 2-4).[16] Spending on amphibious and maritime propositioning ships would make up about 12 percent of the total—up from the average share of 9 percent that they have consumed since 1980.

16. That figure is roughly analogous to the cost-risk estimate for ships in Congressional Budget Office, *The Long-Term Implications of Current Defense Plans: Summary Update for Fiscal Year 2005* (September 2004).

Figure 2-4.

Projected Funding to Construct a 375-Ship Fleet Compared with Actual Ship Funding

(Billions of 2005 dollars)



Source: Congressional Budget Office.

Note: The data in this figure are roughly analogous to the cost-risk case for ships presented in Congressional Budget Office, *The Long-Term Implications of Current Defense Plans: Summary Update for Fiscal Year 2005* (September 2004).

The Navy could address those funding issues in myriad ways. The next chapter examines four alternatives to the Navy's current plan for the amphibious and maritime prepositioning forces. Two of the options would keep spending on those forces at its historical level, and the other two would require spending increases, though not to as great an extent as the Navy's plan would. Chapter 4 compares the capabilities of the forces that would result from those alternatives.

CHAPTER

3

Lower-Cost Alternatives to the Navy's Plan for Amphibious and Maritime Prepositioning Forces

As Chapter 2 described, the Navy faces a funding challenge with its plans for shipbuilding as a whole and for amphibious and maritime prepositioning ships in particular. The Navy could ameliorate that situation in many ways. To illustrate some of them, the Congressional Budget Office constructed four alternative plans for modernizing those ships at a lower cost than under the Navy's plan. All of the alternatives would result in a smaller amphibious force than exists today.

The first two alternatives would modernize the amphibious and maritime prepositioning forces within historical spending levels—an average of $1.1 billion a year, in 2005 dollars—by purchasing either fewer but more-capable ships (Option 1A) or more but less-capable ships (Option 1B). Those approaches represent the most drastic change from the Navy's plan. The other two alternatives would cost about 36 percent more (an average of $1.5 billion a year). Option 2 would reduce the number of expeditionary strike groups from 12 to eight but make those eight capable of conducting sea-basing operations, in conjunction with Maritime Prepositioning Force (Future) ships, by 2035. Option 3, by contrast, would abandon the sea-basing concept and focus on providing forward presence with ESGs. Under that alternative, the amphibious warfare and maritime prepositioning forces in 2035 would look much like they do today, though somewhat smaller.

This chapter describes in detail the different force structures that would result from those approaches. Chapter 4 examines how capable the alternative force structures would be in peacetime and wartime compared with today's expeditionary warfare fleet and with the one envisioned in the Navy's plan.

These options focus only on issues related to shipbuilding. None would change the number or size of Marine Corps units or the total end strength of the Corps (now 175,000 active officers and enlisted personnel). Consequently, they would not alter the quantities of air and ground equipment that the Marine Corps plans to procure in coming years.[1] Nor would any of the alternatives adopt rotational crewing concepts, such as Sea Swap. (Chapter 4, however, describes the effect that Sea Swap would have on maintaining forward-deployed expeditionary strike groups.)

Option 1A: Buy Fewer, More-Capable Ships Within Historical Spending Levels

The first two options that CBO considered are driven mainly by funding issues. Since 1980, the Navy has devoted an average of about $1.1 billion annually to constructing amphibious ships. (It has devoted little to constructing maritime prepositioning ships because most of those vessels are leased from private firms.) CBO estimates that the Navy's plan would require spending an average of $2.4 billion over the next 30 years to build amphibious and maritime prepositioning ships. The service faces funding challenges in other areas as well. Its programs for attack submarines, surface combatants, and aircraft carriers all require more spending than has been available in recent years. (In particular, the Navy wants to buy large numbers of a new small, fast surface combatant

1. For details about those plans, see Congressional Budget Office, *The Long-Term Implications of Current Defense Plans: Detailed Update for Fiscal Year 2005* (September 2004).

called the littoral combat ship. Admiral Vern Clark, the Chief of Naval Operations, has called that ship the Navy's "most transformational effort and number one budget priority.")[2] Since the Navy cannot buy all of the ships it would like at its current level of funding, CBO developed two options to show the implications of modernizing amphibious and maritime prepositioning forces within the $1.1 billion historical funding level—or about half of what the Navy's plan would cost.

Option 1A would continue to pursue the transformational vision of sea basing while reducing the size of the amphibious warfare and maritime prepositioning forces. This approach would gradually cut the number of expeditionary strike groups by half (from 12 to six) and the number of maritime prepositioning squadrons by one-third (from three to two). One of those squadrons would be configured to support sea-based operations, and the other would consist of conventional cargo vessels along the lines of today's maritime prepositioning ships. Although ship purchases would be smaller in this option than in the Navy's plan, the same types of new, more-capable ships would be procured: the LHA(R) amphibious assault ship, the LSD(X) dock landing ship, and the sea-basing-capable MPF(F) ship (as well as replacement cargo ships).

Thus, in modernizing the amphibious and maritime prepositioning forces within the historical funding level, this approach emphasizes quality over quantity. (Option 1B, which is discussed in the next section, takes the opposite tack.) The L-class force, although much smaller than today's, would be replaced with modern and more-capable ships. The maritime prepositioning force would also be cut (though less dramatically) but would include one squadron with new aviation and sea-basing capabilities.

2. Scott C. Truver, "Navy Plans to Develop LCS Fleet with 'Lightening Speed,'" *Sea Power* (May 2003). For more details about that ship, see Congressional Budget Office, *Transforming the Navy's Surface Combatant Force* (March 2003); and Ronald O'Rourke, *Navy Littoral Combat Ship (LCS): Background and Issues for Congress,* Report for Congress RS21305 (Congressional Research Service, July 30, 2004), and *Navy DD(X) and LCS Ship Acquisition Programs: Oversight Issues and Options for Congress,* Report for Congress RL32109 (Congressional Research Service, September 3, 2004).

Shipbuilding Under Option 1A

Overall, this alternative would construct an average of 0.7 amphibious and maritime prepositioning ships a year between 2005 and 2035—less than half the 1.6-ship average under the Navy's plan. For L-class amphibious warfare vessels only, the shipbuilding rate would be 0.3 per year under this option, compared with 0.9 under the Navy's plan, which is also the historical rate.

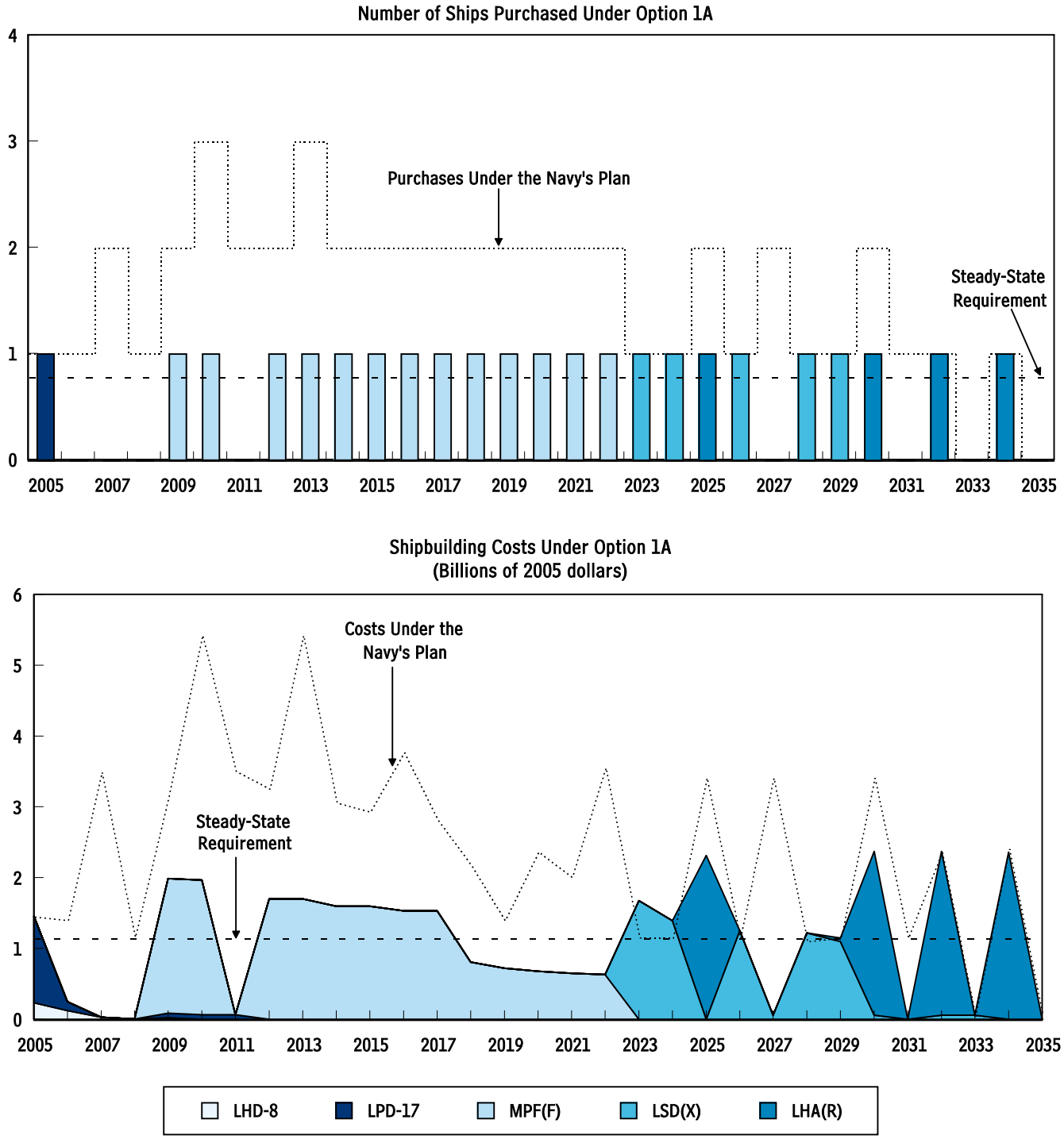
With an approach such as this, in which the level of resources is the driving factor, the Navy could choose among many different programs resulting in different compositions for the amphibious and maritime prepositioning forces. A key factor in determining the potential mix of ships would be the balance between L-class vessels and MPF(F) ships and between the types of ship within each of those categories. With respect to L-class ships, this alternative tries to take a balanced approach, maintaining relatively equal numbers of LPDs, LSDs, and LHA/LHDs. Likewise, with respect to the second category, it buys both MPF(F) ships with sea-basing capabilities and conventional maritime prepositioning ships.

Specifically, Option 1A would shrink the LPD-17 program from 12 to seven ships. It would delay the start of the LHA(R) program until 2025, 18 years later than under the Navy's plan, and would buy only four of those ships by 2035 instead of 10 (see Figure 3-1). The LSD(X) program would be delayed until 2023 and then only five ships would be purchased, compared with 12 under the Navy's plan. The MPF(F) program would be split between buying one squadron's worth (eight ships) of the "constrained" sea-basing-oriented design, which is capable of operating and supporting helicopters and tilt-rotor aircraft, and purchasing one squadron (five ships) of conventional prepositioning cargo vessels, similar to the ones in the force today.

Under this option, the total number of amphibious warfare and maritime prepositioning ships would decline from 51 in 2004 to 31 in 2035 (see Figure 3-2). The number of L-class vessels would remain at the planned level of 36 through 2010 but then fall steadily until 2035, when the force would settle into its new steady-state size of 18 ships—seven LPDs, five LSDs, and six LHA/LHD class ships (compared with 12 of each under the Navy's plan). The number of maritime prepositioning ships would decline from 16 now to 13, although eight of those 13 would be sea-basing ships.

Figure 3-1.

