SMALL BOAT REQUIREMENTS STUDY FY 2006– FY 2015

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National Marine Sanctuaries

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This report presents the capital costs, operation and maintenance costs, mooring facility and personnel needs to meet the existing and forecasted on-the-water requirements of the National Marine Sanctuary Program.

EXECUTIVE SUMMARY

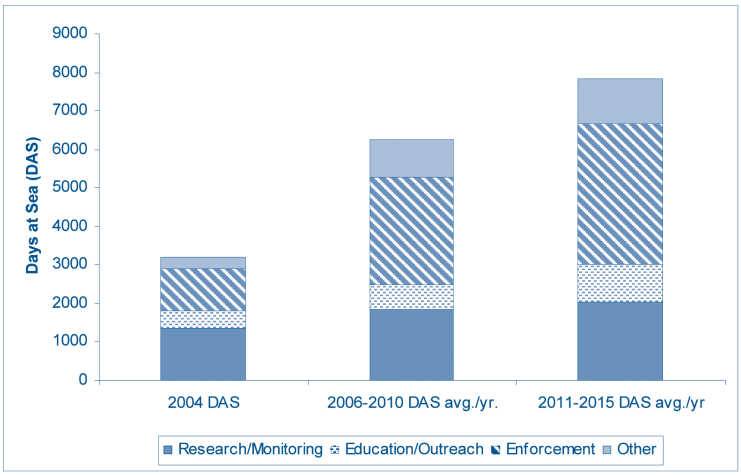
This report quantifies small boat requirements for the National Marine Sanctuary Program (NMSP). It updates information provided by the 2002 report, "Small Boat Requirements Study, 2003-2012." During the past three years, significant changes within the National Marine Sanctuary Program (NMSP) and within NOAA have altered the small boat fleet, the requirement for new and replacement vessels, and the associated costs to ensure safe operations. Moreover, new information is available, through updated site management plans specifying vessel use requirements and new data are available, due to deliberate tracking, specifying costs for capital investments, operations and maintenance, moorings and facilities, and personnel.

The NMSP currently maintains a small boat fleet of 42 vessels that provide more than 3,200 days-at-sea in support of mandated NMSP functions. The fleet includes 22 Type I vessels (less than 29 feet length), 14 Type II (30-49 feet), and six Type III (greater than 50 feet). The majority of small boat operations are associated with enforcement of sanctuary regulations and the monitoring of natural and cultural resources. Many of the existing vessels were acquired, based on fiscal considerations rather than functional requirements, and reflect an aging fleet struggling to keep pace with growing program needs and increasing requirements for safety.

Within the next 10 years, the demand for on-water small boat access is expected to increase by nearly 60%. The annual requirement for days-at-sea is projected to exceed 7,300 by 2015, with the largest gaps occurring in enforcement and resource monitoring. This translates to a need for 18 new or replacement boats, ranging from small and easily maintained Type I vessels, to larger and more complex Type III vessels. While this report does not specifically address boats larger than Type III, NMSP is exploring the need to acquire a larger class of vessel such as a "Small Research Vessel" or "Intermediate Sized Research Vessel". The vessels range in size between 80 – 90 feet and are used as larger regional platforms where sites are located in remote or distant locations from shore or where higher sea states are normally experienced throughout the year. These larger platforms reflect the maturity of the program and the increasingly complex nature of its on-water responsibilities. Given the unsatisfactory experience with used, donated and confiscated vessels, the program is now looking to design and have manufactured small boats that are tailored to the mission requirements and operating environments of sanctuaries. Further, program experience suggests the need for dedicated enforcement vessels for the purposes of public recognition and safety.

Cost estimates have been derived from historic program data and are presented for each of the three vessel types. Total costs for capital investments, operations and maintenance, moorings and facilities, and personnel generally range from $120-250K for Type I, approximately $0.9-2M for Type II, and about $4M for Type III. Figure 1 illustrates days-at-sea required by function over time.

Figure 1. Days-at-Sea Required by Function over Time



National Marine Sanctuaries

I. INTRODUCTION

In 2002, the National Marine Sanctuary Program (NMSP) completed a comprehensive inventory and evaluation of all small boats owned and operated throughout the program (Small Boat Requirements Study 2003-2013). This effort documented the maturing nature of the program and, consequently, the increased requirement for on-water support for site characterization, research and monitoring, education, enforcement, emergency response and other activities. The evolution of the small boat program reflected the history of the sanctuary program itself, in that investments were determined on a site-by-site basis without national coordination and constrained by each site's ability to secure funding sufficient to support infrastructure, staffing and safety. For example, many of the small boats currently in the system were picked up "used" or through confiscation programs – decisions based on fiscal considerations of the site rather than through the matching of vessel types to the actual on-water requirements and functions. The baseline established through the 2002 report helped to define the national strategy now in place to acquire, operate and maintain the program's small boat fleet in accordance with targeted management plan requirements and through protocols that are compliant with national standards and administrative orders for operations and safety. This strategy was also shaped by several important changes within the sanctuary program and within NOAA since 2002.

CHANGES WITHIN THE NATIONAL MARINE SANCTUARY PROGRAM SINCE 2002

Deputy Director for Facilities, Safety, Vessels and Aircraft. In 2003, the visibility and investment in small boats was elevated through program reorganization and the assignment of an NMSP Deputy Director as program lead and establishment of a marine operations team. This action formalized the disparate components of the program, established a mechanism for defining and investing in program-wide requirements, and centralized the ability to comply with agency and national standards. Additionally, it united small boats with the program "facilities" so that infrastructure requirements (e.g. piers) are more tightly coupled.

Vessel Acquisitions and Decommissioning. Since 2002, four vessels have been added to the sanctuary fleet, while three vessels are no longer in service. Among the new acquisitions are two platforms (R/V SHEARWATER and R/V SAM GRAY) that replaced aging and damaged platforms at the Channel Islands and Gray's Reef sanctuaries, respectively. For the first time, vessels have been designed with the operational capacities required for the functions of those sites. The success of these vessels has prompted the acquisition of three additional platforms within this class (currently under construction) that will be tailored to the priority program requirements at other sanctuaries. Thus, new information and data are available to update the investment "profile" of the current fleet inventory, particularly with respect to capital and start-up operational costs.

