

V. Findings and Recommendations

Future oceanographic research and education initiatives require a capable academic research fleet with sufficient capacity to address the critical environmental and societal problems of a blue planet. The vessels in this fleet need to be wisely designed to conduct wide-ranging, cutting-edge research efficiently and safely at sea. The fleet should consist of vessels that can operate in the local, coastal waters of the U.S., as well as vessels that can operate virtually anywhere in world's oceans, including ice-covered regions. The fleet's Global and Ocean Class ships must be able to carry large numbers of scientists, technicians, students, and equipment to sea in order to collect samples, conduct experiments and surveys, and observe ocean processes. The design of the ships must provide flexibility in the use of exterior and interior spaces to accommodate the deployment of a vast assortment of oceanographic equipment and to accommodate specialized atmospheric samplers. The ships' labs must be able to be easily reconfigured to meet diverse, multidisciplinary science needs on a leg-by-leg basis. Technologically advanced and specialized equipment and operations increasingly require large amounts of clean power and high data bandwidths. There is also an increasing need for 24/7 high bandwidth two-way communications to the shore.

The timely ordered replacement of the academic research fleet is vital to oceanographic research and education in the United States. As the ships age, they become more expensive to operate and less capable in supporting the evolving US scientific mission. The Fleet Improvement Committee has over the past few years presented to the community compelling data showing that systematic replacement of major portions of the fleet must begin now. If not, we will be using old and increasingly unreliable ships that do not have the required capabilities to support the science mission. Scheduled operations are also more likely to be interrupted by mechanical breakdowns and unplanned maintenance due to aging equipment.

Renewal of the Academic fleet faces two major issues today. On the short-term time scale,

there is a mismatch of fleet funding, demand, and capacity as shown in the figures of Chapter III. On the longer-term time scale, the fleet is aging and there is a need for the replacement of vessels in all size classes.

Planning and acquisition of new ships generally takes about ten years or more; thus, care must be exercised on making short-term decisions that could have effects over a longer time. In this chapter, we present the findings based on the analysis of the data presented in the earlier chapters and provide some recommendations based on these findings.

Findings

There is an increasing national need for access to the sea, as articulated in several recent studies by the National Academies, the Pew Oceans Commission, the U.S. Commission on Ocean Policy, the Administration's Ocean Action Plan, and others. The science and societal drivers for research and education at sea are at an all time high. Some of these scientific topics were presented in Chapter II.

To maintain our nation's competitiveness in the ocean sciences we must invest in the infrastructure that is necessary to support ocean-going research and education. Increased knowledge of the seas will better enable our nation to understand the ocean's role in climate and to preserve the oceans' natural resources and sustain the economic benefits they offer, including food production, energy and mineral resource development, shipping, recreation and tourism, and medicinal discoveries. The research products resulting from investment in ocean infrastructure are especially needed by policy-makers and stakeholders to help inform and guide decision-making relative to important issues of our time, such as global climate change.

The current fleet is aging and facing severe budget constraints and escalating costs. Federal budgets have either been flat or increasing below the inflation rate. The percentage of federal research funds allocated for ocean sciences has decreased from 7 percent of the total research funds allocation 25 years ago to just 3.5 percent

by 2004 [5]. Fuel and manning costs have been rising faster than general inflation. Additionally, there are new costs associated with security requirements and Safety Of Life At Sea (SOLAS) regulations. As the ships age, there are higher maintenance costs and difficulties in maintaining worn, inefficient systems. The fleet also faces challenges with hiring and retention of crew and marine technicians due to increasing job instability in the research sector and competition from the higher paying commercial sector.

By the year 2025 there will be fewer ships in the UNOLS fleet and fewer ship days available if only the ships included in the Interagency Working Group on Facilities (IWG-F) Fleet Status Report [2] are added (Chapter IV, Table 5). The number of vessels in the UNOLS fleet is projected to decrease from 23 ships in 2008 to 14 ships in 2025, and the number of ship days available from 5085 to 3270. By 2017, all of the Intermediate size ships and all but three of the Regional/Coastal and Local Class ships will be retired. There are no formal plans currently in place for replacement of the Coastal and Local Class ships, so access to local geographic regions and platforms for support of teaching cruises could be lost. By 2025, we will have a significantly reduced capacity to support global-ranging programs that require large, general-purpose Global class ships, with only one available ship (R/V *Revelle*) that will be close to retirement.

In 2007, about 4,000 ship days were funded and the fleet had an excess capacity of about 785 ship days. (Excess capacity is primarily driven by limitations in funding for science rather than ship user demand, and is not distributed evenly over the year.) As ships are retired and fewer ships replace them, by 2016 the fleet's ship day capacity will fall below the 2007 day usage and by 2025 only 3,270 ship days will be available. Thus, we will be increasingly unable to meet science user demands during peak periods in spring and summer. We will lose the required flexibility in fleet scheduling that allows for multi-ship operations and for science expeditions in remote areas.

