Arctic Marine Research Capabilities Committee (AMRCC)

Carin Ashjian, Chair

Woods Hole Oceanographic Institution

January 14, 2026

What is the AMRCC?

- Special UNOLS Committee established by UNOLS Chair and Council at the request of the NSF, ONR, and USARC

  Purpose: Review and refresh science missions and affiliated science mission requirements of future Federal icebreakers operating in the Arctic Ocean and other northern polar regions

- Primary Tasks
  - Assess whether existing Science Missions and Science Mission Requirements (SMRs) meet current and emerging needs for Arctic research on Federal icebreakers
  - Identify any additional SMRs required to ensure that Federal icebreakers will meet the needs of the Arctic marine research community for <u>the next 30 years</u>
  - Review and refresh SMRs for (a) any commercially available polar icebreaker that may be acquired or procured and refit for operation by the Federal government; and (b) the conceptual design of future "medium" or "heavy" federal-flagged and owned icebreakers.

The Committee and liaisons have wide experience in Arctic research

Committee

- Dr. Carin Ashjian, WHOI, Chair
- Dr. Lee Cooper, UMCES
- Dr. Laurie Juranek, OSU
- Dr. Jim Swift, SIO
- Dr. Jeff Welker, UAA
- Dr. Emily Eidam, OSU
- Dr. Laura Whitmore, UAF
- Dr. Christopher Cox, NOAA
- Dr. Bernard Coakley, UAF
- CAPT William Woityra, USCG
- Ethan Roth, OSU
- Brendon Mendenhall, SIO

Liaisons

- Dr. Jamie Austin, Dr. John Farrell (for USARC)
- LT Christine McCulla (USCG)
- Others when they can make it

Approach and Status

- Reviewed previous SMR reports, especially 2012 Polar Research Vessel and 2019 Antarctic Research Vessel
- Three open meetings at scientific conferences to inform and gather input
- Community survey
- Committee in-person workshops and Zoom meetings
- Letter to USCG (reviewed and approved by UNOLS Committee) regarding science upgrades to the USCGC Storis, August 2025
- Draft report completed January 12, 2026; Once formatting is complete, the report will be sent to the UNOLS Council for concurrence and then to the agencies and USCG

Some Elements of the Report

- Case for US preeminence in Arctic research
- Status of the US Icebreaker Fleet and of International Icebreakers
- Present limitations to science using our current Arctic icebreaker assets
    - Multiple missions and needs for *USCGC Healy* make scheduling challenging
    - *R/V Sikuliaq* is not an icebreaker and so is limited seasonally and geographically. Also, too few bunks for large, multidisciplinary projects
- Synopsis of community survey and future science
- Thirteen science missions
- Science mission requirements (SMRs)
- Categorize potential US vessels by their capability to support the science missions
- Intersection of science needs with USCG Statutory Missions

Present and Future US Federal Arctic Icebreakers

USCGC Storis

PSC

- USCGC Healy
- USCGC Storis
- Davie/Helsinki Arctic Security Cutters (MPPS-100)
- Seaspan/Aker Arctic Security Cutter (MPI)
- Polar Security Cutters