Expanded Experience with Hull Designs and Standardization. Where appropriate, standardization of hull materials, design and outfitting is being considered to meet functional requirements for scientific and enforcement vessels. The dual hull, aluminum design tested on R/V SHEARWATER provides a successful model for new and replacement vessels at other sites that require similar scientific and educational on-water capability. Other advantages to standardizing include the expediting of contracting and ship-building processes as well as facilitating more efficient hull outfitting and periodic repairs.

Revised Sanctuary Management Plans and Updated Small Boat Requirements. The requirement for small boats is derived directly from site-based management plans that direct science, education, outreach, enforcement, maritime heritage and emergency response functions that meet the management objectives of that site. These plans are updated periodically (ideally at 5-year increments) and reflect the expanded capacity of each site to achieve elements of its mandated responsibilities. Within the past three years, 10 sanctuaries have been engaged in a public process to update management plans, and by extension, to quantify those functions requiring small boats.

Strengthened Commitment to Safety. Safety is always the primary focus of NMSP's small boat operations. In 2003, NOAA expanded the small boat safety requirement through issuance of NAO-217 that dictated compliance with vessel standards and operator training. In response, NMSP adopted new vessel policies, enhanced operator training, instituted a program-wide dedicated "safety week," and implemented contingency planning and training activities involving small boats. Thus, new information and data are available to update these elements of the investment profile.

National Small Boat Coordinator for Maintenance and Modifications. In 2003, sanctuaries committed to improved tracking of small boat maintenance costs, including equipment replacements and vessel modifications. Thus, additional data are available to update the operations and maintenance profile. Currently tracked through standardized and periodic reporting in spreadsheet format, sanctuaries has recently invested in software to upgrade reporting and analytical capacity. In 2004, a small boat coordinator was added to the FSVA team to standardize equipment purchases and establish program-wide policies.

CHANGES WITHIN NOAA SINCE 2002

New Administrative Requirements and Long-Term Planning and Budgeting. In 2003, NOAA redefined its long-term planning and budgeting process. The Planning, Program, Budgeting and Execution System (PPBES) require programs to quantify its resource needs for "sliding" five-year periods (e.g., in FY05, PPBES focuses on resource needs for FY08-12). Beginning with the original small boat plan in 2002, sanctuaries has been developing 10-year planning documents for most of its major thematic areas. The information presented in these documents is readily translated to the PPBES process – thus, it is one of the drivers for updating small boat 10-year plan.

CHANGING ASSUMPTIONS USED IN 2002

Access to NOAA Fleet Assets. NOAA ship assets (e.g., NANCY FOSTER, MACARTHUR II, HI'IALAKAI) play an important role in the ability of the sanctuary program to access, observe, understand and educate the public regarding the condition of and threats to its trust resources. In recent years, access to these larger vessels has continued to decline, thereby forcing the program to increase reliance on its own small boat fleet. As sanctuary management plans better quantify the on-water requirements, it is increasingly more important for the program to secure the appropriate number of days at sea, at the appropriate time of year, and on a recurring basis to ensure repeatability and trend analysis needed for management of these sites. However, because the types of missions conducted on NOAA fleet assets generally occur in remote areas of the sanctuary, during heightened sea state conditions, and involve multi-disciplinary teams and deep water technologies, the sanctuary program can only

consider Type III small boats as replacement to meet the requirements and ensure safety. In fact, the program is undergoing a study to determine whether a boat larger than a Type III, such as a "Small Research Vessel" or "Intermediate Sized Research Vessel" ranging between 80 – 90 feet, may be more appropriate.

Value of Small Boats of "Opportunity." Given the expense of small boats designed and outfitted to meet sanctuary requirements, the program investigated and ultimately acquired boats through alternative means. For example, 1960s vintage, 85-foot vessels "excess property" made available by the U.S. Coast Guard to the program along with a wide-range of small boat assets confiscated through U.S. Customs seizures. While the initial "capital" investments in these vessels made them attractive alternatives, these vessels were not designed nor outfitted in ways that provided a safe and reusable platform for sanctuary mission requirements. Moreover, the operations and maintenance costs rapidly exceeded the value to the program. The NMSP has sold two of the three U.S. Coast Guard cutters, though one still remains in service. NMSP is no longer pursuing this option.

II. METHODS

This report builds upon and heavily references the first-ever comprehensive assessment of the program's small boats, their uses and projected requirements (Small Boat Requirements Study FY 2003-2013). It follows the same logic and presents updated information for the same four topical sections – the small boat inventory, existing use patterns, projected use requirements, and funding estimation methods. However, the methods used to develop these revised data did not revisit all elements of the original approach to the same extent and, in fact, looked to streamline efforts by focusing on the "projected use requirements" that were most directly affected by the program and NOAA-wide changes since 2002 and the "funding estimation method" that benefited greatly from additional data collected for capital and operating costs. An updated small boat inventory is provided, as is a revised estimate of existing boat use, primarily associated with the acquisition of R/V SHEARWATER at Channel Islands.

A data collection template was developed to quantify, in a consistent manner, the existing and projected small boat use requirements for each sanctuary. Uses were assessed for each of the major functions that support sanctuary management – conservation science, enforcement, education/outreach and maritime heritage as well as other site-specific uses. The total number of days-at-sea currently invested by each sanctuary was readily obtained by reviewing their operations records. No attempt was made to gather updated information related to more-detailed use parameters already documented in the original small boat document, such as trip duration and seasonality.

An assumption was made that those use patterns still reflect present-day conditions, except in the case of R/V SHEARWATER.

Forecasted (projected) use requirements through 2015 were based, primarily, on updated management plans recently completed (or significantly underway) at several sanctuaries.