Annual Purchases and Costs of Amphibious and Maritime Prepositioning Ships Under Option 1A

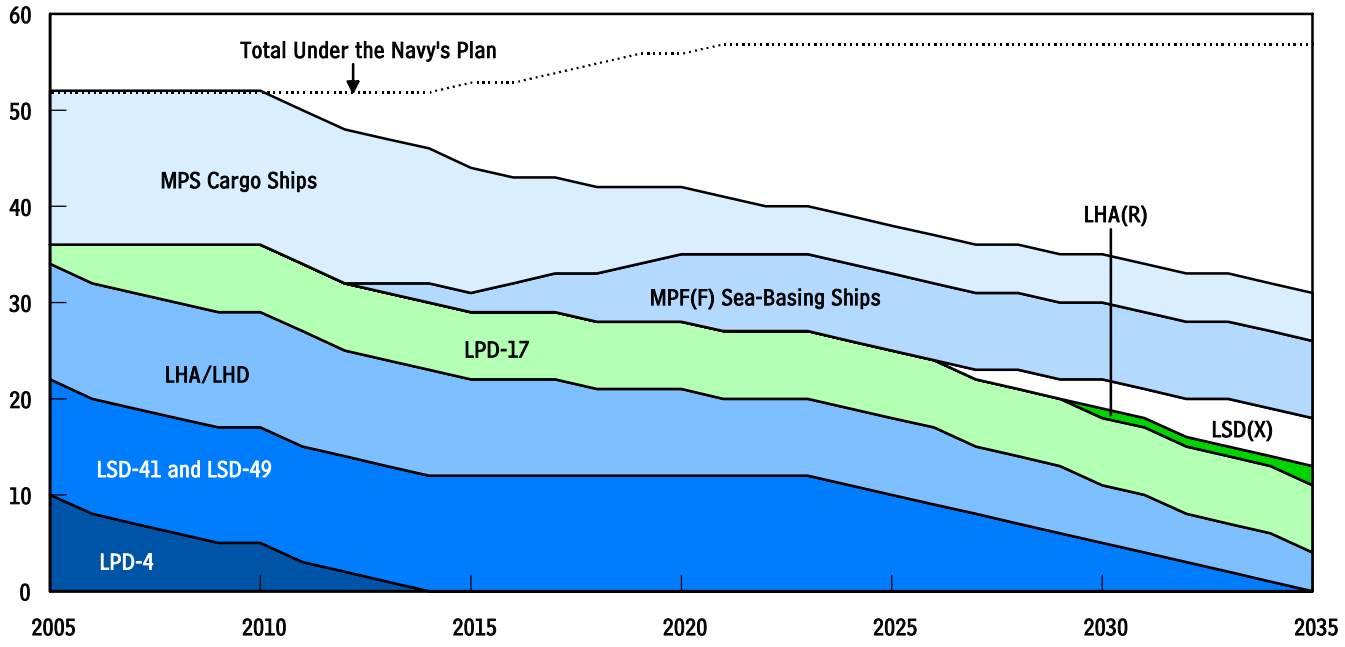


Source: Congressional Budget Office based in part on data from the Navy.

Note: The steady-state requirement is the annual purchases or spending needed to keep the amphibious and maritime prepositioning forces at the planned level (in the case of Option 1A, 31 ships) indefinitely. MPF(F) = Maritime Prepositioning Force (Future).

Figure 3-2.

Inventory of Amphibious and Maritime Prepositioning Ships Under Option 1A



Source: Congressional Budget Office based in part on data from the Navy.

Note: MPS = maritime prepositioning squadron; MPF(F) = Maritime Prepositioning Force (Future).

Lift Capability Under Option 1A

As described in Chapter 2, the Navy's plan would eventually provide enough lift for the equivalent of 5.5 Marine expeditionary brigades: 2.5 MEBs of amphibious lift, 2.0 MEBs of lift on sea-basing ships, and 1.0 MEB of sealift on cargo ships. By comparison, this option would provide 3.25 MEBs of lift overall: 1.25 MEBs of amphibious lift, 1.0 MEB of sea-based lift, and 1.0 MEB of sealift.

Costs of Option 1A

Under this alternative, the Navy would spend an average of $1.1 billion a year on ship construction from 2005 to 2014, $1.1 billion from 2015 to 2024, and $1.2 billion from 2025 to 2035—for an annual average of $1.1 billion over CBO's projection period (see Table 3-1). Including operation and support (O&S) costs for those ships, Option 1A would require an average of $3.4 billion in annual spending during that period. Those costs are much lower than under the Navy's plan, which would spend $3.1 billion on ship construction between 2005 and 2014, $2.3 billion between 2015 and 2024, and $1.8 billion between 2025 and 2035—for an overall average of $2.4 billion a year, or $5.5 billion including O&S costs.

As another point of comparison, if the ships in this option were bought at a steady-state rate (the number of ships in the force divided by their 40-year service life), this approach would require slightly more than $1.1 billion in annual funding (see Figure 3-1).

Option 1B: Buy More, Less-Capable Ships Within Historical Spending Levels

If the Navy is forced to fund amphibious ships at the historical average of about $1.1 billion a year but is loath to cut the L-class force to the extent envisioned in Option 1A, it can maintain a larger number of ships by not investing in any new designs. This option illustrates that approach: it would keep the future amphibious warfare and maritime prepositioning forces at a greater size than under Option 1A but would not pursue the enhanced sea-basing capability sought by the Navy and Marine Corps. In other words, for the same amount of money as Option 1A, this alternative would emphasize quantity over quality.

Table 3-1.

Projected Average Annual Spending for Construction and Operation and Support, 2005 to 2035

(Billions of 2005 dollars)

	2005-2014	2015-2024	2025-2035	Total, 2005-2035
Navy's Plan				
Ship Construction	3.1	2.3	1.8	2.4
Ship Construction and O&S	6.0	5.5	5.0	5.5
Option 1A: Buy Fewer, More-Capable Ships				
Ship Construction	1.1	1.1	1.2	1.1
Ship Construction and O&S	3.8	3.3	3.0	3.4
Option 1B: Buy More, Less-Capable Ships				
Ship Construction	1.1	1.2	1.0	1.1
Ship Construction and O&S	3.9	3.7	3.4	3.6
Option 2: Create a More Survivable Sea-Basing Force				
Ship Construction	1.6	1.3	1.6	1.5
Ship Construction and O&S	4.3	3.5	3.5	3.8
Option 3: Deemphasize Sea Basing in Favor of Forward Presence				
Ship Construction	1.4	1.3	1.8	1.5
Ship Construction and O&S	4.2	3.8	4.4	4.1

Source: Congressional Budget Office.

Notes: O&S = operation and support.

By comparison, between 1980 and 2004, the Navy spent an average of about $1.1 billion per year (in 2005 dollars) on construction of amphibious warfare ships. (It mainly leased rather than built maritime prepositioning ships.)

In this alternative, the number of ESGs would gradually be cut by one-quarter, from 12 to nine (leaving 50 percent more ESGs than in Option 1A). The number of maritime prepositioning ships would be reduced by a little more than half a squadron. Amphibious warfare ships would be replaced by ships similar in size and capabilities to existing classes, and maritime prepositioning ships would be replaced by modern cargo ships with no sea-basing capabilities.

Shipbuilding Under Option 1B

Overall, this alternative would construct an average of 1.0 amphibious warfare or maritime prepositioning ship a year between 2005 and 2035, compared with 0.7 ships under Option 1A and 1.6 under the Navy's plan. The shipbuilding rate for only L-class vessels would be 0.6 per year under this approach—twice the rate in Option 1A but one-third less than in the Navy's plan.

With respect to specific programs, this option would terminate the LPD-17 program at nine ships. It would delay the start of the LHA(R) program by six years, until 2013 (see Figure 3-3). Six of those ships would be purchased through 2035—twice as many as in Option 1A. The LSD(X) program would start in 2020, and a total of nine ships would be purchased. This option would also buy 12 conventional MPF(F) ships, enough for about 2.5 maritime prepositioning squadrons. Unlike in Option 1A, those squadrons would not have any sea-basing capabilities. With those changes, the steady-state amphibious warfare force would number nine LPDs, nine LSDs, and nine LHA/LHD class ships (compared with 12 each under the Navy's plan and seven, five, and six, respectively, under Option 1A).

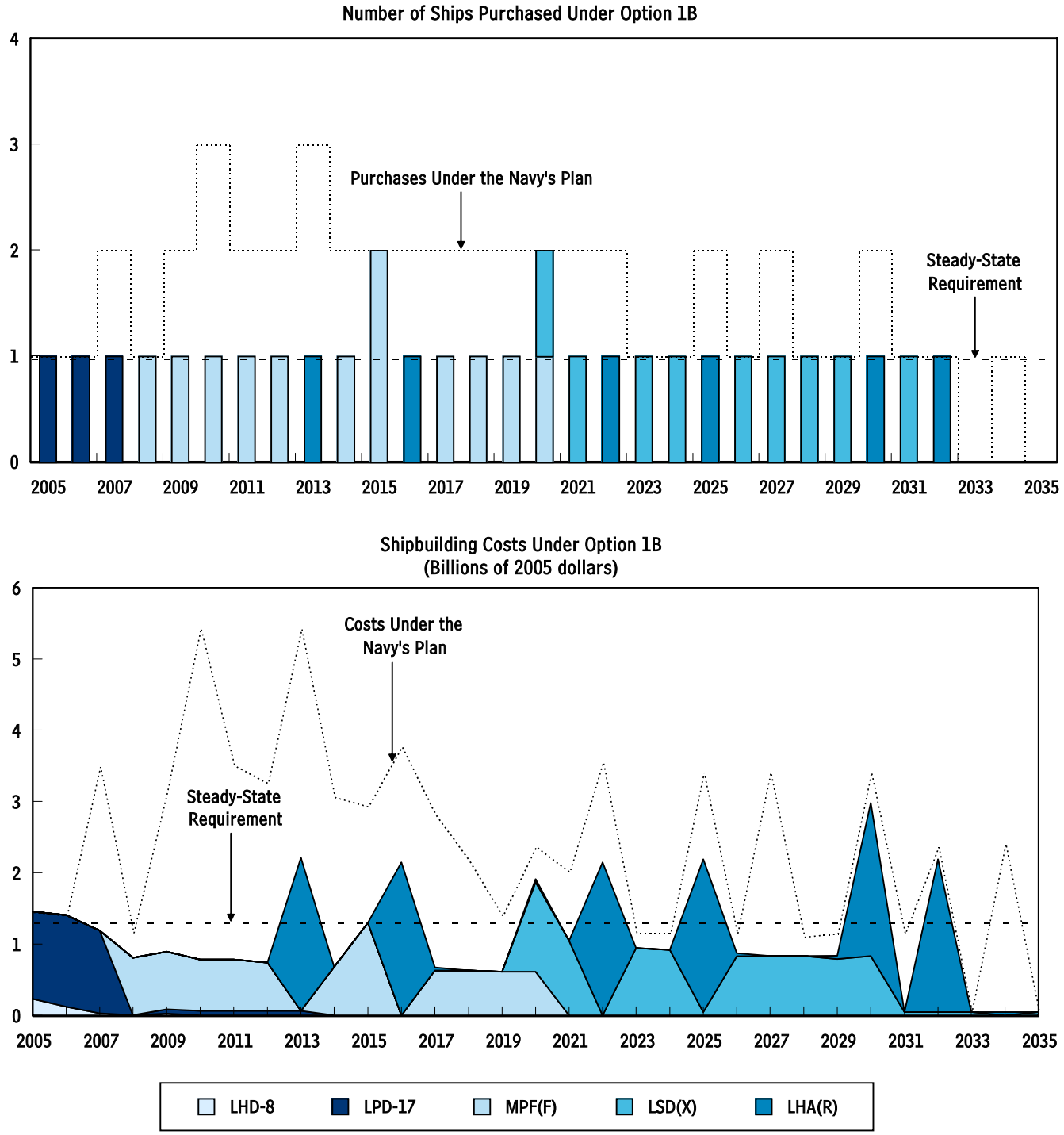
The total size of the amphibious warfare and maritime prepositioning forces would decline throughout the 2005-2035 period under this option (see Figure 3-4), though not as precipitously as under Option 1A. The number of L-class vessels would drop from 36 in 2005 to 27 by 2035, although it would hover in the low 30s through most of that period, falling to the steady-state level only near the end. The maritime prepositioning force would decline from 16 ships now to 12 ships by the 2020s. Thus, the overall force would number 39 ships in 2035, compared with 31 under Option 1A and 57 under the Navy's plan.

Lift Capability Under Option 1B

This approach would result in about 30 percent more lift capability than Option 1A: a total of 4.2 MEBs (1.8 MEBs of amphibious lift and about 2.4 MEBs of sealift) rather than 3.25 MEBs. However, that figure would still fall short of the Navy's planned total of 5.5 MEBs (2.5 MEBs of amphibious lift, 2.0 MEBs of sea-based lift, and 1.0 MEB of sealift). Because this alternative would not procure any ships with sea-basing capability, it would not provide any sea-based lift.

Figure 3-3.

Annual Purchases and Costs of Amphibious and Maritime Prepositioning Ships Under Option 1B

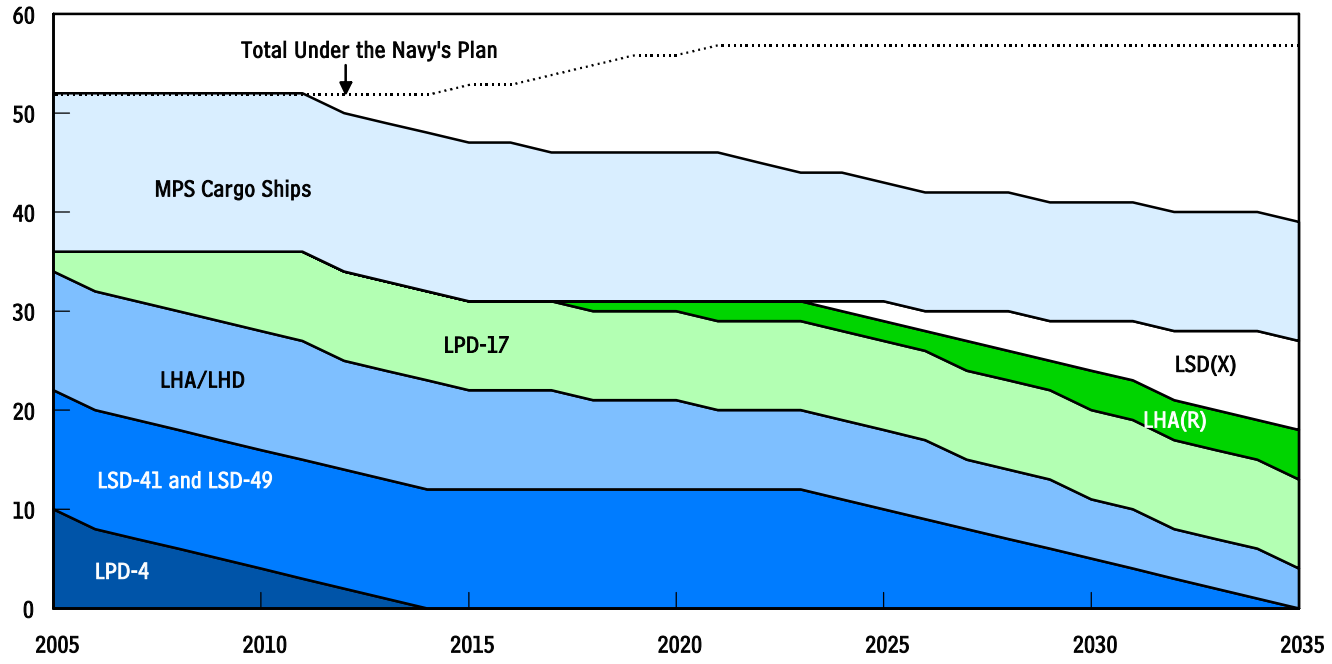


Source: Congressional Budget Office based in part on data from the Navy.