ASC: MPPS-100 Design

Davie Image

ASC: MPI Design

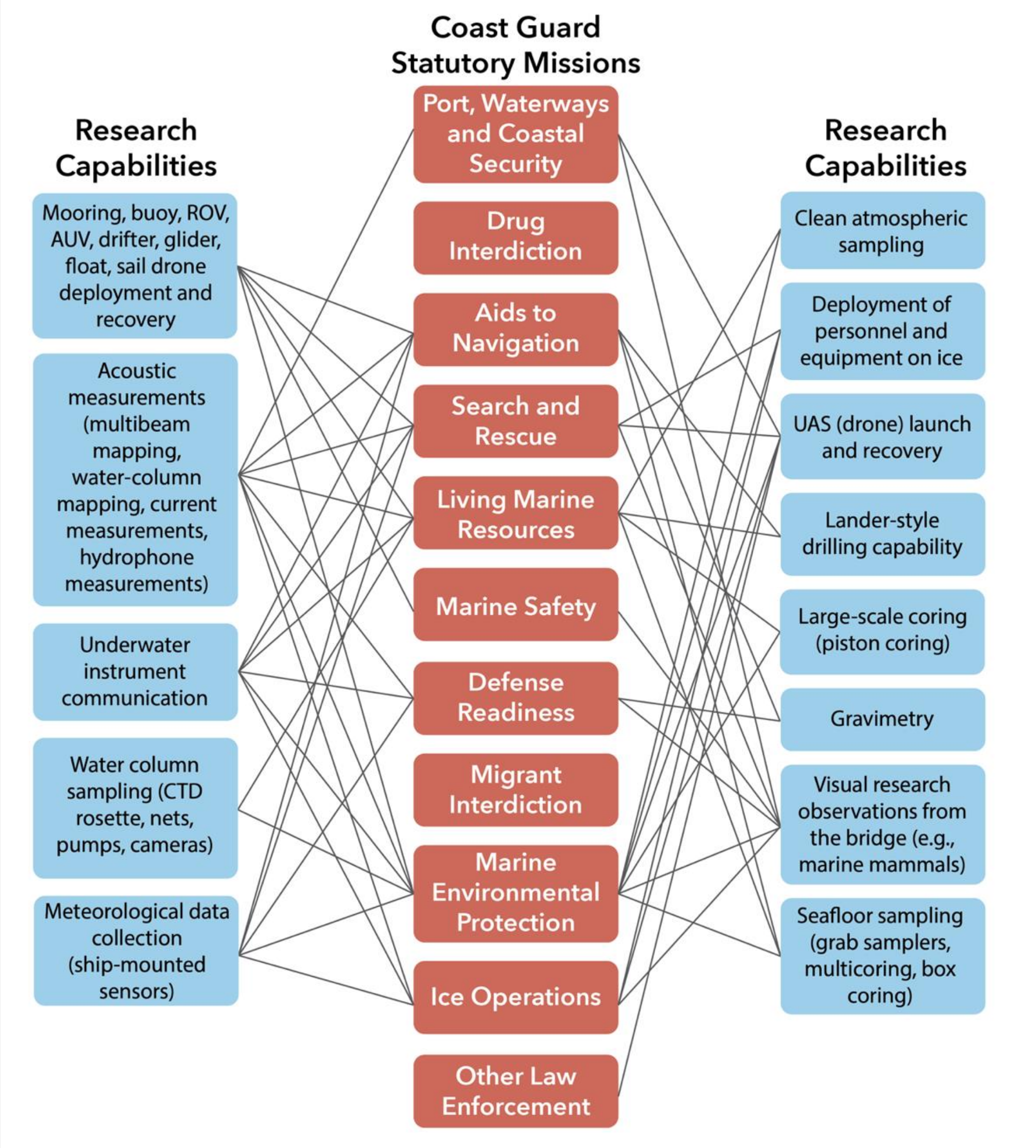
Aker Image

USCGC Healy

Critical Findings/Observations

- Ship-based research will continue to be a core requirement for Arctic marine science over the next 30 years, as a platform for both more "traditional" sampling technology and for more recently developed, and to be developed, assets such as autonomous vehicles (AUVs, UASs, ROVs)
- Modular equipment can expand the capabilities of a ship with only minimal permanent science equipment
- All the science missions can be supported by at least one category of ships being considered
- The US' prominence in Arctic marine research is threatened, in part because of limitations of our Arctic research fleet
- The international community (Canada, China, Japan, Korea, Sweden, Germany) has dedicated significant resources to supporting Arctic marine research and to build icebreakers to conduct marine research. To maintain prominence in Arctic marine research, the US needs to similarly dedicate resources. <u>When the Healy retires, the US's science capability will be severely diminished without new assets.</u>

Critical Findings/Observations



- Many of science's needed capabilities contribute to fulfilling the USCG's Statutory Missions