Figure 2. Sanctuary Management Resource Protection Functions that Require Small Boats

Site Characterization
- Boundary delineation
- Initial resource inventory (natural and maritime heritage)
- Initial threat assessment (submerged and on-water)

Research, Monitoring, and Observing Systems
- Recurring on-board in situ measurements (water quality, habitat, living resources, maritime sites)
- Dive operations
- Technology deployment and maintenance (e.g. buoys, acoustics)
- Benthic mapping
- Damage assessment and recovery

Enforcement
- On-water patrols and encounters

Education and Outreach
- Students, teachers, VIP at-sea
- Volunteer activities
- "Interpretive" enforcement
- Moorings, installation, maintenance and public awareness

Emergency Response
- Spills and threat mitigation

In many cases, the requirements for small boats can be extrapolated directly from these management plans that describe the extent of monitoring, education, enforcement and other resource protection functions required during the next five years. For those sites not engaged in management plan review and for all sites needing to forecast small boat needs 10 years from now, the sanctuary "life cycle" model provided a consistent framework for this assessment. The life cycle defines six stages of sanctuary evolution and, for each stage, defines the capacity (and by extrapolation, the small boat requirement) expected at each sanctuary to fulfill its mandated responsibilities for resource management and protection. Figure 2 illustrates sanctuary management resource protection function that requires small boats.

III. INVENTORY AND CURRENT USE

THE INVENTORY

In June 2005, the inventory of NMSP small boats consisted of 42 vessels distributed among 13 sanctuaries and the proposed Northwestern Hawaiian Islands (see Table 1). Note: Table I includes vessels currently under construction and expected to be delivered in 2006 at Florida Keys National Marine Sanctuary (Type III), Stellwagen Bank National Marine Sanctuary (Type II) and Monterey Bay National Marine Sanctuary (Type III). Vessels have been categorized as one of three types and based on size:

- Type I vessel—up to 29 feet length overall
- Type II vessel—30 to 49 feet with limited overnight capability
- Type III vessel—50 feet or greater with extended overnight capability

TYPE II – R/V SAM GRAY at Gray's Reef NMS

TYPE III – R/V SHEARWATER at Channel Islands NMS

These three categories were generated for the purpose of this study and do not correspond with NOAA vessel "classes" or other such categorizations. Of the 42 boats in inventory, 22 are Type I vessels, 14 are Type II and six are Type III.

Table 1. Inventory of NMSP Small Boats

	Vessel Type	Size (ft)	Primary Use	Condition	Estimated Yr. of Replacement
Thunder Bay					
Heron Explorer		41	Research, Diving, Education (GLERL)	Fair	2010
Stellwagen Bank					
Gannet	I	28	Research, Diving, Enforcement	Fair	2010
Sentinel	II	41	Research, Education, Enforcement	Fair (former USCG vessel)	2009
Tecknicraft	II	48	Research, Education, Enforcement	Scheduled Delivery May '06	2026
Monitor					
None					
Gray's Reef					
Sam Gray	I	33	Research, Diving, Response	New - delivered FY05	2025
Joe Ferguson	II	41	Research, Diving	Fair (former USCG vessel)	2008
Go Fast	II	32	Research, Diving	INACTIVE	
Jane Yarn	III	65	Research, Diving	INACTIVE	
Florida Keys Upper					
Whaler	I	13	Odyssey tender	Good	2016
Whaler	I	17	Education, Research	Poor	2007
Carolina Skiff	I	21	Research, Damage Assessment	Good	2016
Dusky	I	23	Team Ocean, Research	Good	2023
T-Craft	I	24	Mooring Buoys	Fair	State Owned
Robalo	I	25	Research, Diving	Poor	2007
Gulfstream	II	28	Law Enforcement	Good	2012
Corsa	II	30	Law Enforcement	Fair	2008
Manta	II	30	Law Enforcement	Good	2016
Sea Vee 1	II	30	Law Enforcement	Good	2016
Sea Vee 2	II	30	Law Enforcement	Good	2016
Agassiz	II	39	Research, Buoys	Good	2015
Odyssey	III	53	Research, Diving	Good	2010
Florida Keys Lower					
Caribe RHIB	I	10	Research	Fair	2007
Whaler	I	13	Education, Research	Fair	2008
Whaler	I	15	Education, Research	Fair	2008
Carolina Skiff	I	16	Research	Fair	2009
R/V DAC Cat	I	20	Research	Good	2007
Whaler	I	25	Education, Research	Good	2009
Whaler	I	25	Education, Research, Team Ocean	Fair	2009
Gulfstream	I	28	Research, Diving	Good	2009
Rachel Carson	II	39	Research, Buoys	Fair	2010
R/V Cooper	II	41	Mooring Buoys	Good (former USCG vessel)	2009
Dante Fascell	III	53	Research, Diving	Good	2010
Technicraft	III	53	Tortugas Law Enforcement	Scheduled Delivery Dec. '05	2026
Irene C	III	61	Research, Diving	Good	2007
Flower Garden Banks					
Point Glass	III	82	Research, Enforcement, Diving	Fair - recent overhaul	2006
Channel Islands					
Xantu	I	29	Research, Education, Diving, Shuttle	Fair	2007
Shearwater	III	62	Research, Education, Diving	Good	2022
Monterey Bay					
Shark Cat	I	28	Research, Diving, Enforcement, Buoys	Fair	2005
Fulmar	III	65	Research, Diving, Enforcement, Buoys	Scheduled Delivery May '06	2026
Gulf of the Farallones					
Phocena	I	29	Education	Fair	2006
Cordell Bank					
C-magister	II	33	Research	Good	2010
Olympic Coast					
OC – 2: RHIB	I	22	Research	Good	2012
Tatoosh	II	38	Research, Enforcement, Diving	Fair	2008
Fagatele Bay					
Kevlar Cat	I	24	Research, Diving	Fair	2007
Hawaiian Is Humpback Whale					
Sea Cat	I	22	Research, Diving	Good	2009
Manacat	II	40	Research, Diving	Fair	2006
NW Hawaiian Islands					
None					

Florida Keys NMS, with its large area and significant enforcement, damage assessment and emergency response challenges, is by far the largest user of the current fleet, operating 25 vessels of various sizes. Most sites operate only one or two vessels and occasionally share assets. The Monitor and Northwestern Hawaiian Islands do not own or operate any of their own small boats. Thunder Bay recently entered into a cooperative agreement with NOAA's Great Lakes Environmental Research Laboratory (GLERL) office and co-operates the HERON EXPLORER. The average age of these vessel hulls and engines is about eight years. As a rule these vessels operate in nearshore waters and have been adapted, through the years, to meet program requirements.