Note: The steady-state requirement is the annual purchases or spending needed to keep the amphibious and maritime prepositioning forces at the planned level (in the case of Option 1B, 39 ships) indefinitely. MPF(F) = Maritime Prepositioning Force (Future).

Figure 3-4.

Inventory of Amphibious and Maritime Prepositioning Ships Under Option 1B



Source: Congressional Budget Office based in part on data from the Navy.

Note: MPS = maritime prepositioning squadron.

Costs of Option 1B

As in Option 1A, the cost of building L-class vessels and maritime prepositioning ships would average $1.1 billion a year over the 2005-2035 period under this alternative—the same amount that the Navy spent, on average, between 1980 and 2004 and much less than the $2.4 billion annual average needed to fund the Navy's plan (see Table 3-1 on page 35). During the first 10 years of the projection period, construction costs would average a bit less than $1.1 billion. They would vary slightly in succeeding decades, averaging $1.2 billion between 2015 and 2024 and a little less than $1.0 billion between 2025 and 2035. Those procurement costs compare reasonably well with the steady-state spending level of about $1.3 billion a year required to keep the amphibious and maritime prepositioning force at 39 ships indefinitely (see Figure 3-3).

Because this approach would operate more ships than Option 1A, it would entail larger operation and support costs. With both O&S and construction included, this alternative would cost an average of $3.6 billion annually over 30 years, versus $3.4 billion under Option 1A.

Option 2: Create a More Survivable Sea-Basing Force

As noted in Chapter 2, the Navy is considering not only modernizing the amphibious warfare force but also shrinking it as part of a reduction in the number of expeditionary strike groups from 12 to eight. To illustrate some of the implications of such a decision, this option also cuts the number of ESGs to eight.

At the same time, this alternative attempts to address the issue of the survivability of MPF(F)s that was raised in Chapter 2. The Navy plans to build those ships to an enhanced commercial standard (apparently something less than Level I survivability), which is equivalent to the survivability of the Navy's cargo ships, but it intends to use the sea-basing-capable MPF(F)s in potentially demanding wartime environments. This option would instead build those ships to a higher level of survivability than the Navy plans, although less than that of amphibious warfare ships (Level II).[3]

3. For an explanation of the Navy's survivability standards for ships, see Box 2-2 on page 25.

Under this approach, the Navy would modernize both the amphibious warfare force and the maritime prepositioning force but would cut the number of ESGs by one-third and the number of maritime prepositioning squadrons by two-thirds (from three to one). The remaining squadron would be composed of MPF(F)s of the constrained sea-basing design, built to enhanced levels of survivability and capable of operating and supporting helicopters and tilt-rotor aircraft. Because both this option and the next one are meant to emphasize issues other than funding pressures, CBO did not constrain them to the historical level of spending on amphibious ships. Instead, it chose simply to keep costs substantially below the level that the Navy's plan would require.

One of the arguments that the Navy and Marine Corps use to justify the need for sea basing is that, in the future, ballistic and cruise missiles could pose too great a threat to a land base in a theater of operations. In time (or perhaps at the same time), however, those missiles could prove just as threatening to MPF(F) ships. Such vessels would be the second largest ships in the theater (if one of the Navy's large aircraft carriers was also operating there) but would have the lowest level of survivability. Moreover, MPF(F) ships would be some of the most detectable and thus targetable ships in the fleet and would operate much closer to shore than aircraft carriers would.

The Navy argues that Sea Shield—the network of defensive capabilities provided by its ships, aircraft, and sensor and electronic warfare systems—would protect MPF(F) ships from threats posed by missiles, mines, small boats, and submarines. However, an important component of employing Sea Shield would be destroying the sites of ballistic and cruise missiles early, before the missiles could be launched to threaten U.S. forces. Doing that would give an advantage not only to U.S. sea-based forces but also to the land base that sea basing is supposed to replace. The issue, then, seems to rest on whether "leakers"—any surviving missiles that were not destroyed at the point of origin—would pose a greater threat to a land base than to a sea base. As noted in Chapter 2, a strike by a single conventional missile against a land base would probably do less damage to ongoing military operations than would the same strike against an MPF(F), which would represent one-eighth of all of the capabilities of a sea-basing squadron. In addition, land bases, once established, would not be threatened by any mines or submarines that might have escaped the notice of Sea Shield.

Shipbuilding Under Option 2

This alternative would construct an average of 0.8 amphibious and maritime prepositioning ships per year between 2005 and 2035—half as much as under the Navy's plan. The building rate for L-class vessels would be 0.5 ships per year—versus 0.9 under the Navy's plan.

The LPD-17 program would end at eight ships instead of 12 under this approach. The LHA(R) program would be delayed from 2007 until 2022, with six ships purchased through 2035 (see Figure 3-5). The LSD(X) program would begin at the same time as in the Navy's plan (2020), but only eight ships would be bought rather than the 12 now envisioned. This option would also purchase eight constrained-design MPF(F) ships, with sea-basing capabilities and enhanced survivability, starting in 2009. (The potential cost of upgrading the survivability of the MPF(F) is discussed below.)

Under this alternative, the amphibious warfare and maritime prepositioning forces would reach their steady-state sizes—24 L-class ships (eight LPDs, eight LSDs, and eight LHDs/LHAs) and eight MPF(F) ships—between 2022 and 2024 (see Figure 3-6). That overall force of 32 ships would be 24 less than in the Navy's plan.

Lift Capability Under Option 2

This approach would result in 1.7 MEBs of amphibious lift, 1.0 MEB of sea-based lift, and no sealift, for 2.7 MEBs overall. That total is only half of the level in the Navy's plan: 5.5 MEBs overall (2.5 MEBs of amphibious lift, 2.0 MEBs of sea-based lift, and 1.0 MEB of sealift).

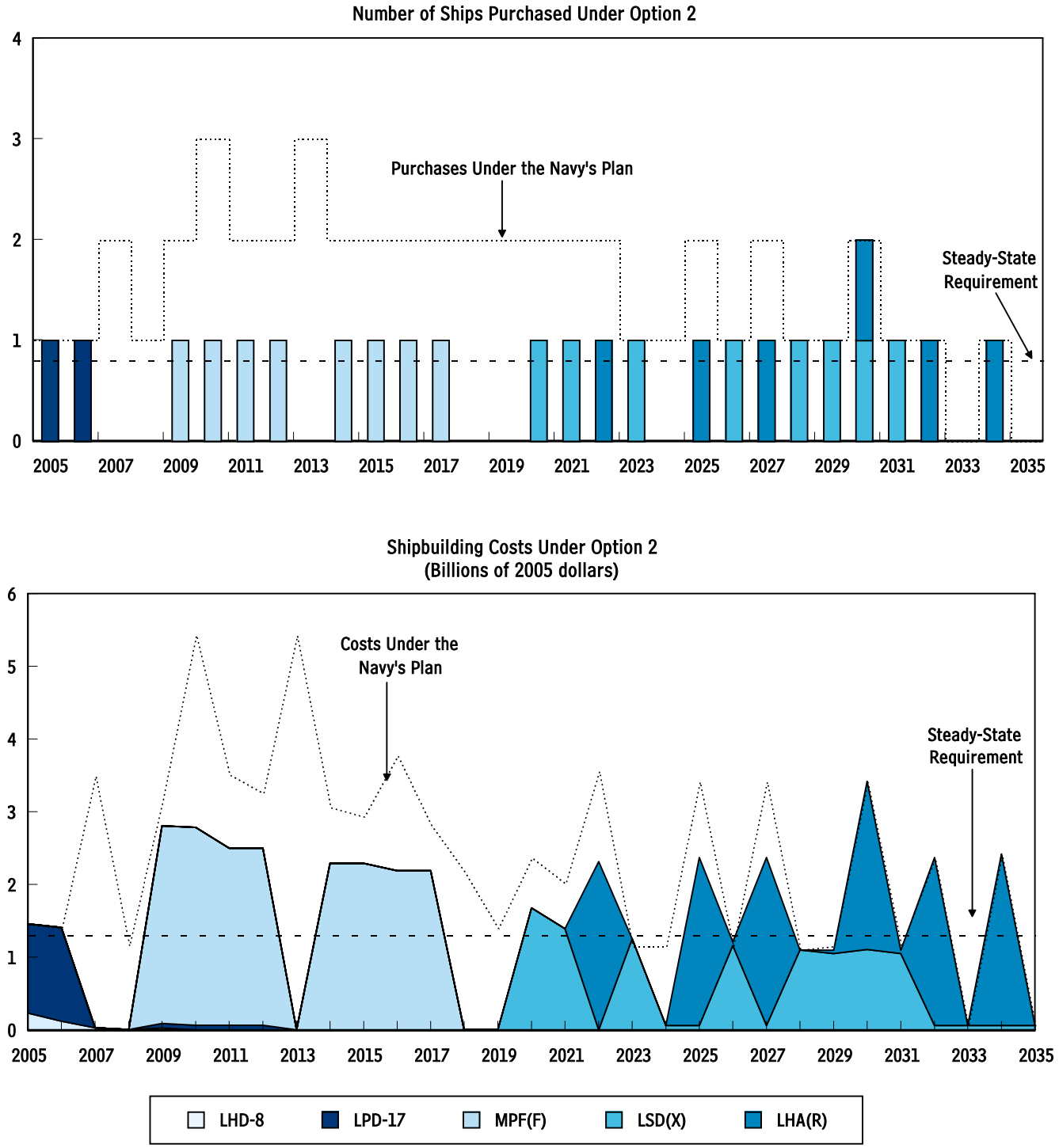
Costs of Option 2

Although it would require more spending on ship construction than either Option 1A or 1B, this alternative would cost substantially less than the Navy's plan, particularly in the next 20 years (see Figure 3-5). Between 2005 and 2035, this option would spend an average of $1.5 billion on ship construction, or $3.8 billion with O&S costs included. By comparison, annual costs under the Navy's plan would average $2.4 billion and $5.5 billion, respectively.

Average construction spending would vary in each succeeding decade of the projection period: $1.6 billion

Figure 3-5.

Annual Purchases and Costs of Amphibious and Maritime Prepositioning Ships Under Option 2

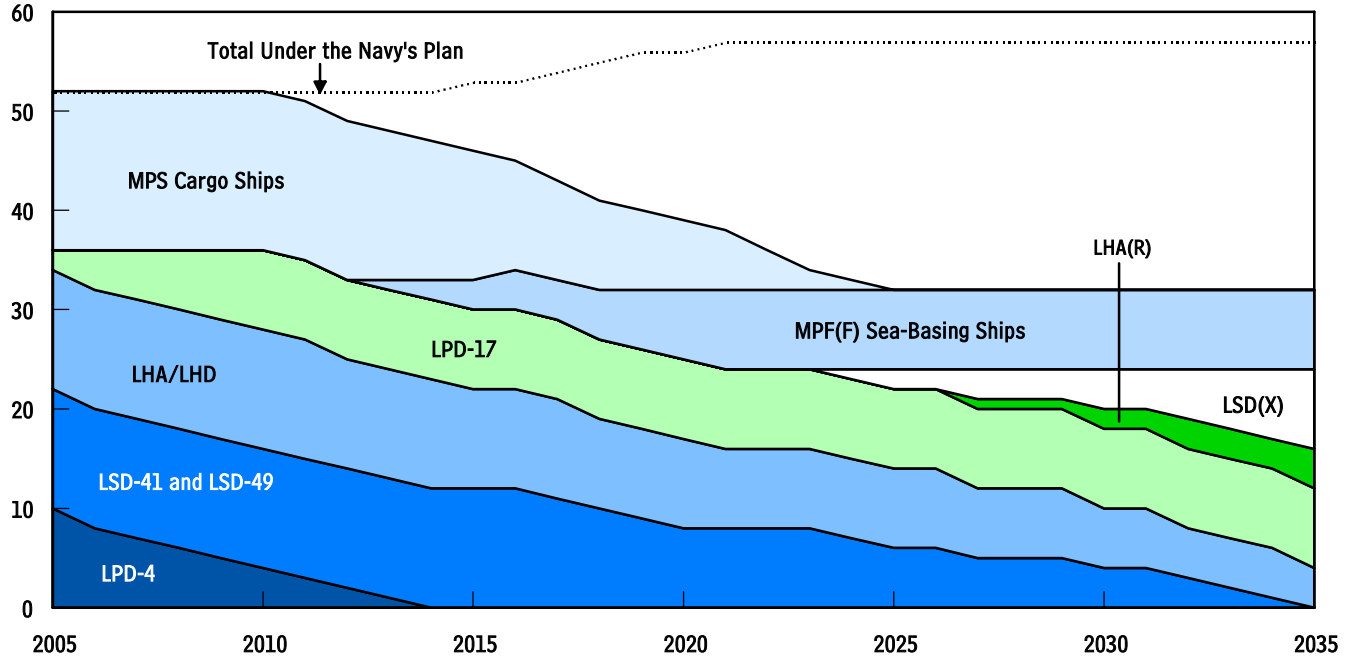


Source: Congressional Budget Office based in part on data from the Navy.