Recommended capabilities are categorized in three tables – see report

Category	Science Enabling Capability	Modular Potential	Required Supporting Systems	Specific Additional National Security Needs
Core	Hull mounted transducers	No	Cable conduits, space above water line for transceivers, anti-freeze flooded tanks, ice windows	
	Berthing and hotel services: Accommodations for minimum 25-26, goal 35 including science techs	No		
	Permanent Interior Lab Space	No	Flexible chemical/flame resistant work surfaces, network connections, clean power, comms, network, fume hoods, UPS, compressed air, sinks, deionized water, segregated hazmat storage	
	Moon pool	No	Gear handling equipment	Deploy subsurface gear, such as AUVs, undetected
Overboarding and Ship Handling	Dynamic positioning	No		
	High capacity stern A-frame	No		
	Oceanographic winches	No		
	Ability to tow packages from the stern in ice	No		
Meteorological and Underway Observing	Flow through science seawater with capacity for multiple permanent and temporary sensors	No	Navigation, data infrastructure	Pollutants, contaminants, HABs, surface sound speed
	Platforms for meteorological sensors	Yes	Foremast 16-20 m above mean water line (ideally forward-tilting); climbable; ability to mount auxiliary equipment; accesss to 110/220 VAC, freshwater source on bow for cleaning, science network	Situational awareness (e.g., Row 16 AWS), atmospheric/ice observations including those assimilated into forecast models for sea ice prediction and weather
Science Network and Data	Independent science network & data storage system	No	Navigation, SATCOMS, UPS, airgapped unclassified network	Inputs to forecast models including sea ice prediction and weather, enables participation of non-USCG personnel on deployments
	High bandwidth satellite comms system, internet, telepresence	Yes	Power, undisturbed field of view for science antennas	
	Access to ice radar (X-band) data feed (archived is OK)	NA	Navigation, networked data storage (see Healy system)	Situational awareness, sea ice drift analysis
	On-board situational awareness system (e.g., shipwide GIS system, ice products, bathmetry, remote sensing) accessible to both operators and scientists	Yes	Simultaneous access to data and imagery products for operators and scientists, including navigation data, science network connectivity and computer for bridge	
	CCTV systems to monitor decks, winches, etc.	Yes but not desirable	Networking and/or dedicated cable runs to relay data, power	
Modular Capabilities	Modular specialized lab capability	Yes	Tie down, power/water/HVAC/comms/on-deck plumbing that doesn't freeze for modular labs.	
	Capability to install modular equipment (e.g., Winches, launch/recovery systems, compressors)	Yes	Sufficient deck strength, deck bolt pattern, appropriate electrical power to support modules	
	Heated, weather protected staging area with deck access for other science equipment (e.g., AUV, ROV, Electronic equipment)	Yes	Freshwater, drains, electricity, deck bolt pattern, compressed air, wide door deck access	
	Heated, weather protected staging area for CTD	No	Freshwater, drains, electricity, deck bolt pattern, compressed air, wide door deck access	

Science Enabling Capabilities

- Enable scientific work on a ship, even if the ship is not a dedicated research vessel
- Most partly permanent characteristics of equipment on the ship although some can be brought aboard for a specific science mission
- May not be used for all the ship's missions but generally are necessary to conduct science missions or missions that include a scientific work component
- Identified for each:
  - If it can modular
  - Needed supporting systems (e.g., cables, network, gear handling)
  - Potential contributions to national security (not for all)
- Example: Hull mounted transducers
  - Cannot be modular
  - Require cable conduits, space above water line for transceivers, anti-freeze flooded tanks, ice windows

Research Capabilities – what we want to measure/collect

- Types of data or samples to be collected and associated equipment to be deployed from or installed on a ship
- Many can be accomplished using modular equipment brought on board for the science mission
- Identified for each:
  - If it can modular
  - Needed supporting systems (e.g., cables, network, gear handling)
  - Contributions to national security
  - USCG statutory missions supported by this research
- Example: Sea-floor sampling
  - Can be modular,
  - Requires winch/A-frame, dynamic positioning, and ambient seawater,
  - Contributes to validation of multibeam/backscatter measurements, detection of pollutants in seabed, support of fisheries, detection of harmful algal blooms
  - Supports USCG Statutory Missions “Aids to Navigation”, “Living Marine Resources”, and “Marine Environmental Protection”

Research Capable Small Boat

- Need: Sampling in shallow water or away from the ship where the upper water column is undisturbed
- Permanent equipment and capability to support researcher supplied equipment
- Identified for each type of equipment and instrumentation:
  - If it can modular
  - Related research goals
- Example: Hull-mounted multibeam
  - Cannot be modular
  - Mapping
- Example: Shelter/cabin for equipment and personnel
  - Mapping, Sampling, Deployments

Not all future icebreakers will have all the recommended enabling capabilities or ability to conduct needed measurements but all Science Missions can be supported by at least one ship

Ship Science Capabilty	Mission Scenarios												
	1	2	3	4	5	6	7	8	9	10	11	12	13
Minimal	x					x							x
Moderate	x			x[#]		x	x	x	x[*]	x[#]			x
Healy or UNOLS Global Class	x	x	x	x	x	x	x	x	x	x	x	x	x
USCGC Storis	x	(x)	(x)	(x)	(x)	x	x	x	(x)	(x)	(x)	x	x
Davie/Helsinki ASC (MPPS-100)	x		x[^,#]	x[^,#]		x	x		x[#]	x[^,#]	x	x[^]	x
Seaspan/Aker ASC (MPI)	x[%]					x[%]	x[%]		x[#]		x	x[%,^]	x

[*] If equipped with stern A-frame and crane

[#] If sufficient deck space and overboarding equipment

(x) Science capabilities should be phased in with time and more missions accommodated

