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As requested in Admiral Watkins' letter of May 30, 2002, here are responses to the questions raised:

1. Q. It would seem that there are many "platforms of opportunity" available for research purposes. Offshore oil and gas platforms, cruise ships, tankers and freighters, commercial and recreational fishing vessels, and even commercial aircraft. I know that the research community has taken advantage of these, but is there a way to make better use of them, especially in the context of a coordinated national ocean observing system? What about the potential of smaller platforms associated with State resource management agencies or marine labs?

1. A. Vessels and platforms of opportunity are indeed valuable facilities for certain aspects of research at sea and are used in this mode. They lend themselves to deployments of simple, often expendable, instruments and to the gathering of routine measurements underway - activities that do not interfere unduly with the main work of the platform or vessel. They are less suitable, or not suitable at all, for focussed experiments at sea where the overall schedule and track are driven by science, where the platform has to respond in real time at sea to changing scientific demands, where the full suite of oceanographic capability (winches, cranes, positioning systems, navigation systems, computer networks, samplers, laboratory facilities, and much more) has to be adapted to the experiment of the moment and has to be at the beck and call of the onboard scientific group or groups, and where much specialized equipment has to be fitted to the ship in advance for the specific experiment to be performed. These are the kinds of efforts at sea for which dedicated, purpose-built, adaptable research vessels are needed and toward which the FOFC fleet renewal plan is primarily addressed.

The question of whether various kinds of platforms of opportunity could be used more effectively for the subset of scientific tasks for which they are suited is perhaps best addressed to scientific constituencies already making some use of them. Use of commercial volunteer observing ships for repeat XBT sections and ARGO float deployments, for example, appears to me to be going well, but I would defer to the scientific leaders of those efforts for comments about whether the situation could somehow be improved. I believe the key limitation in many such efforts is not the unwillingness or unsuitability of the ships or platforms per se, but rather the inescapable fact that vast regions of prime oceanographic interest lie far away from shipping routes, fishing grounds and oil exploration provinces, so that platforms of opportunity simply will never be available in those areas.

Small vessels of marine labs and state agencies should of course be used where that makes sense. Small vessels are intrinsically local, so it is difficult to generalize - the

researchers in a local area should be cognizant of local possibilities and use the most efficient ones. Given the severe economies forced on most researchers by funding constraints, I feel some confidence in suggesting that most researchers are keenly aware of any potentially "good deal" on a facility that suits their purposes, including use of suitable small vessels from nearby sources. Indeed, my concern at this point in time is more the reverse - that funding stringencies can press researchers and vessel operators alike to try to do "more with less" up to and beyond the point of prudence with respect to safety, work in bad weather, continued use of worn-out staff or equipment, etc. The margins for error in this regard in most projects at sea are small, and the economic pressures to make them smaller are substantial.

2. Q. What is the proper mix of federally operated versus privately owned/leased/chartered vessels for activities that are of paramount public interest but that also have significant legal liability, such as mapping and charting of coastal waters? What about the potential of smaller platforms associated with State resource management agencies or marine labs?

2. A. In the main, member institutions of UNOLS - universities and similar bodies - have not played a large role in mapping and charting of this kind, in part because of the attendant legal liabilities. UNOLS ships and researchers are interested in using the same kinds of shipboard bathymetric survey systems, but not to produce official charts for which they can be held legally responsible, only to pursue scientific goals, say in marine geology and geophysics. So UNOLS is probably not the best body to comment on this particular question. It seems to me that it is a matter for discussion and negotiation between the federal agencies that do undertake charting (especially NOAA) and the private firms that can undertake similar tasks. I would think that marine labs would have liability concerns and a desire to pursue research vs. charting similar to UNOLS member institutions. State agencies could have a variety of different agendas and inclinations toward charting in state waters, and different levels of readiness to confront any legal issues.

3. Q. What should be the role of oceanographic research vessels as the next generation remote observing system is developed?

3. A. In a word, "central." In my written submission to the Commission I mentioned the "Assessment of Future Science Needs in the Context of the Academic Oceanographic Fleet," a NSF-sponsored workshop held in August 2000 at Oregon State University that is an important source of information on exactly this question. NSF has not published this report in paper form but it is on the web at <http://www.unols.org/fic/biennial/futship.pdf>. I noted that "The workshop focused on future scientific requirements in relation to the fleet. Workshop participants all agreed that we are indeed currently witnessing a breathtaking increase in the capabilities of unmanned systems, in terms of space and time coverage and in terms of the suite of variables that can be sensed. Satellite-derived maps of sea surface temperature, ocean color and sea surface height are perhaps the most dramatic examples. But this fact does not consign research ships to the museums of the future; on the contrary. For the first time in the history of the science, we can anticipate using smart combinations of unattended devices and directed, adaptive observations from ships to sample ocean processes on space and time scales appropriate to the phenomena. For the first time we can see how to obtain contemporaneous information on the numerous variables that

may be key to the processes - temperature, salinity, current, a welter of chemical and biological variables, details of the seafloor, and much more. For the first time we can envision a ship not as an isolated and lonely point in mid-ocean forever incapable of observing both "here" and "there" at once. The ship instead can become a sort of maritime AWACS or mobile concentration of brainpower governing the deployments, movements and schedules of its own sophisticated sampling work and also the actions of associated arrays of less sophisticated unmanned devices. Those aboard, and even those at the end of communication links ashore, will be able to make decisions based on the real-time flow of information from the ship, from many or all of those unmanned devices and from various ongoing global observing systems. This is indeed a new prospect in observing the ocean and understanding its processes."

In other words, the advent of the new remote observation systems will spark many new and more sophisticated uses of research vessels. Scientists will be able to see the larger context in nature, courtesy of the remote observations. They will therefore be able to design and carry out hitherto impossibly daring and complex experiments at sea, intelligently guided by that context so as to reach a far more fundamental understanding of the real physical, chemical and biological processes that give rise to the actual ocean we see. As the workshop concluded, "New observational tools will extend the reach of the fleet, but will not replace or reduce the fundamental use of vessels to conduct basic observational and experimental research at sea. This "dual use" of the fleet will lead to increased demand for ship time. The need for expanded capabilities is driven by the requirements of the pending scientific questions, as well as by the continual technical advances in sensors and observational systems."