Note: The steady-state requirement is the annual purchases or spending needed to keep the amphibious and maritime prepositioning forces at the planned level (in the case of Option 2, 32 ships) indefinitely. MPF(F) = Maritime Prepositioning Force (Future).

Figure 3-6.

Inventory of Amphibious and Maritime Prepositioning Ships Under Option 2



Source: Congressional Budget Office based in part on data from the Navy.

Note: MPS = maritime prepositioning squadron; MPF(F) = Maritime Prepositioning Force (Future).

from 2005 to 2014, $1.3 billion from 2015 to 2024, and $1.6 billion from 2025 to 2035. Those averages compare well with a steady-state funding requirement of $1.4 billion per year for a 32-ship force.

Because the MPF(F) ships in this option would be built to higher survivability standards than the Navy intends, they would have a higher price tag than their counterparts in the other options. L-class ships, which are built to Level II survivability, cost about $80 million per thousand tons (see Table 3-2). The estimates for lead ships in the analysis of alternatives conducted by the Center for Naval Analyses—which CBO used for its options—suggest that sea-basing MPF(F) ships would cost about $40 million per thousand tons. To illustrate what a more survivable version might cost, CBO priced the MPF(F) ships in this option at about $60 million per thousand tons. At that price, eight ships of that class would cost about $2.2 billion apiece, on average—comparable with the LHD-8 and the LHA(R). CBO did not analyze or estimate specific survivability enhancements to the MPF(F) designs proposed in the analysis of alternatives. Rather, the higher price per ton is intended to illustrate the potential effect on the Navy's budget of addressing concerns about survivability.

CBO cannot show in any measurable way how much more survivable these MPF(F) ships would be than the less expensive ships purchased under the other options and the Navy's plan. More-survivable ships clearly cost more, but not all survivability features of L-class vessels could be incorporated into the MPF(F), even if the Navy wished to do so. For example, design elements that increase a vessel's survivability include greater compartmentalization and watertight doors. However, because an MPF(F) would need to serve, at least in part, as a floating warehouse, it could not easily be designed and built with numerous watertight compartments. Nevertheless, the combat logistics ships that operate with carrier battle groups are built to a Level II survivability standard and thus are able to "fight hurt." CBO envisions that the MPF(F) ships in this option will have a greater ability to fight hurt, depending on the actual level of damage, than their counterparts in any other option or in the Navy's plan.

Table 3-2.

Estimated Costs of New Amphibious and Maritime Prepositioning Ships

	Light-Load Displacement (Thousands of tons)	Average Unit Cost (Billions of dollars)[a]	Cost per Thousand Tons (Millions of dollars)[b]
Ships Under Construction			
LPD-17	17.0	1.3	80
LHD-8	28.3	2.2	80
Proposed Ships			
LHA(R)[c]	30.5	2.4	80
LSD(X)	15.0[d]	1.2	80
Maritime Prepositioning Force (Future)			
Replacement-cargo-ship version (Navy's plan and Options 1A, 1B, and 3)	32.0	0.7	20
Sea-basing-capable version (Navy's plan and Option 1A)	38.0	1.6[e]	40[e]
More-survivable version (Option 2)	38.0	2.2[f]	60[f]

Source: Congressional Budget Office.

a. Rounded to the nearest $100 million.

b. Rounded to the nearest $10 million.

c. Based on the aviation-variant design.

d. CBO's estimate.

e. Estimate from the Center for Naval Analyses' analysis of alternatives for the MPF(F) program.

f. Derived from the sea-basing-capable version.

Option 3: Deemphasize Sea Basing in Favor of Forward Presence

Under this approach, the Navy would modernize both the amphibious warfare force and the maritime prepositioning force but with none of the sea-basing capability envisioned in the Navy's plan. The number of ESGs would be cut by one-sixth (from 12 to 10), and the number of maritime prepositioning squadrons would remain at three, although they would not be designed for sea basing. Once implemented, this option would provide much the same peacetime forward presence and maritime prepositioning capabilities as today's fleet.

The logic behind this approach is that the Navy's and Marine Corps's desire to develop a sea-basing capability could prove too expensive or difficult (or both) to achieve. In the most ambitious vision of sea basing, the military would have the ability to launch Operation Iraqi Freedom without using Kuwait as a staging area.[4] A more modest version would involve the ability to deploy two reinforced infantry battalions 110 nautical miles from their supporting ships. As noted in Chapter 2, that would require a large investment in sea-basing-capable MPF(F) ships—which, according to the Center for Naval Analyses, would cost two to four times more than a conventional replacement cargo ship. A host of new technologies would also be required to make sea basing work, including potentially costly heavy-lift rotary-wing aircraft and other ship-to-shore support craft (see Box 1-2 on page 13). Even if the investments necessary to produce those

4. According to Marine Corps Commandant Michael Hagee, "We come into the [Persian] Gulf, we do the arrival and assembly, we do the reception, staging, onward movement and integration at sea." Quoted in John T. Bennett, "Marine Corps Commandant, DSB Describe Visions of Sea Basing Concept," *Inside the Pentagon*, October 30, 2003, p. 1.

craft were made, it is not clear from current analyses that Marine Corps units could be deployed and adequately sustained from the sea in a variety of operating environments. In addition, although the likelihood of mounting an opposed amphibious assault in the future is unclear, it appears limited.

For all of those reasons, this approach emphasizes the peacetime crisis-response capabilities of the Navy and Marine Corps rather than their ability to conduct an opposed amphibious assault. The Navy's amphibious ready groups (now expeditionary strike groups) have responded frequently to crises around the world. Between 1991 and 2000, amphibious and (occasionally) maritime prepositioning ships took part in at least 55 operations, ranging from wars to various humanitarian operations. Cutting the crisis-response capability provided by amphibious ships in order to buy the new sea-basing capabilities of the MPF(F) may not make sense.[5] The Navy and Marine Corps would argue that the new MPF(F) ships would also be able to perform crisis-response missions, either independently or in conjunction with L-class amphibious ships, although that ability would depend on the design and operating concept of MPF(F) ships, which are still undetermined. Nevertheless, the ships of an expeditionary strike group are more versatile than the proposed sea-basing ships, can respond more quickly, and are far better equipped to handle unexpected problems or threats. Sacrificing the sea-basing capabilities of maritime prepositioning ships in exchange for a larger L-class force may therefore represent a viable alternative to the Navy's approach.

Shipbuilding Under Option 3

This alternative would construct more amphibious and maritime prepositioning ships than any of the other options that CBO examined: 1.2 per year between 2005 and 2035, compared with 1.6 under the Navy's plan. The building rate for L-class vessels would be 0.7 per year, which is close to the historical rate of 0.9 ships per year that the Navy's plan would provide.

With respect to specific programs, this option would end the LPD-17 program at 10 ships instead of 12. It would also delay the start of the LHA(R) program until 2013 and buy eight rather than 10 of those ships through 2035 (see Figure 3-7). The LSD(X) program would be delayed until 2022 and, as with the LPD-17, only 10 ships would be bought instead of 12. The MPF(F) program would include enough ships for three full squadrons, but they would be prepositioned cargo ships along the lines of today's vessels.

This option represents a smaller decline in fleet size relative to the Navy's plan of 57 ships than any of the other options examined in this study. The total expeditionary warfare fleet would remain at around 50 ships through 2013 and then decline to its steady-state level of 45 ships in 2023 (see Figure 3-8). That steady-state fleet would comprise 30 L-class ships—10 LPDs, 10 LSDs, and 10 LHA/LHDs (instead of 12 each under the Navy's plan)—and 15 conventional maritime prepositioning ships.

Lift Capability Under Option 3

This alternative would result in nearly as much lift capability as the Navy's plan and about the same as exists today: 5.0 MEBs overall (2.0 MEBs of amphibious lift and 3.0 MEBs of sealift) compared with the Navy's planned total of 5.5 MEBs overall (2.5 MEBs of amphibious lift, 2.0 MEBs of sea-based lift, and 1.0 MEB of sealift). Like Option 1B, this approach would not provide any sea-based lift because it would not procure any ships with sea-basing capability.

Costs of Option 3

With respect to average annual costs, this alternative would be much less expensive than the Navy's plan, but its costs would be higher than the historical funding level for amphibious ships. Between 2005 and 2035, this option would require spending an average of $1.5 billion a year to build new amphibious and maritime prepositioning ships. That spending would average $1.4 billion over the next 10 years, $1.3 billion from 2015 to 2024, and $1.8 billion from 2025 to 2035 (compared with $3.1 billion, $2.3 billion, and $1.8 billion, respectively, under the Navy's plan). With operation and support costs included, the Navy would need to spend an average of $4.1 billion a year on its expeditionary warfare force under this option (see Table 3-1 on page 35).

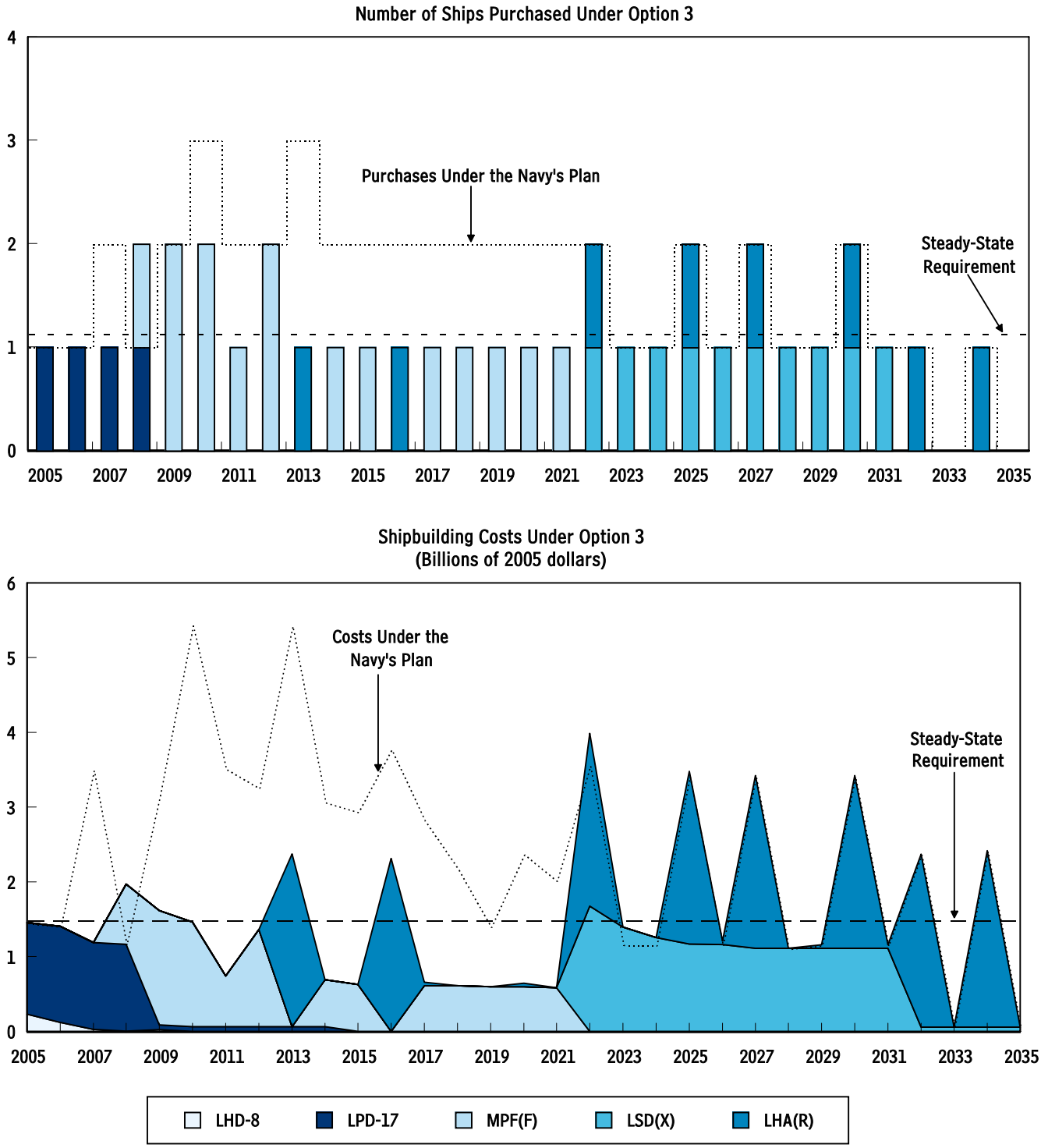
Effects of the Options on the Industrial Base

Any change in production plans for amphibious ships would have implications for the industrial base that

5. See, for example, Jason Ma, "Admiral Touts ESG's Quick-Response Capability for War on Terror," *Inside the Navy*, October 11, 2004.