EXISTING USE SUMMARY

Data gathered for the 2002 small boat assessment indicated that, on average, sanctuary vessels logged more than 3,200 days-at-sea each year during 2002-2004. About 45% were for scientific purposes (e.g., research and monitoring), while nearly one-third supported enforcement missions. Education and outreach accounted for 15% of at-sea days and other missions about 10%. Predictably, boat use peaks in spring and summer months, accounting for two-thirds of the annual total. Almost 90% of all missions were full-day operations, with a small fraction of these (2%) lasting overnight. Figure 3a illustrates average days at sea to support sanctuary missions 2002-2004. Though a greater need exists, most sanctuary vessels do not have sufficient capacity nor meet safety guidelines to support additional overnight operations. Boats like the R/V SHEARWATER expand overnight capability and greatly enhance the ability of NMSP to fulfill these mission requirements.

Figure 3a. Average Days at Sea to Support Sanctuary Missions, 2002-2004

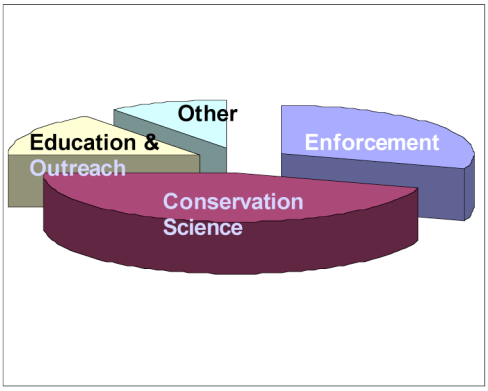
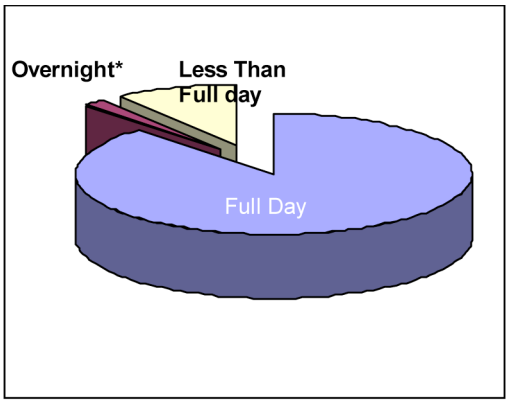


Figure 3b. Average Duration of Small Boat Trips, 2002-2004



Despite the recent turnover of vessels within the past three years, use patterns were not expected to change significantly from those depicted in the 2002 study, as many of the newly acquired were comparable replacements for those decommissioned. One notable exception is the R/V SHEARWATER that posted just over 200 days-at-sea during 2004. This vessel represents the first vessel designed and acquired by NMSP to safely conduct specific mission requirements for conservation science and education. With berthing capacity for nine persons, a stable dual-hull design, dive provisions, stern A-frame and 5-day endurance, this vessel has radically enhanced NMSP's ability to fulfill mission requirements and attract partnership opportunities. Recent data from SHEARWATER indicate 75% and 15% of mission days devoted to science and education/outreach, respectively. Moreover, 60% included at least one overnight. Figure 3b illustrates average duration of small boat trips 2002-2004.

IV. FORECASTING REQUIREMENTS FY2006—FY2015

THE FORECASTING PROCESS

With more than 30 years of small boat experience, NMSP has an informed foundation for looking into future requirements. A 10-year planning window was selected because it coincides with the time period of three program and NOAA planning processes that affect small boat requirements. These include: (1) site-specific sanctuary management plans that define management and resource protection priorities for a 5-10 year period, (2) the sanctuary "life cycle" framework that describes the evolution of a given site from designation to adaptive management during a 10-20 year period, and (3) NOAA's Planning, Programming, Budgeting and Execution System (PPBES) that quantifies requirements of all NOAA programs to achieve their mandated responsibilities during a 5-10 year period.

The process was conducted in consultation with sanctuary managers, vessel operators, research and education coordinators, NMSP's strategic planning team and other experienced personnel. For each site, a standard template was used to forecast program requirements for small boats and to quantify the trip characteristics. Specific, detailed vessel needs grew out of this analysis, down to the exact equipment, transit time, endurance requirements, operators and—most importantly—the roles and missions requiring new or replacement platforms. The raw data were evaluated in light of efficiencies, budgeting and manpower realities. Factors taken into consideration included how sanctuaries adjacent or in close proximity to one another might share small boats as their programs continue to develop until new or replacement boats come on line. In addition, forecasts for sanctuaries similar in size and mission requirements were compared and adjusted to ensure forecasts fell within a reasonable range.

Sanctuary Management Plans Day-to-day operations at each sanctuary are defined by priorities established in its management plan. These plans are derived directly from the provisions of the National Marine Sanctuaries Act and define the 5-10 year priorities needed to fulfill NMSP mandates. Many of the existing (and the one proposed at Northwestern Hawaiian Islands) sanctuaries are in the process of completing their most recent versions, which are developed through an extensive and highly-participatory public process. This process results in site-based action strategies for all functions of site management, resource protection, and public access. For example, detailed action plans are often available for Enforcement, Education and Outreach, Research and Monitoring, and Infrastructure Maintenance. These spell out on-water requirements (including the spatial and temporal characteristics) that can be translated to small boat uses.

Sanctuary "Life Cycle" Evolution From the time of its designation, each site undergoes a common and predictable maturation, termed its "life cycle", Figure 4. This evolution is defined by six phases that occur over a 10-20 year period, including (1) pre-designation and designation, (2) start-up and early operations, (3) transition – first management plan review, (4) mature operations, (5) recalibration – second management plan review, and (6) adaptive management. Each phase describes the capacities and capabilities expected of each sanctuary to carry out all elements of site management and infrastructure (including small boat acquisitions and operations). While the order of phases is consistent across all sanctuaries, the rate at which sites progress through each phase and the level of resources required will differ according to site complexity (e.g., site size, remoteness, ecosystem type), as well as the type and extent of human uses within the sanctuary. Figure 5 illustrates the status of each sanctuary with respect to life cycle stages.

Figure 4. Description of Sanctuary Life Cycle Phases

Phase 1 (Pre-designation and designation). Sites are evaluated for addition to the NMS Program. Extensive public involvement is used to determine what sanctuary resources and qualities are potentially at risk and how threats could best be addressed. The acquisition and use of small boats in this phase is relatively uncommon, as needs have not been clearly assessed and management priorities have yet to be established.

