UNOLS Arctic Icebreaker Coordinating Committee

Report to the UNOLS Annual Meeting

September 14, 2000

James H. Swift, Chair AICC

The UNOLS Arctic Icebreaker Coordinating Committee (AICC) is focused on US vessels used for academic science support in the marine Arctic, with emphasis at the present time upon USCGC's Polar Sea, Polar Star, and Healy. The AICC facilitates communications and provides advice on matters of mutual concern regarding science planning, operations, equipment, and technical support from science users, vessel operators (chiefly the US Coast Guard), and funding agencies (chiefly NSF). The AICC's model for the Coast Guard's relationships with the Arctic marine science community remains the equivalent activities of UNOLS large ship operators. Examples include UNOLS-like documentation and information for scientists, participation of the Coast guard in UNOLS infrastructure and meetings (e.g., UNOLS Council, Research Vessel Operators Committee, RVTEC, etc.), ship time requests and vessel scheduling procedure parallel to UNOLS, informal participation (to a degree) in the UNOLS equipment pool, and participation of Coast Guard Marine Science Technicians on UNOLS cruises as part of their training.

USCGC Healy is a new four-season, icebreaking Arctic research vessel with science facilities matching those on the large UNOLS vessels. Healy was from its inception meant to be operated by the Coast Guard for the academic science community and together with the research and icebreaking capabilities these defined the vessel which was delivered by Avondale Industries to the Coast Guard in late 1999. The Healy is a large vessel with a complex physical plant. The Coast Guard is taking steps to move some key personnel to longer rotations and has encouragement from the highest levels to take innovative steps to maintain and support the vessel. At the same time efforts are underway to bring the three Coast Guard icebreakers into step, where feasible, regarding science equipment, training, and planning. All three icebreakers are based in Seattle.

AICC activities in 2000 have been dominated by the science systems testing for USCGC Healy. Jack Bash and John Freitag from UNOLS arranged a cadre of top-flight UNOLS technical specialists to evaluate each primary science system on the ship, first in warm water trials and then in cold water testing.

AICC member Lisa Clough was Chief Scientist, with member Larry Lawver assisting, during the Healy's warm water trials in February-March 2000. They endured a start date saga as the Coast Guard readied the ship. Once underway the trials were a strong success, not that problems were not found - a list was growing before the first trial day at sea - but because a huge amount was learned and accomplished in virtually every arena. Perhaps the most spectacular scientific success was coring in over 5000 meters of water, but that led a long list on the plus side.

The AICC was a significant presence during the Healy's Baltimore public relations visit 22-24 March. The AICC had solicited science posters from the community and there was a strong response. The posters were set up in the ship's laboratories, where the AICC hosted many visitors during the open house. In addition to the posters there were videos, a model of a coring rig, the actual core from warm water trials, and science equipment on the decks and in the staging bays. Visitors included the general public, teachers and students, press, many from the Coast Guard, including several admirals, an NSF contingent, and representatives from Congressional and departmental staffs.

AICC member Joe Coburn was aboard during the first phase of the Healy's ice trials in April and May between Canada and Greenland. This program put the Healy through increasingly heavier ice conditions during two three-week legs of icebreaking designed to thoroughly shake down the ship. Propulsion plant lessons did not come without cost, but the vendors and Coast Guard worked out the problems and the ship

performed well. The ship was heavily instrumented, yielding a wealth of data on icebreaking performance and the attendant stresses. Terry Tucker, Dev Sodhi and their team from CRREL provided information on the sea ice characteristics to match with the readouts from the ship. Official results have not yet been published, but the vessel's icebreaking specifications were met or exceeded, there is not excessive milling of the ice by the props, and the vessel is responsive and maneuvers well in the ice.

Each of the four cold water science systems test legs during May-July 2000 had a focus. The tests emphasized both the "test memo" approach, where a science system was methodically checked out, and also the "science cruise" approach, where equipment was used in the mode expected on a typical research cruise. What made the testing exercise so valuable was the enthusiastic joint participation of the Coast Guard personnel who will be supporting the systems, technical experts from the UNOLS community, and seagoing scientists, including on various legs Kelly Falkner, Jim Swift, Terry Whitledge, Lisa Clough, Larry Lawver, and Garry Brass.

Leg 1 tests included science acoustic equipment (the SeaBeam 2112 swath mapping system, the 150 and 300 kHz ADCPs, and the Bathy2000 and Knudsen bathymetry systems), the XBT system, and the science data network. All of the tests were completed with the exception of testing in the ice. The ice had simply retreated too far north to reach within the allotted time frame. (The acoustics gear was, however, exercised during in the ice during legs 2-4.)