Figure 3-7.

Annual Purchases and Costs of Amphibious and Maritime Prepositioning Ships Under Option 3

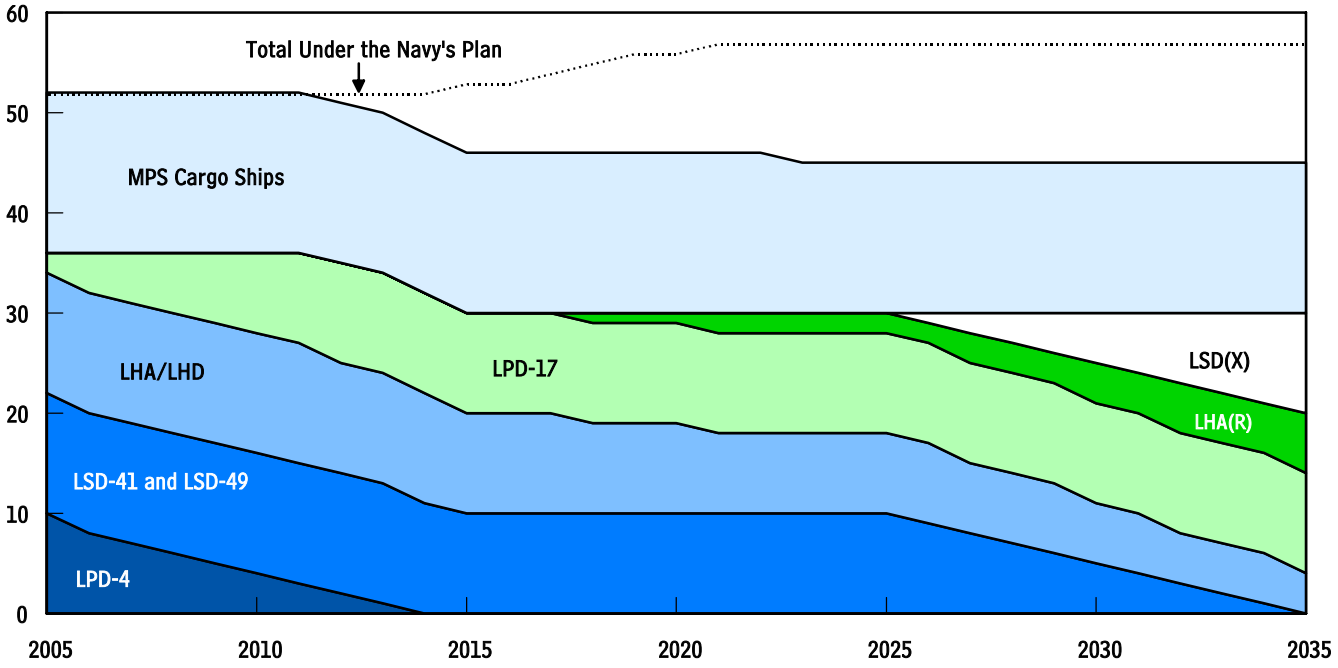


Source: Congressional Budget Office based in part on data from the Navy.

Note: The steady-state requirement is the annual purchases or spending needed to keep the amphibious and maritime prepositioning forces at the planned level (in the case of Option 3, 45 ships) indefinitely. MPF(F) = Maritime Prepositioning Force (Future).

Figure 3-8.

Inventory of Amphibious and Maritime Prepositioning Ships Under Option 3



Source: Congressional Budget Office based in part on data from the Navy.

Note: MPS = maritime prepositioning squadron.

builds those vessels. Assessing the precise impact over the next 10 years is difficult in the absence of data about how many man-hours would be needed to build the different MPF(F) designs. However, some studies have shown that overcapacity exists in the shipbuilding industrial base, in that today's 293-ship Navy could be supported with fewer than the six private shipyards that make up that base.[6]

Two shipyards—Bath Iron Works (owned by General Dynamics) and Avondale Industries (owned by Northrop Grumman)—are capable of building LPD- or LSD-sized amphibious ships. However, under a recent agreement brokered by the Navy, Bath will not receive any LPD-17 work; instead, it will build all of the remaining DDG-51 destroyers, the last three of which were authorized in the 2005 budget. Bath also anticipates receiving orders for the new DD(X) destroyer to provide it with work after the DDG-51s are completed. Under current plans, the second DD(X) is to be awarded to Bath (the lead ship of that class was awarded to Northrop Grumman), but that will not happen until 2007 or possibly later, depending on the progress of the program. In the case of Avondale Industries, reductions in LPD-17 work could lead the shipyard to cut its workforce by 2,000 people—and fall below the level it considers necessary to maintain its viability—by 2007 unless it receives new orders to take the place of the reduced LPD-17 work.

Ingalls Shipbuilding (also owned by Northrop Grumman) argues that the Navy's plan, which would authorize the LHA(R) in 2007, will reduce its workload in 2007 and 2008 below what it considers viable. Delay or cancellation of the LHA(R) program could prolong that period, depending on the final status of other ship programs, particularly the DD(X).

6. See Industrial College of the Armed Forces, *ICAF Industry Studies 2003: Shipbuilding* (Washington, D.C.: National Defense University, 2003), p. 8, available at www.ndu.edu/icaf/industry/IS2003/. In addition to the four shipyards mentioned below—Bath Iron Works, Avondale Industries, Ingalls Shipbuilding, and National Steel and Shipbuilding Company—Electric Boat Corporation (owned by General Dynamics) and Newport News Shipbuilding (owned by Northrop Grumman) also build Navy vessels.

The MPF(F) could provide additional work to any of those shipyards, but the first ship of that class is not scheduled to be authorized until 2009, and major production on it would not ramp up until 2010. Moreover, none of those yards has built logistics ships for the Navy in recent years. National Steel and Shipbuilding Company (owned by General Dynamics) is one of the Navy's traditional suppliers of sealift-type ships and hopes to participate in the MPF(F) program. That shipyard currently builds the T-AKE logistics ship, the last of which is scheduled to be authorized in 2007. However, it may receive or share in orders for the four T-AOE(X) combat logistics ships planned for 2009 and 2010.

CHAPTER

4

Measures of Capability Under the Options

The different approaches to structuring the amphibious warfare and maritime prepositioning forces described in Chapter 3 would provide differing capabilities. To evaluate how those force structures would compare with each other and with the Navy's plan, the Congressional Budget Office used various measures of both peacetime and wartime capability:

- The total number of amphibious warfare and maritime prepositioning ships in the Navy;
- The amount of amphibious lift available on L-class amphibious warfare ships, measured in terms of five traditional components: the number of troops, landing craft, and helicopters that can be carried as well as the amount of space for vehicles and cargo;
- The total amount of lift (amphibious lift, sea-based lift, and sealift) provided by amphibious warfare and maritime prepositioning ships;
- The total number of Joint Strike Fighters carried by amphibious assault ships;
- The number of expeditionary strike groups deployed in forward areas; and
- The time needed to deploy Marine infantry battalions in a hostile environment.

The Navy's principal mission in peacetime is to maintain a combat-credible forward presence. Thus, the most important measure of how well the amphibious force performs during peacetime is arguably the capabilities it provides on-station in three overseas theaters of operations: Europe, the Indian Ocean, and East Asia. In wartime, a better measure is how much actual combat capability the force can bring to bear in a particular period. The measures that CBO chose capture aspects of both the peacetime and wartime missions.

The strength of those measures is that they provide a clear picture of the kinds of capabilities that each option sacrifices in order to save money. Relative to today's capabilities, every alternative examined in this study would reduce forward presence by ESGs and decrease the number of Marine battalion landing teams that could be deployed. Those changes would take place fairly gradually: for example, under all of the options, the first reduction in the number of ESGs would occur in 2012.

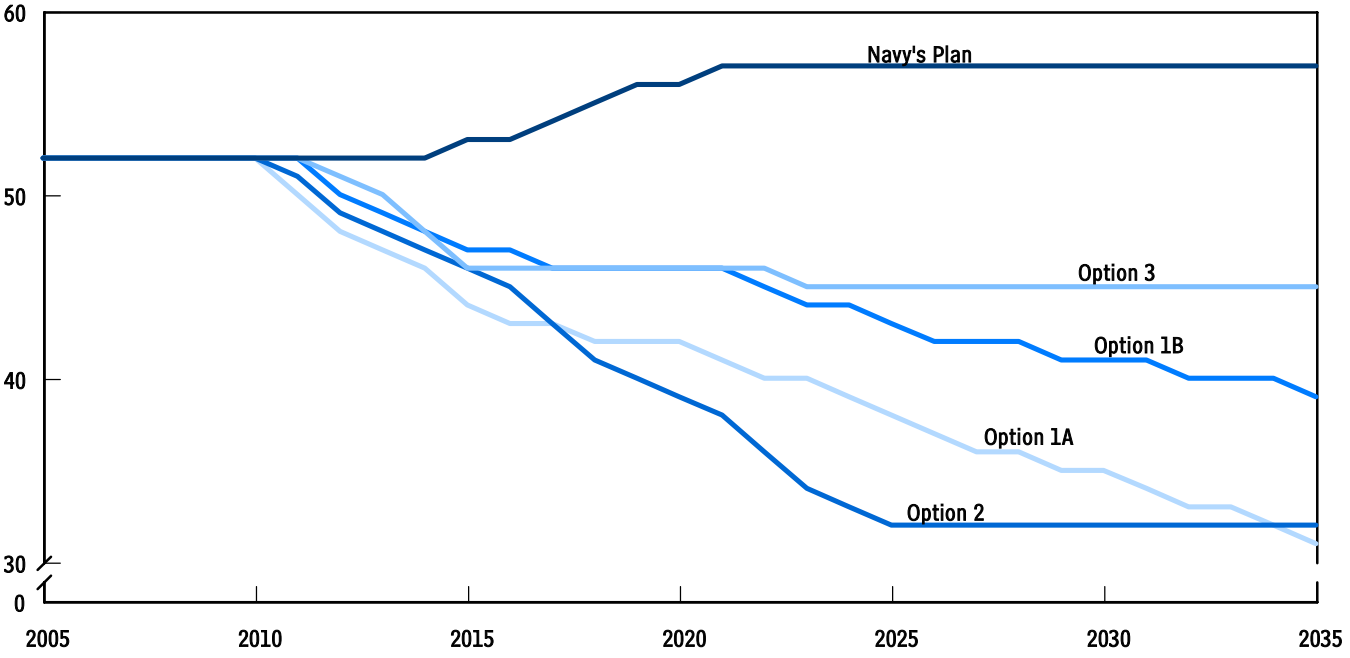
The measures of capability used in this analysis have limitations, however. Probably the most important shortcoming is that, if sea basing can be made to work, it will fundamentally alter the way the Navy and Marine Corps conduct military operations. Only the last measure—the speed with which Marine battalion landing teams can be put ashore—captures some of that effect. But none of the measures demonstrate the operational maneuverability that sea basing would provide to the amphibious forces that were equipped for it. The ability to move quickly and unpredictably is highly prized by today's Navy and Marine Corps leadership. Unfortunately, CBO could not find an effective way to quantify that ability.

Number of Amphibious Warfare and Maritime Prepositioning Ships

The total inventory of amphibious warfare and maritime prepositioning ships under the Navy's plan and the four alternatives that CBO examined measures the overall capacity of the force. (In no situation, however, would the entire force ever be available to deploy to a conflict, because at any one time some ships would be undergoing long-term maintenance and some units would be in training.)

Figure 4-1.

Total Number of Amphibious and Maritime Prepositioning Ships Under Alternative Force Structures



Source: Congressional Budget Office based in part on data from the Navy.

As with all of the measures used here, the Navy's plan would provide the largest number of amphibious warfare and maritime prepositioning ships: 57 by 2035 (see Figure 4-1). The less expensive alternatives would provide substantially fewer ships. Of those alternatives, Option 3 would produce the largest force, with 45 ships, followed by Option 1B, with 39 ships, because they would not buy the more expensive sea-basing maritime prepositioning ships. Options 1A and 2, which would invest in sea-basing capabilities, would result in much smaller forces: 31 and 32 ships, respectively. However, those two options differ in the speed with which they would reduce the force. Option 1A draws down the force less quickly than Option 2 does, so it results in more ships between 2016 and 2034 (even though it ends up with fewer ships than Option 2 by the end of CBO's projection period).