Phase 2 (Start-up and early operations). Priorities at this stage include: 1) filling resource information gaps; 2) addressing routine management functions (such as inter-agency cooperation); 3) developing initial scientific and educational programs; 4) laying the groundwork for long-term programs and 5) gathering data to support the first management plan review (Phase 3). Smaller vessels may be acquired to support initial field research, limited monitoring, some enforcement and, perhaps, education or trips to the sanctuary for local stakeholders.

Phase 3 (Transition and first management plan review). An important milestone for a site, the first management plan review marks the transition from initial "vision" to more concrete management objectives. Assisted by public input, sites seek to identify emerging issues, create measures of effectiveness for management interventions and develop specific management objectives and long-term programs. Vessels are used in this phase primarily to collect information on the status of site resources.

Phases 4—6 (Mature operations, second management plan review and adaptive management). As sites mature, small boat requirements evolve in response to specific, long-term management objectives as identified through the second (and subsequent) management plan review and specific action plans. This will include relatively complex and sophisticated research, monitoring and enforcement activities requiring a substantial, on-the-water presence in order to meet pre-defined measures of effectiveness. At these stages, managers have sufficient resources to "flex" their assets in response to crises, emerging issues, or shifting priorities. Currently, Florida Keys NMS best represents what sanctuary operations might look like during these later stages of site evolution.

Figure 5. Status of Sanctuaries with Respect to Life Cycle

The Sanctuary Life Cycle			Sanctuaries in Phase During FY 2004
Phase	Description	Duration (years)	
1	Pre-Designation and Designation	1 to 3	NW Hawaiian Islands*
2	Start Up and Early Operations	2 to 5	Thunder Bay
3	Transition and First Management Plan Review	1 to 2	Cordell Bank Fagatele Bay Flower Garden Banks Monitor Monterey Bay Olympic Coast Channel Islands Gray's Reef Gulf of the Farallones Stellwagen Bank
4	Mature Operations	3 to 5	HI Humpback Whale
5	Recalibration and Second Management Plan Review	1	None
6	Adaptive Management	2 to 4	Florida Keys

Predictably, the responsibilities and, therefore, the resource requirements for less complex sites in early phases of their life cycles is less than those for more complex sites in more mature phases. Accordingly, the requirement for small boats varies considerably across sites and increases with site maturity.

V. PROJECTING DAYS-AT-SEA REQUIREMENTS: 2006 - 2015

THE NATIONAL SUMMARY

Days-at-sea requirements are defined for two periods, 2005-2010 and 2011-2015. These periods coincide with (1) period of concentration for most recent management plans completed by several sites; and (2) approximate transition point for several sanctuaries expected to mature to next phase of life cycle.

By 2010, the sanctuary program projects a need for more than 6,200 days-at-sea in small boats to meet its mandated requirements (Table 2). This figure is approximately 48% higher than present-day use. It reflects the expected addition of the Northwestern Hawaiian Islands as the program's 14th sanctuary as well as the increased program requirements at several sites based on revised management plans. On-water access for research and monitoring and for education and outreach functions is expected to increase by about 26% as all sites fully implement "system-wide monitoring" and expand "point of access" interactions with the public through education efforts. NMSP also expects to concentrate small boat activities that support enforcement of sanctuary regulations and protection of its resources – the existing enforcement infrastructure cannot support the program's current requirement, let alone the increased demand as new sanctuaries, marine reserves and protection regulations are realized. The 2010 estimate also reflects the acquisition of new vessels at Gray's Reef (delivered 2005) and those under construction for the Florida Keys, Monterey Bay and Stellwagen Bank sites. These vessels are anticipated to significantly change site operations, increasing focus on vessel-based activities. By 2015, this estimate increases to over 7,800 days, or 59% above the current use, reflecting the anticipated maturation of 12 sites to the sixth phase of their life cycles and the associated increase of activities requiring on-water access.

Table 2. Small Boat Days-at-Sea Needed on a National Level

		FY 2006-2010			FY 2011-2015		
Function	**2002 - 2004 Avg. Days at Sea**	**DAS/yr. 100% req.**	**Additional DAS/yr. to meet 100% req.**	**% Diff. from 2004**	**DAS/yr. 100% req.**	**Additional DAS/yr. to meet 100% req.**	**% Diff. from 2004**
Research/Monitoring	1371	1850	479	25.9%	2022	651	32.2%
Education/Outreach	454	637	183	28.7%	1006	552	54.9%
Enforcement	1074	2800	1726	61.6%	3649	2575	70.6%
Other	319	967	648	67.0%	1172	853	72.8%
	3218	**6254**	**3036**	**48.5%**	**7849**	**4631**	**59.0%**

REGIONAL PRIORITIES

Regional summaries mirror increasing small boat requirements at the national level, though the nature of the priorities is more apparent at this scale (Table 3). In the Pacific Islands, the priority is on research and monitoring with a growing need for enforcement. Along the West Coast research and monitoring represents approximately half of the small boat days at sea needs with enforcement needs making up approximately one third of the boat days. In the South Atlantic and Gulf of Mexico enforcement makes up approximately half of the days with increasing needs in the 2011 to 2015 timeframe. For the Northeast and Great Lakes research and monitoring and enforcement each represent approximately 40% of the days-at-sea needs.

As the sanctuary program evolves into a regional office structure, small boat planning and operations will be more fully integrated and optimized across regions.