Based on examination of real time data, dramatic improvements in the ship's SeaBeam 2112 system were made since the warm water trials, largely due to recabling and to repositioning the vertical reference unit, and the system now appears to be functional. Potential users of SeaBeam on the Healy can expect to obtain good bathymetric data in moderate seas, at most headings and at reasonable speeds (up to 15 knots) in open waters, and surprisingly good data in ice-covered waters. They can expect to encounter similar data artifacts, reliability and capabilities that have been experienced by the science community on UNOLS vessels.

The 300 kHz ADCP is not presently acquiring water velocities below about 20 m. But the 150 kHz ADCP appears to operate as well as can be expected of a broad band instrument. The Bathy2000 bathymetry system is functional, and the system successfully tracked a pinger to 2000m in moderate seas. The Knudsen bathymetry system functioned well and is readily configured with straightforward controls. It produced clean 12 kHz bottom traces to 4000 m at speeds of 15 knots. The Sippican Mk12 XBT system was tested and worked without problems.

The Healy science data network functions well in many cases, though aspects of the system operation were identified for improvement. In addition, issues regarding maintaining the system, shoreside troubleshooting during missions, expertise on board, and keeping abreast of technological developments are being discussed. The Coast Guard is likely to migrate to the NOAA underway data software used by many UNOLS vessels.

On Leg 2 the uncontaminated seawater system received a careful going over. Seawater supply flow rate and temperature tests were completed at all locations. The thermosalinograph and fluorometer were working. Debugging and fixes improved performance and knowledge of the system. The intake clogs in the ice and adjustments are underway.

MOCNESS tows with the 0.680" conducting cable from the aft A-frame were an unqualified success, beginning with an open water tow, then progressing to a tow in light ice cover, and finally a tow in 80+% ice cover. The ship's bow simply pushed the ice aside. Little ice was ducted into the wake of the ship and so there was never adverse effect on the tow. The MOCNESS and winch systems and deck operations worked very well.

The CTD tests were successful, with a small number of minor problems identified. Steady 30 knot winds did not deter over-the-side operations, with the Healy riding with very little undue motion. In-ice CTD operations did not differ in any significant manner from open water operations. A problem with the outboard sheave for the 0.322" wire was identified and the unit will be modified or replaced for the first field year.

Leg 3 focused on deployment and recovery of an anchor-last scientific mooring in open water, deployment and recovery of an anchor-first a scientific mooring in heavy ice cover, and continued testing of the ship's underway systems, winch control systems, communications, and CCTV. The mooring tests were meant to mimic the complete sequence of events that would occur during real deployments and recoveries, as if they were separated by months in time; they were a complete success. The UNOLS team led on the first mooring and for the second the ship's company carried out much of the work. The coordination between the bridge, deck crew, MSTs, and science party was very good throughout. The deployments and recoveries were videotaped, with copies made for the ship for training and to assist community evaluation.

Other tests continued. The Healy's biochemistry laboratory is specified to have tight temperature control so that instruments and analyses sensitive to laboratory temperature can be carried out to specification. Several days of logging biochemistry laboratory temperature at 15-minute intervals demonstrated the inability of the installed controller to meet the specifications for this space. Modifications have been recommended so that specifications can be met.

During a test cast to continue scientific evaluation of the winch control system, the ship's company carried out a successful dredge haul in approximately 900 meters of water in a long lead in the ice field, bringing up rocks, mud, and several bottom dwelling organisms.

Testing of the environmental control systems in the climate control chambers continued, imitating use cycles with a schedule of door openings, and with placement of a small heater in one chamber to mimic the thermal load of a person and equipment.

On Leg 4, although there were a few miscellaneous tests to retire, such as those for the science hoist and deck communications system, and a few ongoing tests, such as the climate control chambers and continued evaluation of the science data network and winch control systems, the focus was on evaluating the Healy's coring and dredging capabilities. All parties agreed that the Healy's coring capabilities in open water over the aft A-frame were amply proven during warm water testing, so the emphasis on Leg 4 was on coring over the starboard, and in ice. Associated with this was use of the SeaBeam and 3.5 kHz sub-bottom profiler to survey prospective sites