Amount of Amphibious Lift on L-Class Ships

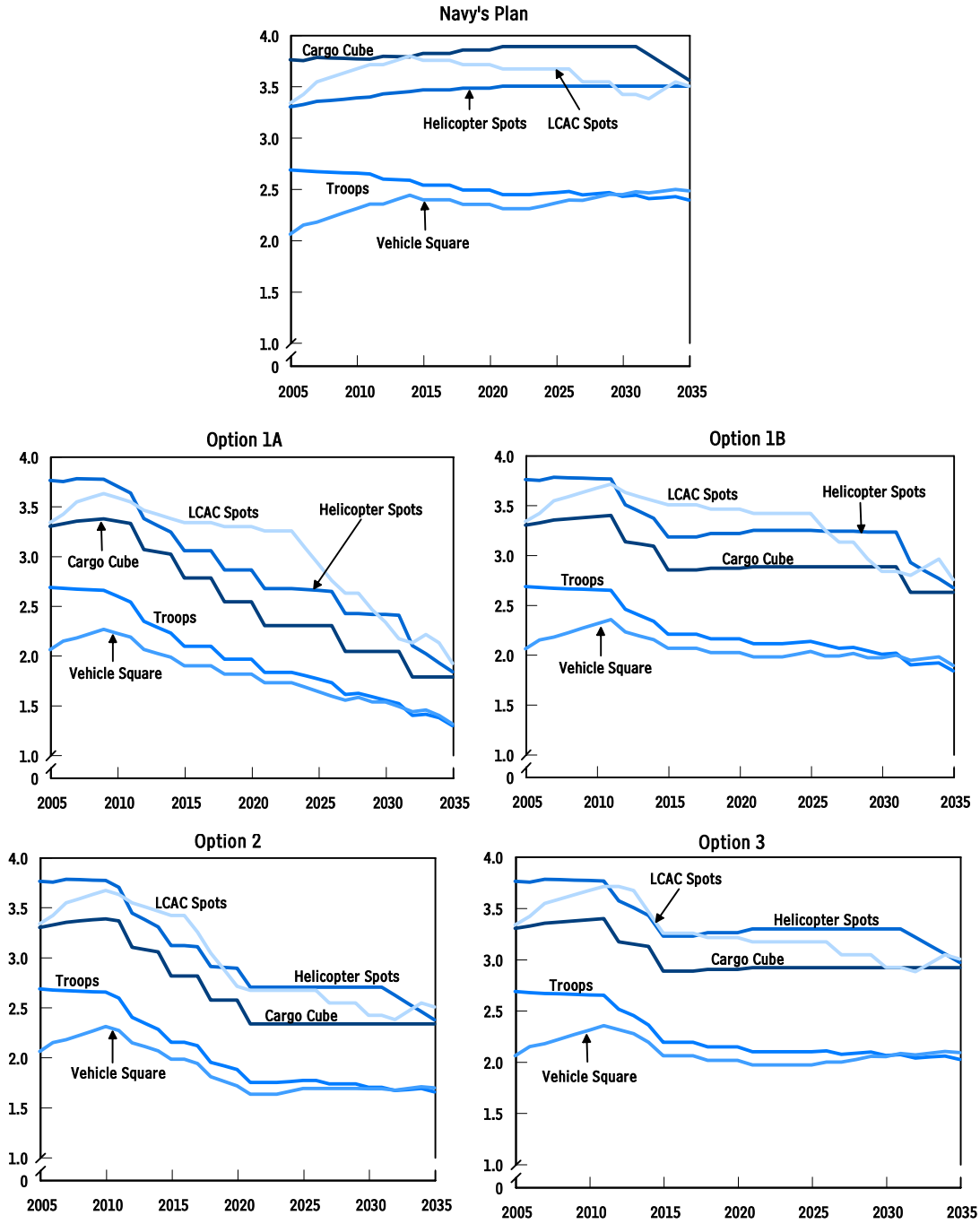
As noted in Chapter 1, for decades the traditional measure of capability for the amphibious force was its ability to carry Marine expeditionary brigades or some equivalent unit. Amphibious-lift capability is measured by five components: the amount of cargo space (called cargo cube) available; the number of troops that can be transported; the amount of space for vehicles such as tanks and trucks (referred to as vehicle square); the number of spots for carrying rotary-wing aircraft (expressed as CH-46 helicopter equivalents); and the number of spots for carrying air-cushion landing craft (or LCACs).

Since the early 1990s, the Marine Corps's official requirement for lift has been 3.0 Marine expeditionary brigades. The Navy has been unable to afford enough amphibious ships to provide that amount of lift, so it has adopted the "fiscally constrained" goal of 2.5 MEBs. However, actual amphibious-lift capacity is measured by the smallest component. Today, the amphibious force has enough vehicle square for only 1.9 MEBs (although it has excess capacity in the other components of amphibious lift), so that number is the current capability. It is set to rise to 2.1 MEBs by the end of 2005 with the arrival of the first LPD-17 class ship. Under the Navy's plan, amphibious-lift capability would grow to nearly 2.5 MEBs by 2025 and remain there through 2035 (see Figure 4-2).

Figure 4-2.

Components of Amphibious Lift on L-Class Ships Under Alternative Force Structures

(Marine expeditionary brigade equivalents)



Source: Congressional Budget Office based in part on data from the Navy.

Note: The five components of amphibious lift are the number of troops a ship can carry; its vehicle storage area, measured in thousands of square feet (or vehicle square); its cargo storage area, measured in thousands of cubic feet (or cargo cube); the number of spots for parking vertical takeoff and landing aircraft (expressed as CH-46 helicopter equivalents); and the number of spots for air-cushion landing craft (known as LCACs).

All of the alternative approaches in this study would result in less amphibious lift than the Navy's plan would. Option 1A would produce the greatest decline because it would cut the number of L-class vessels the most. By 2035, it would provide only enough amphibious lift for 1.3 MEBs. By contrast, Option 3, which would sacrifice sea-basing capability to maintain a larger L-class force, would provide enough amphibious lift for 2.0 MEBs—only slightly more than the amount available today. Options 1B and 2 would provide lift for 1.8 and 1.7 MEBs, respectively.

As is the case today, vehicle square would be the limiting component of amphibious lift under all four of the options for most of the period covered by this analysis. Troop space would also be in relatively short supply by 2035. (Figure 4-3 provides more detail about how the Navy's plan and the alternatives in this study compare in terms of those two key components.)

Total Amount of Lift on Amphibious Warfare and Maritime Prepositioning Ships

Amphibious lift is only one aspect of transporting and sustaining Marine Corps units in naval expeditionary operations. A broader measure of capability is the total lift for troops and equipment provided by the amphibious warfare and maritime prepositioning forces. Currently, that total is 4.9 MEBs—1.9 on amphibious warfare ships and 3.0 on conventional maritime prepositioning ships—although the Navy's goal is a total lift capacity of 5.5 MEBs. By introducing sea basing, the Navy's plan would achieve that goal but would change its composition—to 2.5 MEBs of lift on L-class ships, 2.0 MEBs on new sea-basing maritime prepositioning ships, and 1.0 MEB on conventional cargo ships similar to the maritime prepositioning vessels in the fleet today.

Of the alternatives examined in this study, Option 3 would provide the largest amount of lift: 5.0 MEBs in 2035 (see Figure 4-4)—less than under the Navy's plan but more than exists now. That higher capacity results because Option 3 would retain the largest number of conventional maritime prepositioning ships and forgo the Navy's and Marine Corps's sea-basing initiative. At the other end of the scale, Option 2 would provide the least amount of total lift—2.7 MEBs by 2035—because the goal of procuring more-survivable sea-basing maritime prepositioning ships would come at the expense of a larger overall lift force. Options 1A and 1B would provide 3.3 MEBs and 4.4 MEBs, respectively, by 2035, while keeping the amount spent on procuring the new ships that provide that lift at the historical funding level.

Number of JSFs Carried on Large Amphibious Assault Ships

Comparing the number of Joint Strike Fighters that the Navy's amphibious assault ships can carry highlights the importance of that aircraft, in the eyes of many Marine Corps officials, for future amphibious operations. The JSF is designed to have the range and payload to provide close air support to distant Marine operations ashore. The more JSFs available on amphibious ships, the better able the force will be to perform the close-air-support mission.

The JSF's importance is also reflected in the Navy's decision to design the new LHA(R) amphibious assault ship to support more flight operations by such aircraft. The first LHA(R)—what is being called Flight 0—is being designed to carry 23 JSFs. The Navy hopes that future versions of the ship—Flight 1—will carry up to 30 of those fighters. (For the purposes of this analysis, however, CBO assumed that all subsequent LHA(R)s would carry the same number of JSFs as the first one.) In addition, the Navy expects existing LHA and LHD class amphibious assault ships to carry 20 JSFs when the ships are configured in a carrier role. As a result, the Navy's plan would produce an amphibious assault fleet capable of carrying a total of 264 JSFs by 2035.

Of the alternatives, Option 3 would come closest to the Navy's plan because it would retain the largest number of big amphibious assault ships. By 2035, that option would provide the capacity to carry 218 Joint Strike Fighters, followed by Option 1B with 195, Option 2 with 172, and Option 1A with 126 (see Figure 4-5).

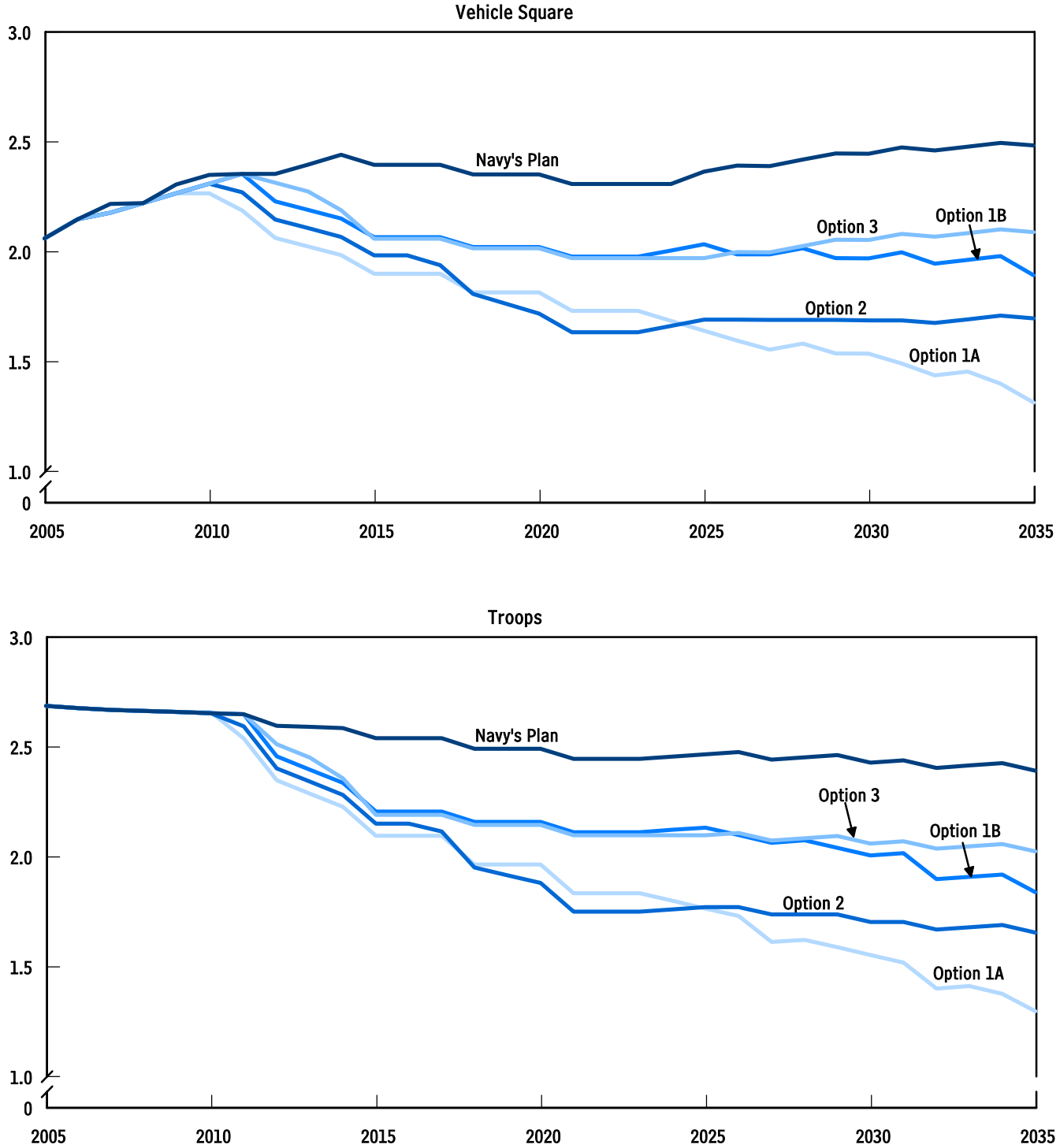
Number of Forward-Deployed Expeditionary Strike Groups

Although amphibious-lift capacity has long been the traditional measure of capability for the Navy's amphibious forces, the amount of forward presence provided by expeditionary strike groups has grown in importance. Amphibious ships are often called on to respond to small-scale crises around the globe. For example, they are the

Figure 4-3.