Table 3. Small Boat Days-at-Sea Needed by Region and Function

Function	FY 2006-2010 DAS/yr. 100% req.	FY 2011-2015 DAS/yr. 100% req.
N.E. and Great Lakes	*562*	*675*
Research/Monitoring	202	235
Education/Outreach	80	140
Enforcement	280	300
Other	0	0
S.E. and Gulf of Mexico	*3601*	*4786*
Research and	583	700
Monitoring	354	609
Education/Outreach	1880	2501
Enforcement	784	976
Other		
West Coast	*1812*	*2048*
Research and	935	955
Monitoring	155	200
Education/Outreach	605	763
Enforcement	117	130
Other		
Pacific Islands	*279*	*340*
Research and	130	132
Monitoring	48	57
Education/Outreach	35	85
Enforcement	66	66
Other		
	6254	**7849**

TRANSLATING DAYS-AT-SEA REQUIREMENTS TO VESSEL ACQUISITIONS AND REPLACEMENTS

By 2010 more than half of the sanctuary "fleet" will have reached its operational and safe limit – 12 Type I, 12 Type II, and four Type III vessels are scheduled to be decommissioned. Many of these vessels reside in the Florida Keys and currently serve research and education missions. During this same period, aging Types II and III often represent the largest vessel at other sites and therefore will

have a significant impact in ability to conduct most offshore science and education missions. By 2015, three additional Type I and II vessels are scheduled for replacement, including a Type II enforcement boat in the Upper Florida Keys. There are few existing dedicated enforcement boats throughout the program, thus, NMSP is currently unable to meet existing requirements for enforcement. This "gap" is expected to widen as the few aging enforcement vessels are decommissioned and sanctuary management plans define greater needs for this critical function.

Throughout NMSP, a total of eight new vessels and 18 replacement vessels will be required by 2015 (Table 4). Of these, eight are Type III, 10 are Type II, and eight are Type I. In some cases, translating days-at-sea requirements to the number and types of vessels is relatively straight-forward, particularly with respect to replacements for aging and unsafe platforms. Of the 31 vessels scheduled for decommissioning by 2015, a total of 18 replacement vessels are expected to pick up much of the functions for research, education and to a lesser degree, enforcement. Priority has been given to those sites where a decommissioned vessel would have the most direct impact on a site's ability to conduct the required on-water functions (e.g. Flower Garden Banks Type III and Stellwagen Bank Type II). A fewer number of replacement boats has been identified because of: (1) streamlined NMSP fleet operations/costs; (2) better targeting equipment to mission requirements; (3) taking advantage of regional "sharing" of vessels; and (4) decommissioning dates may have flexibility pending sufficient funding for maintenance and operation. However, the more challenging conversion was for new vessels and/or replacements to address the most critical program gaps and emerging issues. By far, the largest and highest priority gaps exist within for enforcement and for site characterization (research, monitoring and observing of natural and maritime heritage resources).

Eight new vessels including four Type III, three Type II reflect fundamental gaps in program ability to safely conduct enforcement and science missions in areas typically requiring platforms capable of long durations, operating in high seas, and with specialized equipment and capabilities.

Table 4. Forecast Vessel Acquisitions and Replacements

Sanctuary	Existing			Vessel Requirements FY06 – FY15					
				New			Replacement		
	I	II	III	I	II	III	I	II	III
Thunder Bay					1				
Stellwagen Bank	1	1			1			1	1
Monitor									
Gray's Reef	1	2	1					1	
Florida Keys (Upper)	6	6	1	1	1		4		
Florida Keys (Lower)	8	2	2			1	2	1	1
Flower Garden Banks			1						1
Channel Islands	1		1					1	
Monterey Bay	1					1*		1	
Gulf of the Farallones		1							1
Cordell Bank		1						1	
Olympic Coast	1	1				1			
Hawaiian Islands Humpback Whale	1	1						1	
Fagatele Bay	1						1		
Northwestern Hawaiian Islands						1			
TOTAL	**21**	**15**	**6**	**1**	**3**	**4**	**7**	**7**	**4**

* Vessel will be based in Monterey shared with Gulf of the Farallones and Cordell Bank

Enforcement. With a projected gap of 2,325 days-at-sea by 2015, it is recognized that a large portion of the new boats that have been identified would be targeted for enforcement. Today, the Florida Keys is the only sanctuary to have dedicated enforcement boats. Although Sanctuary enforcement is sometimes carried out on vessels that are also used for science and education purposes, best practices dictate that enforcement functions should be limited to a dedicated platform. This not only assists with public recognition but also keeps scientists, educators and untrained personnel out of potential harm associated with intentional or unintentional enforcement encounters. Enforcement vessels have special design considerations, including markings, speed, surveillance equipment, large and stable platforms for boardings, and an increasing requirement for overnight provisions to patrol remote areas (e.g., Tortugas in Florida Keys or Northwestern Hawaiian Islands). These mission requirements are generally met by Type II and III vessels.

Site Characterization (Natural and Maritime Heritage Resources). The gap to support site characterization and repetitive monitoring of natural and maritime heritage resources is expected to reach nearly 600 days-at-sea by 2015. Activities typical of this function that require small boat assets include mapping, monitoring, observing system moorings/buoy installation and maintenance, deployment and operation of remotely operated vehicles (ROVs) and other scanning technologies, and an evolving requirement for early detection of and response to natural and anthropogenic threats (e.g., spills). In recent years, the existing small boat fleet has been sufficient to characterize and conduct limited monitoring of many nearshore areas using techniques commensurate with Type I and II vessels. However, many remote areas remain relatively unexplored, let alone repetitively monitored to determine resource status and condition. As NMSP looks to fill these gaps and to employ advanced technologies that further understanding and protection, increasingly larger platforms will be required. These platforms will need berthing capacity, galleys, heads, wet and dry lab space, and other operational capabilities typical of Type III vessels.

In some cases, it is most practical to accept gaps and dedicate vessels to accommodate site-specific needs. However, as NMSP looks to keep down costs and gain efficiencies where practical, this assessment took into account regional solutions as well as benefits gained through standardizing hull and engine types

VI. ESTIMATING FUNDING METHODOLOGY

To generate funding requirements, cost estimates were made for four categories: 1) capital costs; 2) operations and maintenance (O&M); 3) mooring and facilities requirements and 4) personnel. Specific factors considered by each cost category are described below. A “high” and “low” cost estimate was generated for each category, though the “best” estimate is represented by the mean (average).

DEFINITIONS

Capital Costs. Capital costs are one-time acquisition and outfitting costs by vessel size and defined by characteristics such as engine type, hull type, accommodations and deck equipment. Length, width and draft are usually the basis for estimating costs of vessels; this document will also consider hull material (fiberglass and aluminum) and hull design (monohull or catamaran). Although some older wood and steel vessels exist in the current inventory, future acquisitions will consider only fiberglass and aluminum due to

the superior performance, reduced maintenance cost, durability, strength and speed achievable with these materials. To maximize return on investment, new Type II and Type III vessels will for the most part, consider either fiberglass or aluminum because of their superior performance, long life, reduced maintenance cost, and structural integrity.