There is a recognized trade-off between the cost effectiveness of a fully utilized fleet and the fleet flexibility that is required to meet science

requirements. While a fleet with all ships fully scheduled may be more cost effective, a fully scheduled fleet will be unable to accommodate weather-related delays, easily respond to short-notice urgent requests for ship support (such as retrieval of broken moorings), or respond to important episodic events (e.g. earthquakes, volcanic eruptions, tsunamis, harmful algae blooms) without negatively impacting previously scheduled work. A fleet that is fully scheduled also lacks the needed flexibility to accommodate seasonal and occasional surge demands for ship time.

New and emerging technologies, such as autonomous underwater vehicles, gliders, and ocean observatories, will not obviate the need for ocean-going research vessels, but will in many cases change the nature of the research expedition. Whereas in the past the ship itself was the primary platform for data collection, these newer technologies will greatly increase the spatial and temporal footprint of information gathering far beyond what was previously achievable with a ship alone. The role of the ship will be to deploy and service these more mobile or enduring assets, and act as a nexus for the information aggregation. The ship will complement the simpler robots by executing the more complex tasks and experiments. Thus the ship of the future will require the utmost in maneuverability, high-bandwidth communications, and the ability to deploy heavy payloads over the side safely.

The US Commission on Ocean Policy's vision and strategy for the 21st century and beyond articulates strong support for ocean research, including ample access to modern, well-equipped research vessels [5]. This vision can not be realized by the fleet renewal scenario outlined in the IWG-F Status Report, but will require increased support for ocean infrastructure in addition to research and education programs.

Recommendations

First, we strongly recommend that the Federal agencies implement the fleet renewal activities that are currently underway (the Alaska Region Research Vessel [ARRV], the three Regional Class ships, and the two Ocean Class ships), under

the timeline shown in the 2007 IWG-F Fleet Status Report ([2]). These ships represent the absolute minimum level of renewal that is necessary to maintain needed vessel capability. This level of renewal omits two Ocean Class ships from that were previously recommended in the 2001 *Long-Range Plan for Renewal* [7].

Planning and acquisition of new ships generally takes at least ten years. Therefore it is crucial to begin the process now for other ships that will be needed in 2017 and beyond. Two of the existing general purpose Global Class vessels (R/V *Knorr* and R/V *Melville*) are scheduled for retirement by 2017, so replacement planning needs to start now. A minimum of one and preferably two new general-purpose Global Class vessel(s) should be planned for, funded, and constructed by 2018. Because the new, smaller Ocean Class vessels have both design and scheduling limitations that restrict their suitability for much of the large, global-ranging expeditionary science missions envisioned in the future, the replacement Global Class vessels need to meet or exceed the specification standards of the current Global Class ships.

The ARRV, Regional, and Ocean Class ships will not enter service until several years from now. There have been delays in the timelines for delivering the new ARRV and Regional Class ships into the fleet. Some of the current ships nearing retirement should have their service life extended so that they can be maintained at an adequate operational level to meet near term science requirements until the new ships come on line. However, UNOLS considers the service life extension approach as an option that should only be considered if there is a demonstrated need for ship days and funds for new construction are unavailable or delayed. The optimal course is to initiate the planning, budgeting, and construction of new vessels that meet the science mission requirements now rather than later.

If budget projections remain at the current low level, retirement of the least capable ships near the end of their service lives should be considered. Any decisions on ship retirement versus lay-ups should be made based on multi-year projections of

ship time demand rather than single year figures of fleet utilization.

To realize the vision of the U.S. Commission on Ocean Policy for strong support for ocean research, including ample access to modern research vessels, the UNOLS fleet must increase beyond the current projected levels detailed in the IWG-F Status Report. This will not only require increased funding for support of ocean science research and education but also increased funding for facility construction, maintenance, and operation from both public and private sectors.

The Federal fleet renewal plan only considers vessels greater than 40 meters (131 ft). Smaller UNOLS vessels are normally constructed with state or institutional funding. To continue to meet current requirements for the entire academic oceanographic community, UNOLS should encourage the timely replacement of Local vessels and Coastal/Regional vessels by institutions, state governments, and regional partnerships.

New state-of-the-art ships with technically sophisticated equipment will require more highly-trained and specialized personnel to provide technical support. Personnel strategies must be developed to improve the staffing and retention of experienced technical support personnel and crew.

In conclusion, the U.S. Research Fleet is an extremely vital component of the national maritime enterprise. The U.S. ocean science research and education programs have benefited by broad access to the best possible mix of modern, capable, efficiently run, and well-operated research vessels, aircraft, submersibles, and other major shared-use facilities. Timely implementation of the recommendations presented in this Fleet Improvement Plan will ensure that the oceanographic community will continue to have access to a capable fleet of vessels to support the open ocean and coastal science initiatives that are important to the nation over the next 20 years.