Lift Capacity for Troops and Vehicles on L-Class Ships Under Alternative Force Structures

(Marine expeditionary brigade equivalents)



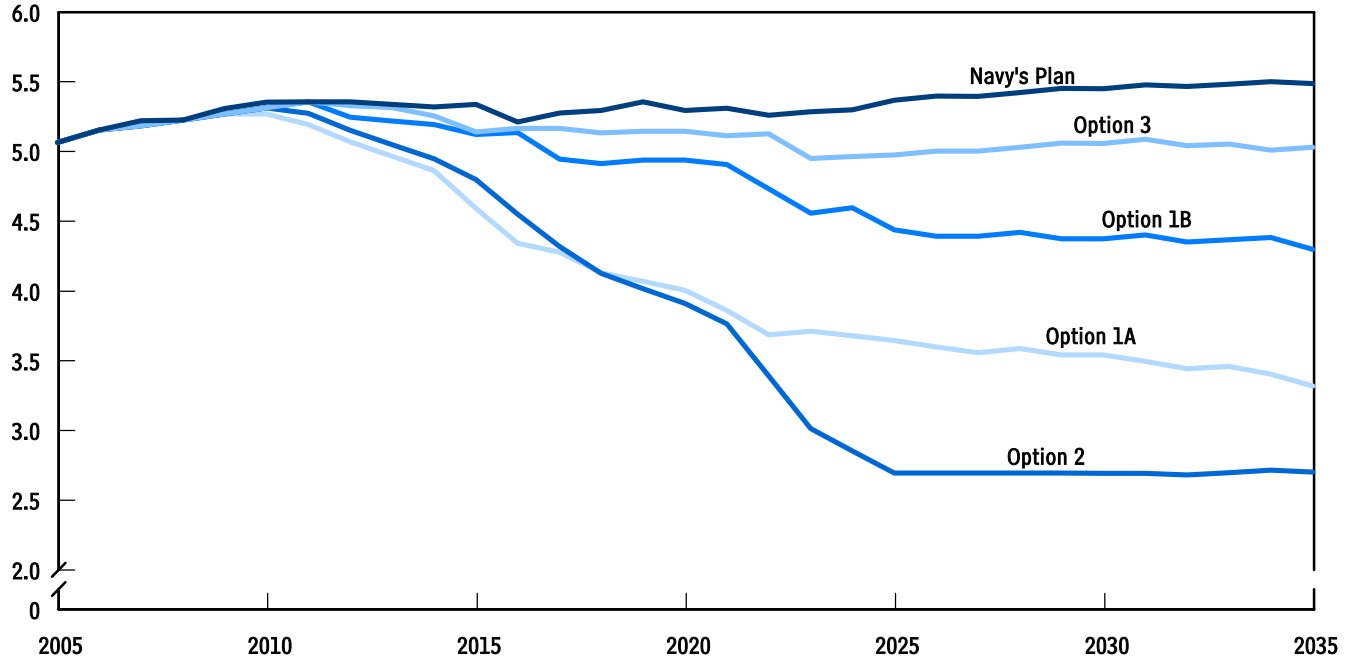
Source: Congressional Budget Office based in part on data from the Navy.

Note: Vehicle square is vehicle storage area measured in thousands of square feet.

Figure 4-4.

Total Lift Provided by the Amphibious and Maritime Prepositioning Forces Under Alternative Force Structures

(Marine expeditionary brigade equivalents)



Source: Congressional Budget Office based in part on data from the Navy.

Note: Total lift comprises amphibious lift on L-class ships, sea-based lift on sea-basing-capable Maritime Prepositioning Force (Future) ships, and sealift on conventional maritime prepositioning ships.

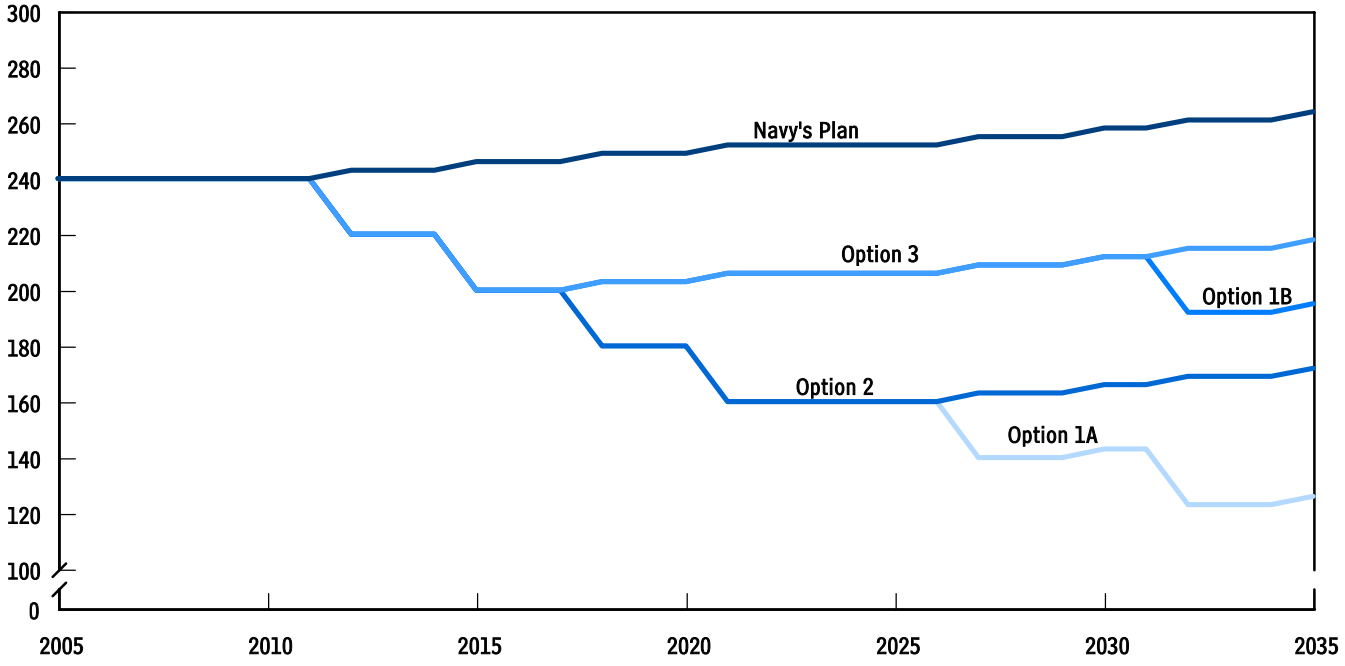
military's tool of choice for evacuating U.S. personnel from a country or providing humanitarian aid because the Marine Corps units on those ships have the skills and equipment to transport goods and people between ship and shore. In many cases, amphibious ships do not operate together when they are forward deployed. A group of three amphibious ships will often split up to cover two or three locations and thereby extend those ships' unique capabilities to a broader area.

Under current practices for crewing, maintenance, and training, an average of about 2.7 ESGs are forward deployed at any given time out of the 12 in the fleet. Recently, senior Navy leaders, including Chief of Naval Operations Vern Clark, have suggested that the Navy experiment with rotating crews and marines to forward-deployed amphibious ships (rather than having a ship and its crew and marines return home between deployments) in order to provide more presence with fewer ships. A similar policy, called Sea Swap, is being used on some types of surface combatants. The Navy has found that Sea Swap allows Arleigh Burke class destroyers to provide about 35 percent more presence than ships of the same class not using crew rotation. If the Navy achieved the same results with ESGs and maintained 12 such groups, it could keep an average of 3.6 ESGs forward deployed. (As a practical matter, however, Admiral Clark has indicated that he hopes the use of crew rotation will allow the Navy to reduce the size of the amphibious force and still maintain roughly the current level of overseas presence.)

With current operating practices, the Navy's plan would provide the highest level of forward presence by ESGs (see Figure 4-6). Because all four options would cut the number of ESGs, they would provide less overseas coverage. Option 3 would put an average of 2.4 ESGs on-station by 2035—slightly less than under the Navy's plan—and Option 1B would provide 2.2 ESGs. Option 2, which, with respect to L-class vessels, is consistent with proposals to reduce the amphibious force to eight expedi-

Figure 4-5.

Total Number of Joint Strike Fighters Carried by Amphibious Ships Under Alternative Force Structures



Source: Congressional Budget Office based in part on data from the Navy.

tionary strike groups, would keep 2.1 ESGs forward deployed, on average. Option 1A would keep only 1.8 ESGs on-station because it would make the deepest cuts to the L-class force.

If the Navy could successfully rotate crews to amphibious ships, along the lines of Sea Swap, that picture would be brighter. Three of the alternatives would provide more forward presence than today's larger amphibious force, which does not yet employ rotating crews. By 2035, Option 3 would keep an average of 3.2 ESGs forward deployed, followed by Option 1B with 3.0 ESGs and Option 2 (which maintains a total of eight strike groups) with 2.8 ESGs. Only Option 1A would provide less than the current level of forward presence, with an average of 2.4 ESGs forward deployed at any one time.

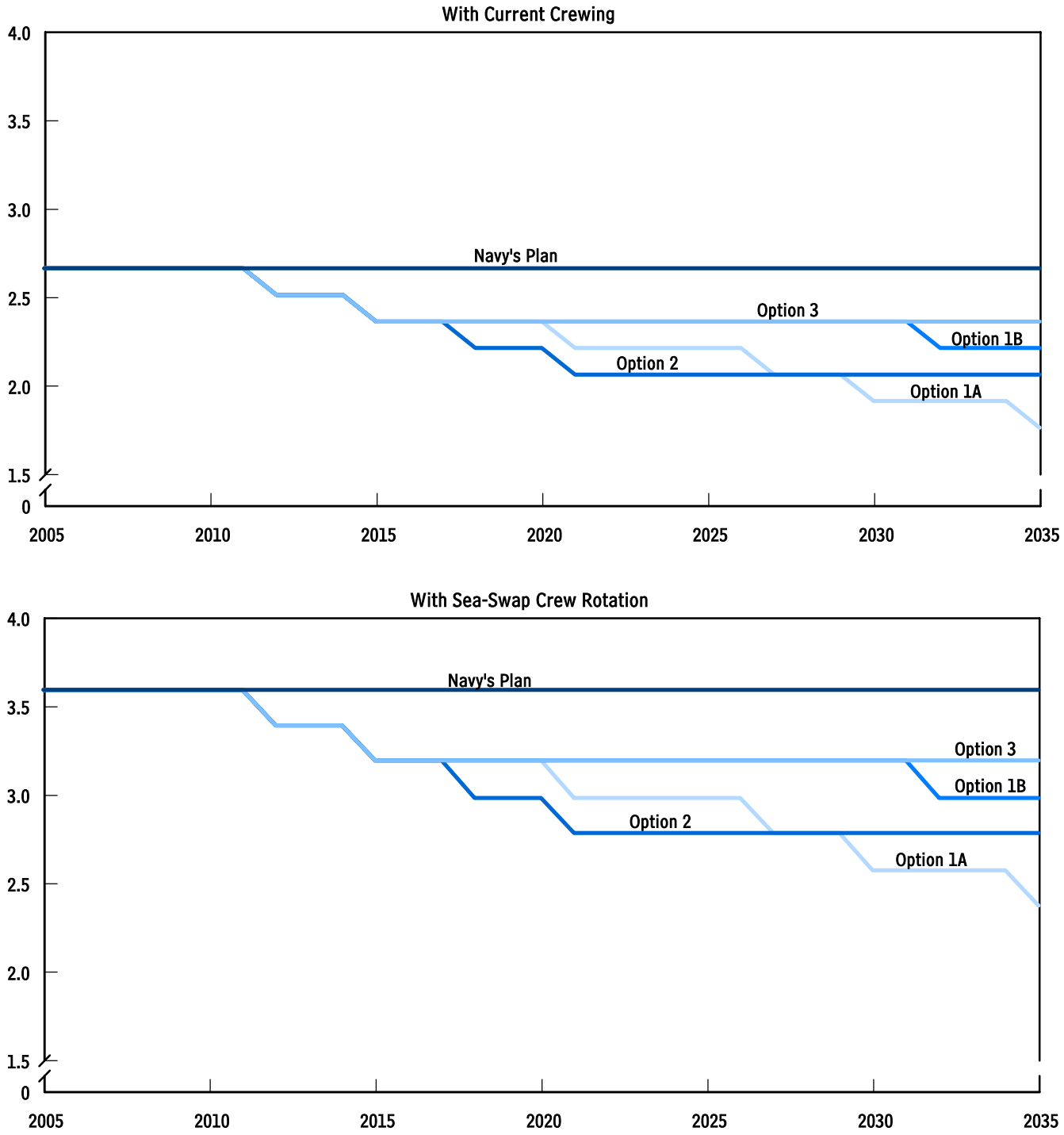
Time Needed to Deploy Marine Infantry Battalions to a Conflict

The Navy and Marine Corps use the speed with which Marine battalion landing teams can be put ashore in a hostile environment—more than any other measure—to demonstrate the potential effect of sea basing. Today, with a total force structure of 12 expeditionary strike groups and three maritime prepositioning squadrons, the Navy believes it could insert 15 Marine infantry battalions into a theater of operations within 10 weeks (see the top panel of Figure 4-7). That estimate assumes that no land base on friendly territory would be available in the theater; instead, the marines on L-class ships would have to seize a beachhead and secure it before the battalions supported by the maritime prepositioning squadrons could be assembled and begin operating. The first battalions to arrive would come from the two ESGs that would be forward deployed at any given time. Another four battalions would come from amphibious ships surged from bases in the United States and would start operating by the fifth week. The nine battalions supported by the maritime prepositioning squadrons could begin operating (a few battalions at a time) in weeks eight, nine, and 10.