Operational and Maintenance Costs. Operational costs are based on the actual costs of operating a vessel of each type based on fuel expense and the number of hours per year these vessels have operated. Other incidental costs factored into operational costs includes oil, first aid equipment, foul weather gear and some habitability items (as well as their maintenance). In larger vessels, operational costs might include charts and navigation devices as well as consumables for the galley and head.

Maintenance costs are based on size of vessel and operating hours. For smaller vessels, the operator and mechanic can do most routine cleaning and inspections. For these vessels, a local boat shop performs contract work such as tune-ups and over-hauls. Larger Type II and Type III vessels have more complex equipment and operate (on average) more hours per year. These vessels require regular hands-on checks by the vessel staff. The man-hours for these vessels are directly related to the size and complexity of their on board systems. As vessels' scientific equipment complement increases, so does the required number of man-hours to maintain that equipment. For example, a hydraulic winch and A-frame/J-frame on a Type II vessel may only require random inspection and hose replacement. A Type III vessel may include a full A-frame with oceanographic winch with conducting wire and remote read-outs. Larger vessels also require additional compliance/safety requirements due to their increased complexity. This is derived due to larger and more sophisticated propulsion, auxiliary, and mission equipment/machinery onboard these vessels. In addition, the electronic packages are more complicated and sophisticated. Their costs increase accordingly and are reflected here.

Mooring and Facilities. Every vessel program needs to consider the facility and manner in which the vessels are or will be berthed. This will vary greatly, depending on the size of the vessel. For example, a Type I vessel approximately 20 feet long might be kept on a suitable trailer not far from a boat ramp. On the other hand, a Type III vessel displacing approximately 50 tons not only needs a dedicated berth, but must also have support services such as electrical power, potable water, telephone service, T1 line, security systems (flooding, fire, pilferage and protection), logistical support (loading stores), maintenance support (bilge de-watering system), and equipment storage. In this study, mooring and facility costs consider the following for each vessel type:

- Renting or owning a protected slip or mooring at an appropriately sited marina.
- Trailer and foul-weather storage for smaller vessels.
- For larger vessels, appropriate on-site office, workshop and maintenance space.
- Maintenance and upkeep of the waterfront facilities, moorings, etc.

Personnel Requirements. Small boat personnel are a mix of federal employees, contractors and NOAA Corps. They support a range of vessel operations based on vessel size and the functional requirements:

- **Vessel Operators.** For smaller Type I vessels, the operator will normally have passed a boat-handling course and have demonstrated a responsible attitude and years of experience with small boats. For large vessels where the number of potential passengers increases as well as the complexity of the mission, the operator likely holds a Coast Guard license or is a bridge-

certified commissioned officer. In the case of Type III vessels, all operators are either licensed civilian masters or NOAA Corps officers.

- **Crew.** A crewmember on any vessel is specifically assigned to assist the operator with the operation of the vessel and completion of the sanctuary mission. For smaller Type I vessels, crew requirements will be determined by the complexity of the operation or potential for severe conditions. In the case of large Type II vessels, a crewmember is considered part of the operational complement and may require specific certifications. For Type III vessels, the crewmember may be a mate and/or a second licensed captain capable of operating all equipment on board the vessel.

- **Maintenance Staff.** The maintenance staffs for all vessels are responsible for the upkeep, inspection and maintenance of engineering equipment, deck equipment and other systems such as electrical or plumbing. For Type I vessels only, it is assumed that the operator can receive appropriate training from the engine manufacturer to maintain and troubleshoot the engine. In the case of larger Type II and Type III vessels, the maintenance person is probably an experienced mechanic who is required to receive regular training to properly maintain the engineering equipment and other associated systems on the vessel. Many Type III vessels, due to their complex equipment, require an engineer to either maintain the vessel during imports or while the vessel is underway.

COST ESTIMATES BY VESSEL TYPE

Total costs associated with vessel acquisition and operation take into account the four factors listed above – capital investments, operations and maintenance, moorings and facilities and personnel. Data collected during the past several years, and particularly within the past three years, provides the foundation for citing a range of cost estimates associated with each vessel type (Table 5). As the Program migrates toward standardized hulls and power plants, the reliability of these cost estimates continues to improve. Program data indicate that the purchase price of a Type I vessels typically ranges from $75K to $175K, plus another $45K to $75K to support operations and maintenance, moorings and facilities and personnel. Composite costs for Type II vessels range from $0.9M to $1.7M, while a fully-outfitted Type III vessel may exceed $4M.

Table 5. Funding Profiles: Cost Estimates by Vessel Type

		Type I	Type II	Type III
Acquisition Specifications	**Construction**	Fiberglass	Fiberglass / Aluminum	Aluminum
	Characteristics/ Equipment	- Dive platform - High-speed - Canopy/small cabin	- Dive platform and ladder - J-frame or A-frame - Winch - High-speed - Full cabin	- Dive platform with ladder - Full A-frame - Oceanographic winch - Small boat/crane - High speed/endurance - Crew quarters/galley - Wet/dry lab space
	Cost Range	$75K – $175K	$750K – $2000K	$2000K – $4000K
Operations and Maintenance	**Powerplant**	Twin outboard engines (100 hp avg.)	Twin inboard diesels	Twin inboard diesels + Auxiliary gen. Set
	Fuel Usage	15 gal/hr	20 gal/hr	30 gal/hr
	Annual Use	1000 hr/yr	1500 hr/yr	1500 hr/yr
	Operations Cost	$15K/yr	$35K/yr	$70K/yr
	Maintenance:			
	Operator	20 man hours/yr	80 man hours/yr	100 man hours/yr
	Mechanic	N/A	100 man hours/yr	150 man hours/yr
	Boat Yard	$10K/yr (boat shop)	$25K/yr	$40K/yr
	Other	Operator maintained	Haul-out and repair	Haul-out and overhaul
	Cost Range	$15K – $35K	$45K – $75K	$80K – $100K
Mooring and Facilities	**Mooring Facility**	Trailer/boat ramp	Pier or trailer	Pier w/power
	Seasons Required	Seasonal usage	Extended season	Year-round
	Capital Required	N/A	Rent / own	Owned
	Vessel Storage	Yard / canvas	Yard / warehouse	In-water
	Buildings	N/A	Office	Office & workshop
	Maintenance	N/A	Minimal upkeep	Berth upkeep / power
	Cost Range	$3K – $6K	$7K – $9K	$10 – $12K
Personnel Requirements	**Operator**	Boat Course Training	Licensed Captain	Commissioned Officer/ Licensed Captain
	Crew	N/A	Assistant / mechanic	Mate
	Maintenance Staff	Local boat shop	N/A	Engineer / mechanic
	Operations Staff	N/A	Manager / supervisor	Operations supervisor
	Cost Range	$25K – $35K	$80K – $110K	$120K – $180K