The first core, with 40 feet of pipe, was launched and recovered without incident, having plunged in to the core head. The entire operation was capably led by the UNOLS groups, who worked out procedures and instructed the Coast Guard personnel. Next a 60 foot core was launched. This operation was led by the Coast Guard personnel, with the academic technical specialists coaching. This went well, triggering and pull-out were excellent, and the corer brought back a nearly full barrel of mud. As the team prepared to do a second 60-foot core, to the surprise and dismay of all it was learned that the fine control the trawl winch requires to work safely with the massive core head was no longer available. Fixes were attempted, to no avail. This problem demonstrated clearly that changes were needed in the winch control system, and there was an immediate effort to guarantee that an improved system will be ready for the 2001 field year. An 80 foot coring rig was prepared, moved to the vertical and then hoisted back up onto the platform. This uncovered a few minor issues with cranes and handling, but these were easily solved. Thus the Healy was proven ready to carry out up to 80 foot cores, the maximum length currently feasible. All coring operations were videotaped.

Enriching the test cruises were teachers from NSF's TEAA program, arranged through the efforts of Kelly Falkner. The AICC could not have been more impressed with the teachers. Their enthusiasm, energy, and unique perspective helped to bring everyone on board together. More than that, they brought the ice trials and science systems tests to the public - to anyone with an internet connection - with accuracy, breadth, humor, and insight. The AICC urges that anyone wishing a closer look at the tests and trials examine their web sites:

http://tea.rice.edu/tea_kolbfrontpage.html

http://tea.rice.edu/tea_klinkhammerfrontpage.html

http://tea.rice.edu/tea_rosenbergfrontpage.html

http://tea.rice.edu/tea_hindmanfrontpage.html

http://tea.rice.edu/tea_schauerfrontpage.html

While the list of suggested modifications, fixes, and new acquisitions for Healy is long, these belie a longer list of successes. Matters are basically business as usual for a new ship, and the ship will clearly be ready for science support in 2001. Every person who has been aboard comes away impressed with the professionalism, support, interest, and friendliness of the entire ship's company. The AICC will be preparing a report to supplement the test memos. The report will be ready for the public in early 2001, for example as a pdf file on the UNOLS web site.

The AICC stood ready to provide advice to NSF and the Coast Guard during the Healy's scheduling process, which is now nearly completed for 2001. The AICC plans to contact PIs (after they have been notified through official channels) to help them reach key Coast Guard personnel, to help them assess their logistics, personnel, and work plan needs, and to provide feedback to NSF and the Coast Guard about the panoply of logistic considerations that are much clearer to the AICC now that testing is completed.

Healy's commissioning ceremony was August 21st in Seattle. The AICC was there, and held a meeting on board in the science conference room on 22-23 August.

The AICC will assist and advise the Coast Guard regarding scientific equipment and technical support requirements for the 2001 field season, which will include the first "paid science" cruises for the vessel. Due to the yard demands of the post-shakedown warranty period, the ship will not be free until spring, but then is expected to have a busy Arctic science support schedule through late 2001. Future years look busy!

The outlook is positive for NSF's Arctic marine science programs, including both that Healy funding will not eat into science funding at NSF and that OPP Arctic science funding looks healthy. The deadline for OPP Arctic proposals is now the same as for other ocean science programs at NSF. NSF agrees that expeditionary planning will be important for developing cohesive programs. The Arctic Section is working on the question of how to handle equipment upgrades and new equipment needs and has hired an Arctic Research Support and Logistic Manager. It is possible that OPP may adopt practices similar to those in Ocean Sciences, where technical support is shifting over from the research budgets to the technician support budgets.

The Coast Guard plans to continue permitting science participation on a "not to interfere" basis on shakedown cruises in the western Arctic. These "Science Of Opportunity" (SOO) cruises have been a popular venue for informal data collection, pre-proposal investigations, and instrument tests. The AICC reviews SOO requests for logistical feasibility and compatibility.

Regarding Arctic science proposal submissions, ship costs for use of Healy (and the Polar-class icebreakers) are no longer contained in NSF proposal budgets, but ship use requirements must be clear in accompanying documentation, (for example the "831" form or NSF/OPP's logistical support form for Arctic research).

The AICC is working with UNOLS to maintain a web site containing a rolling five year plan for US Arctic icebreaker use, beginning with conceptual plans and then updated to show proposal submission and status, and, for the lucky few, scheduling. Judging from the large number of ship time requests already generated there is substantial community interest in Arctic icebreaker use.

The AICC can be reached by writing to the Chair (jswift@ucsd.edu) or to the UNOLS Office (office@unols.org).