According to the Navy and Marine Corps, sea basing would accelerate that process by at least three weeks. With a force structure of 12 ESGs (including 36 am-

Figure 4-6.

Average Number of Expeditionary Strike Groups Forward Deployed Under Alternative Force Structures



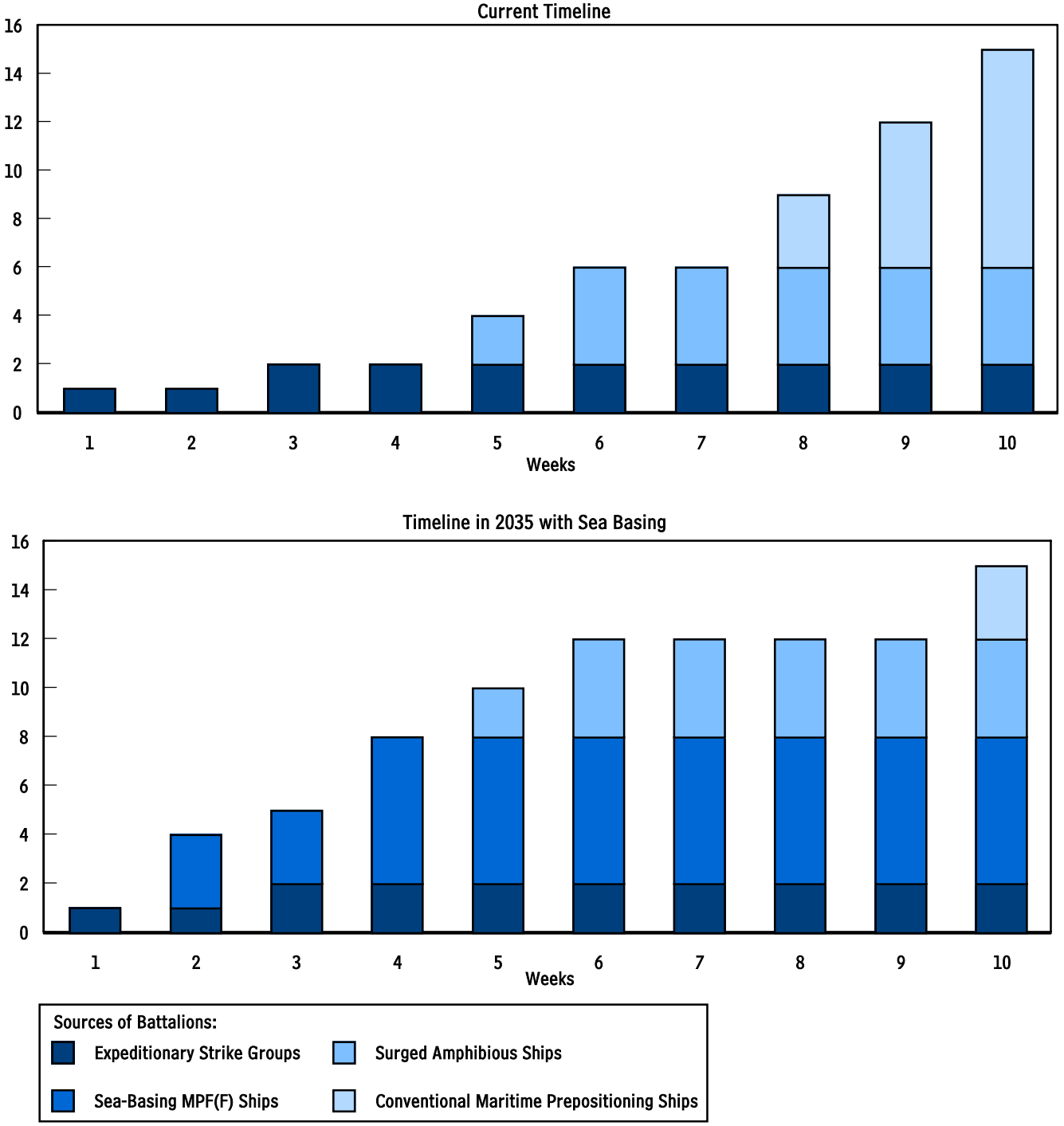
Source: Congressional Budget Office based in part on data from the Navy.

Note: Sea Swap is the Navy's plan to rotate crews every six months to forward-deployed ships in order to increase the amount of forward presence they provide.

Figure 4-7.

Time Needed to Deploy Marine Infantry Battalions in a Hostile Environment Under the Navy's Plan

(Number of battalions)



Source: Congressional Budget Office based on data from the Navy.

Notes: Under the current timeline, the amphibious assault would begin in week 5 or 6. Under sea basing, operations could begin as early as week 2. MPF(F) = Maritime Prepositioning Force (Future).

phibious ships), two squadrons of sea-basing-capable MPF(F)s, and one squadron of conventional maritime prepositioning ships, the time needed to get 12 battalions deployed would drop from nine weeks to six weeks under the Navy's plan (see the bottom panel of Figure 4-7).

Put another way, sea basing would allow twice as many Marine infantry battalions to be in place by week six (12 battalions instead of six) as would be the case today, the Navy and Marine Corps say. Four of those battalions would be deployed by the second week: one from the first forward-deployed ESG to arrive and three from the first MPF(F) squadron to arrive. By the fourth week, four more battalions would be deployed, one from a second forward-deployed ESG and three from the second MPF(F) squadron. As would be the case today, additional battalions arriving on amphibious ships from the United States would deploy by the fifth week. Finally, by week 10, the three battalions supported by the conventional maritime prepositioning squadron would deploy. Thus, the Navy and Marine Corps would have the same total number of battalions operating after 10 weeks as they would today, but the bulk of those units would enter the conflict more quickly.

All of the alternative force structures analyzed in this study, because they would be smaller and less capable than the Navy's planned force, would deploy fewer battalions, sometimes less quickly, in 2025 or 2035 (see Figure 4-8). CBO compared the results for both years because the alternatives vary in the pace at which they would reduce the number of amphibious ships over time. In 2025, Options 1B and 3 would deploy fewer Marine infantry battalions to a conflict through week seven than the other alternatives or the Navy's plan because they lack sea-basing-capable MPF(F) squadrons. After that, however, they would deploy more battalions than Options 1A and 2 because of their larger conventional maritime prepositioning forces. (Option 1B diverges from Option 3 after week nine because it has one fewer Marine infantry battalion to deploy.)

The same general pattern would hold true in 2035. Options 1A and 2 would get four Marine infantry battalions into the conflict by the second week, compared with only one battalion under Options 1B and 3. By week 10, however, Option 3 would deploy more battalions than any other option—a total of 14, compared with 12 for Option 1B, nine for Option 1A, and only seven for Option 2. However, this measure does not capture the investment in survivability that Option 2 would explicitly make. Theoretically, its single MPF(F) squadron would be better able to sustain operations in the event that antiship threats had not been completely eliminated from the theater of operations.

Implications of the Analysis

The central conclusion of CBO's analysis is that with respect to amphibious warfare and maritime prepositioning forces, less money spent on the force structure will mean less overall capability than exists today.[1] CBO found no alternative that would allow the Navy and Marine Corps to have substantially more overall capability than the current fleet but at a price significantly below what the Navy plans to spend on its amphibious forces.

Some important questions for the Congress (which CBO did not attempt to answer) arise from this analysis. Are the strategic, operational, and tactical benefits of sea basing worth their monetary cost? And if procuring those benefits means reducing the number of L-class amphibious ships, are they worth the loss of other capabilities? For example, the Chief of Naval Operations has stated that he considers speed one of the most important—if not the most important—criterion for determining what capabilities the Navy should procure. If a given capability allows the Navy to bring force to bear in a conflict faster than it can today, he favors investing in it rather than in programs that do not further that aim. Is the ability to advance the timeline of Marine amphibious operations by several weeks worth the many billions of dollars that a sea-basing capability will require or worth a cut of one-third in the number of expeditionary strike groups—a trade-off that senior Navy leaders are explicitly considering? Are the freedom of action and operational flexibility that might be gained with sea basing worth those costs? (As stated at the beginning of this chapter, CBO's measures of capability cannot capture the value of independent action or operational flexibility.)

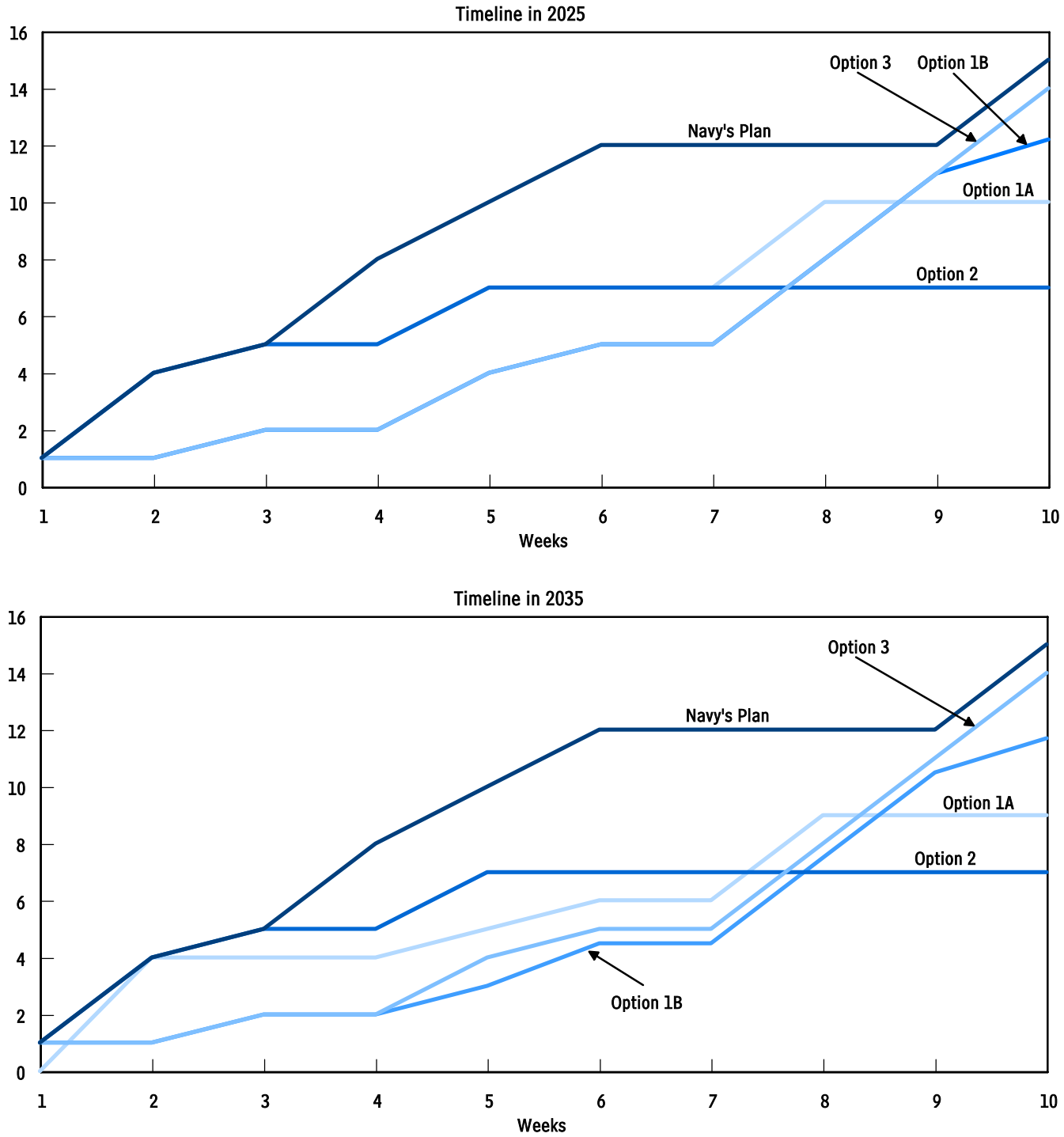
The four options described in this study represent ways to defer significant increases in spending on amphibious

1. By contrast, CBO's analysis of the surface combatant force found that several alternatives costing less than the Navy's plan would leave the force larger and more capable than the current fleet of surface combatants. See Congressional Budget Office, *Transforming the Navy's Surface Combatant Force* (March 2003).

Figure 4-8.

Time Needed to Deploy Marine Infantry Battalions in a Hostile Environment Under Alternative Force Structures

(Number of battalions)



Source: Congressional Budget Office based in part on data from the Navy.

forces for the next 30 years. In the meantime, the Navy could use the money not devoted to amphibious or maritime prepositioning ships to pay for other transformational efforts, ship programs, or needs. However, deferring that spending would have significant consequences for the size and composition of amphibious forces. Whether the Navy should make that trade-off is a matter for defense officials and lawmakers to decide.