REPORT OF THE

ARCTIC MARINE RESEARCH CAPABILITIES COMMITTEE

A UNOLS SPECIAL COMMITTEE

Arctic Marine Research Capabilities Committee Report

Carin Ashjian, AMRCC Chair

April 28, 2026

Primary Task

- Identify SMRs required to ensure that Federal icebreakers will meet the needs of the Arctic marine research community for the next 30 years
- “Federal icebreakers” include (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

Report Completed January 28, 2026

- Report edited and laid out by Ellen Kappel
- Report sent to UNOLS Council for Concurrence on February 22, 2026.
- Unanimous concurrence on February 28, 2206
- Final report sent to USCG, USARC, NSF, and ONR on March 5, 2026
- Available on UNOLS Web Site

What the Report IS and What it is NOT

What it does:

- In the absence of any other planned ships, assumes that the options for federal Arctic icebreakers are limited to the existing and to be built USCG ships
- Identifies potential science missions from which SMRs are derived
- Describes the basic science infrastructure for ships that will enable a broad suite of scientific measurements using both installed equipment (acoustics) and modular equipment brought on to support the mission
- Describes the science measurements that will need to be taken and science capabilities

It does NOT:

- Describe the ideal Arctic research icebreaker
- Make specific recommendations about instrument type/model. Wire types/strengths, sizes of spaces, etc.
- Describe how to conduct science operations

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
- 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

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
- 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
- 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>
- US Arctic scientific research contributes critically to US maritime capabilities in the Arctic, including economic benefits, safe navigation, national security and defense, national sovereignty, and long-term strategies
- Many of science's needed capabilities contribute to the USCG's Statutory Missions

Present and Future US Federal Arctic Icebreakers

USCGC Storis

PSC

- USCGC Healy
- USCGC Storis
- Arctic Security Cutters – Medium icebreakers
  - Two designs: MPPS-100 and MPI
- Polar Security Cutters – Heavy icebreakers

ASC: MPPS-100 Design

Davie Image

ASC: MPI Design

Aker Image

USCGC Healy

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
- First 4 ships nominally to be completed by 2028

Storis and PSC

- 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. Based on modified design for future Polarstern II. Contracted for 2 so far. Primary mission is to support Antarctic icebreaking. Likely to have some science capability (CTD, MB, met data collection)

The Core of the Recommendations are in Three Tables

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	

- <u>Science Enabling Capabilities (Table 5)</u> – Basic infrastructure that will enable scientific work on the ship
- <u>Research Capabilities (Table 6)</u> – What we want to measure and/or collect and equipment we need to deploy
- <u>Research Capable Small Boat (Table 7)</u>– A well-equipped small boat

Table 5: 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
- Examples: Hull mounted transducers, berthing, lab space, moon pool, overboarding, flow through science seawater, science data network and internet, modular capability

Table 6: 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”

Table 7: 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

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 type of ship

Modular equipment can greatly expand the science capabilities of a 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

Questions?