VII. PROJECTING FUNDING REQUIREMENTS: FY2006—FY2015

The fiscal requirement for small boat acquisitions and replacements can be considered over a 10 year time period, with priorities based on management requirements of sites and regions as well as the replacement schedule for aging and obsolete vessels to ensure safe operations. This report has spread out the acquisition of new and replacement boats in a 4-year cycle where the funding levels try to remain constant, while allowing for a mix of types of boats. This cycle begins in FY2006 with the construction of a Type III, followed by the construction of two Type II's and one Type I in FY2007, followed by the construction of a Type III in FY2008, followed by the construction of one Type II and two Type I's in FY2009. This sequence would be repeated through FY2015 and beyond. In the 2006-2015 period, a total of five Type III's, eight Type II's, and seven Type I's could be completed. This is six boats short of the number identified in Table 1 (eight-Type III, 10 Type II, and eight Type I). If funding allowed for the acceleration of the acquisition and construction of boats, NMSP would adjust.

The determination of where each new or replacement boat would go would be discussed by the NMSP's senior leadership at the time funding is secured. The condition of the current inventory, tied to where the site is in its life cycle, will determine destination. If funding is available in FY2006 for a Type III, the decision has been made by NMSP to provide a Type III in the Flower Garden Banks National Marine Sanctuary. The total costs projected for FY2006-FY2015 approximates $37M for the acquisition and replacement of 20 boats (plus an additional $11M for six vessels identified in Table 1 that would be built after 2015) (Figure 6). Over this same period FY2006-2015, approximately $5.3M is needed for Operations and Maintenance of only "new boats" (Figure 7). Approximately $3.4M is needed for moorings and facility requirements (Figure 8), and approximately $8.6M for personnel of the "new" boats (Figure 9).

Figure 6. Capital Cost of New and Replacement Vessels

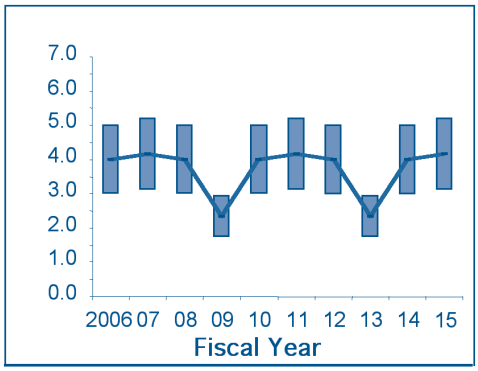


Figure 7. Annual Operations and Maintenance Cost for New Vessels

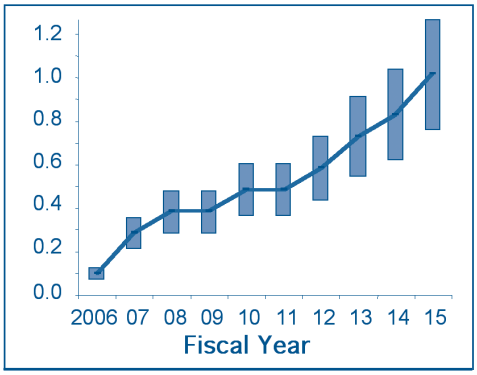


Figure 8. Annual Moorings and Facility Requirements

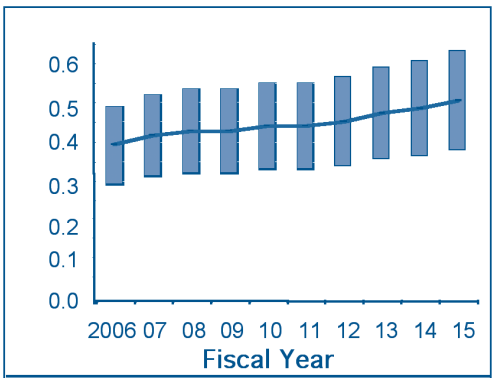
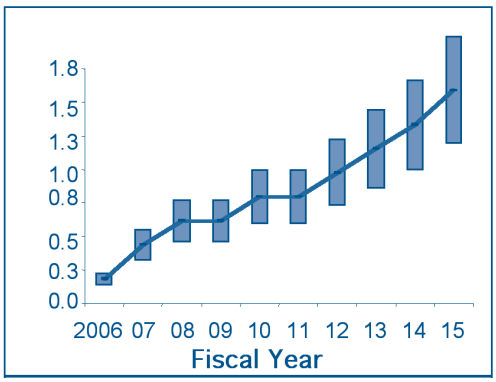


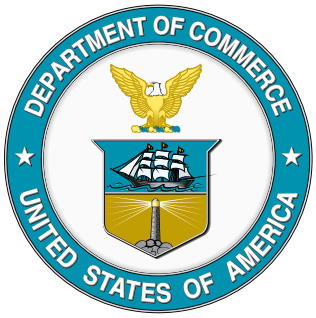
Figure 9. Annual Personnel Investment



VIII. CONCLUSION

This report demonstrated the steps taken to move closer to the goal of the 10-year plan. It attempted to prioritize that sites will get new or replacement vessels. Determining this priority will depend on (1) detailed mechanical assessment of the vessels in question, (2) current program management requirements and priorities, and (3) the actual funds available to spend on small boats that fiscal year.

The small boats that will be acquired will be more reliable than existing boats, and their data collection capabilities will be more complex. To protect this investment in platforms, it is critical that proper maintenance support be provided as the new boats come on line. Routine maintenance support will continue to be the responsibility of each site in association with the small boat maintenance engineer contracted by NMSP. A centralized approach to all major repairs, maintenance items, and modifications will maximize the overall safety of the platforms and enhance the life of the vessels.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