[%] If ice free region can be maintained along side of ship

^If science party complement is sufficient

Key Suggestions for the USCGC Storis

- Provided recommendations for 1) high priority infrastructure, 2) overboard handling, 3) meteorological and other underway sensors, 4) laboratory and staging spaces, and 5) science network and data handling
- Included general estimates of the phasing and scope of each modification and whether the capability could be modular/portable (i.e., brought on board for a science mission)
- Described needed supporting infrastructure for each capability (e.g., wiring for sensors, deck strength for heavy modular equipment)
- Identified how each science capability contributes to US National Security needs and the type of science it would support

Key Suggestions for the USGC STORIS

- High Priority Infrastructure
  - Hull Mounted Transducers
  - Capacity for up to 35 science
- Overboard/Handling
  - DP
  - Stern A-Frame
  - Support for modular equipment
  - LARS
  - Oceanographic winches
- Met. and underway sensors
  - Flow through SW
  - Met mast or equivalent
- Laboratory/Staging
  - Permanent lab space
  - Capability for modular lab and science equipment
  - Heated/weather protected staging space(s)
  - Science cargo hold
- Science Data/Network
  - Independent science network and data storage
  - High bandwidth satellite coms (internet, telepresence)
  - Situational awareness (e.g., navigation and bathymetry data)
  - Access to ice radar
  - On-board CCTV system to monitor deck activities, winches, etc

How can you reach us?

- Carin Ashjian, Committee Chair:
  cashjian@whoi.edu

- Doug Russell, UNOLS Executive Secretary
  doug@unols.org

Questions?

Science Mission Scenarios

MISSION SCENARIOS	
SM1	Single PI Project with Space for Others
SM2	Internationally Coordinated Basin-Scale Survey Cruise.
SM3	Marine Geology and Geophysics– Lander Drilling and Giant Piston Coring
SM4	Marine Geology and Geophysics - Multibeam and Seismic Mapping, Rock Dredging, Sediment Coring
SM5	Winter Ecosystem Study
SM6	Science of Opportunity
SM7	Ocean Exploration
SM8	GO-SHIP, including BIO GO-SHIP or Geochemistry Options
SM9	Physical Oceanography – Arctic Mobile Observing System
SM10	Multi-Ship Multidisciplinary Arctic Basin Studies
SM11	Near Shore Coastal and/or Rapid Response Mission
SM12	Fjord Survey
SM13	Air-Sea-Ice Interactions

Arctic Survey Cutter (ASC) Designs and Shipyards

MPPS-100

Davie Image

MPI

Aker Image

- Multi-Purpose Polar Support Ship (MPPS-100) to be built by Davie/Helsinki Shipyard Texas. Two ships to be built in Finland, 3 ships to be built in Texas (5 total)
- Multi-Purpose Icebreaker (MPI), originally designed for the Canadian Coast Guard, to be built by Bollinger/Rouma/Aker/Seaspan consortium. Two ships to be built in Finland, 4 ships to be built in Louisiana (6 total)
- Note different locations of the working decks on the two designs

Developments in "New" federal ships that will be operated in the Arctic. To date, none outfitted specifically for science

- USCGC STORIS, WAGB21 (formerly the Aiviq that was owned by Edison Chouest). Needs modifications to be a "cutter". Has good potential to support science. Commissioned and did her first deployment this summer. Procurement specified that ship must have Healy science capabilities.
- Polar Security Cutters (3) – Heavy Icebreakers, minimal science infrastructure, being built in US by Bollinger. Nominal date of first delivery in 2030.
- Arctic Security Cutters (up to 11) – Two designs. Medium icebreakers with icebreaking capability not as good as Healy. Executive order authorizing procurement of up to 11 ships, including of non-US built ships, signed October 8. Aim for first ship delivered in 2028.

Primary Arctic-Related Scientific Challenges

1) Closing gaps in terrestrial, ocean, and atmosphere research at scales from local to globa scales
2) Improving remote/autonomous/semi-autonomous sensing
3) Providing resources for more sampling in more areas at more times of year (including in heavy ice, during shoulder seasons, and in winter)
4) Collecting data that will support potential resource extraction
5) Advancing fully-coupled earth system modeling
6) Adapting observing strategies to the changing Arctic
7) Sustaining (or regaining) our preeminence in Arctic research and technology.

Scientific Topics

- Water masses and circulation
- Bathymetry and continental shelf mapping
- Carbon and water cycles
- Collecting data that will support potential resource extraction
- Geochemistry
- Biology/ecology
- Sea ice
- Snow
- Atmosphere
- Fisheries and other resource use
- Human activity and transportation
- Changes in freshwater input and Atlantic water fluxes
- Shelf-basin exchanges
- More….