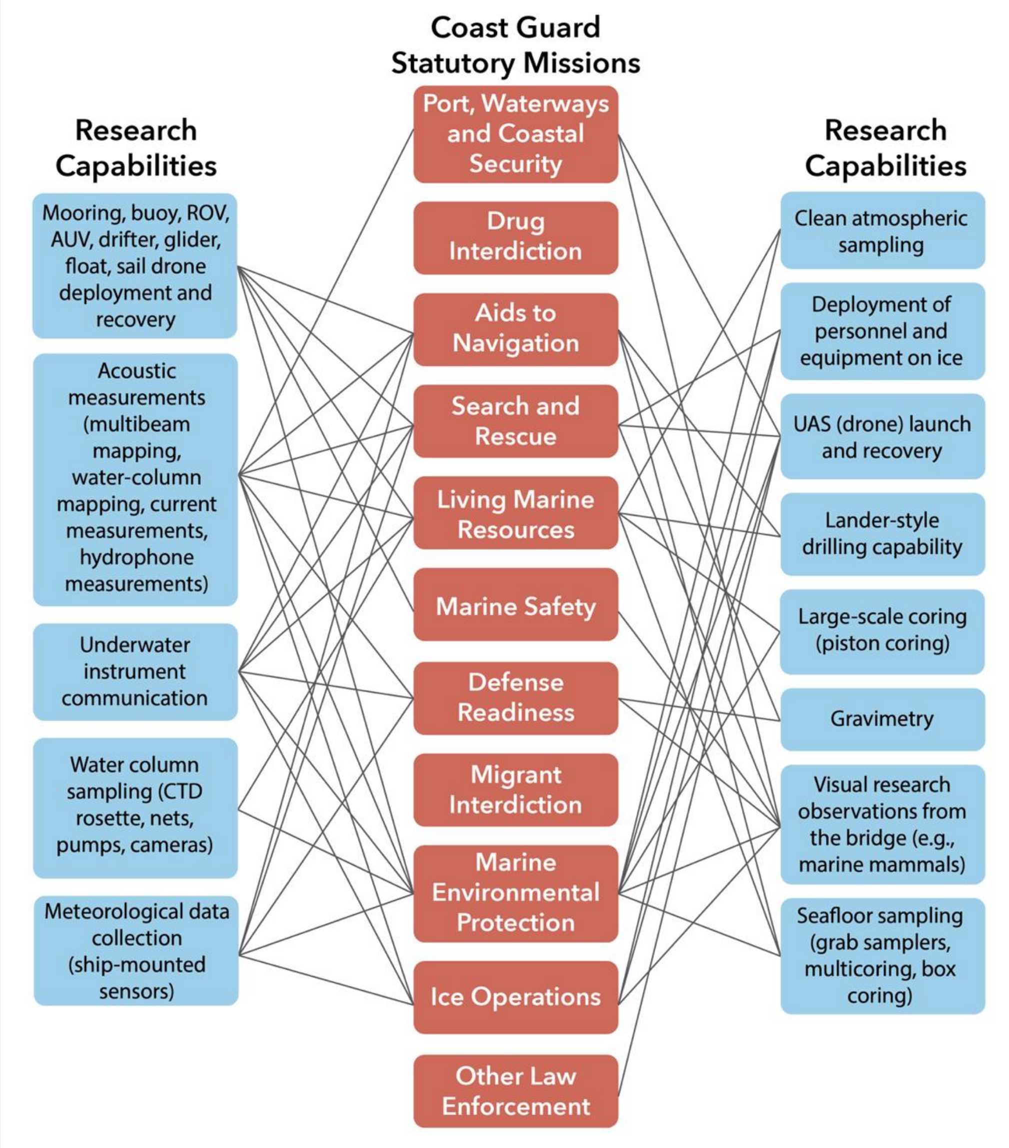
Comparison of Past, Present, Future (?) Ships

	USCGC Polar Star	*RVIB Nathaniel B. Palmer*	*USCGC Healy*	*RV Sikuliaq*	*USCGC Storis*	**Polar Security Cutter**	**MPI ASC**	**MPPS 100 ASC**	**Antarctic Research Vessel**
Length	399'	305.8'	420'	261'	360'	460'	328'	328'	365'
Beam	84'	60'	82'	52'	24'	88'	67'	69'	80'
Draft	31'	22.5'	29.3'	28'	28' 3"	36'	21'	22-25'	32.5'
Icebreaking	6' @ 3 kts	3' @ 3 kts	4.5' @ 3 kts	2.5' @ 2 kts	3.3' @ 3-5 kts	6-8' @ 3 kts	3.3' @ 4 kts	5' @ 3 kts	≥4.5' @ 3kts
Range	28,275 nm @ 13 knts	15,000 nm @ 12 kts	16000 nm @12.5 knts	18,000 nm @ 10 knts	15,500 nm @ 10 knts	6500 nm @ 12 kts	12000 nm @ 10 kts	6500 nm @12 kts or 12000 nm @ 12 kts	17,000 nm
Endurance (Days)	90	65	90-100	45	n/a	90	n/a	90	90
Power	75,000 hp	12,700 hp	30,000 hp	16000 hp	22,000 hp	45,200 hp	9655 hp	17,400 hp	
Crew	145	22	85	22	28	186 (total)	50 (total)	124 (total)	29
Science Party	~18	45	51	24	36	(?)	(?)	(?)	55
Country of Construction	USA	USA	USA	USA	USA	USA	Finland and USA	Finland and USA	TBD
In Service and Flagging	1976, USA	1992, USA	1999, USA	2014, USA	2025, USA (as USCGC)	TBD, USA	late 2020s?, USA	late 2020s?, USA	TBD, USA
Moon Pool	No	Yes	No	No	No	TBD	No	Yes	Yes

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

Critical Findings/Observations



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

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