U.S. Antarctic Program
Ship Support

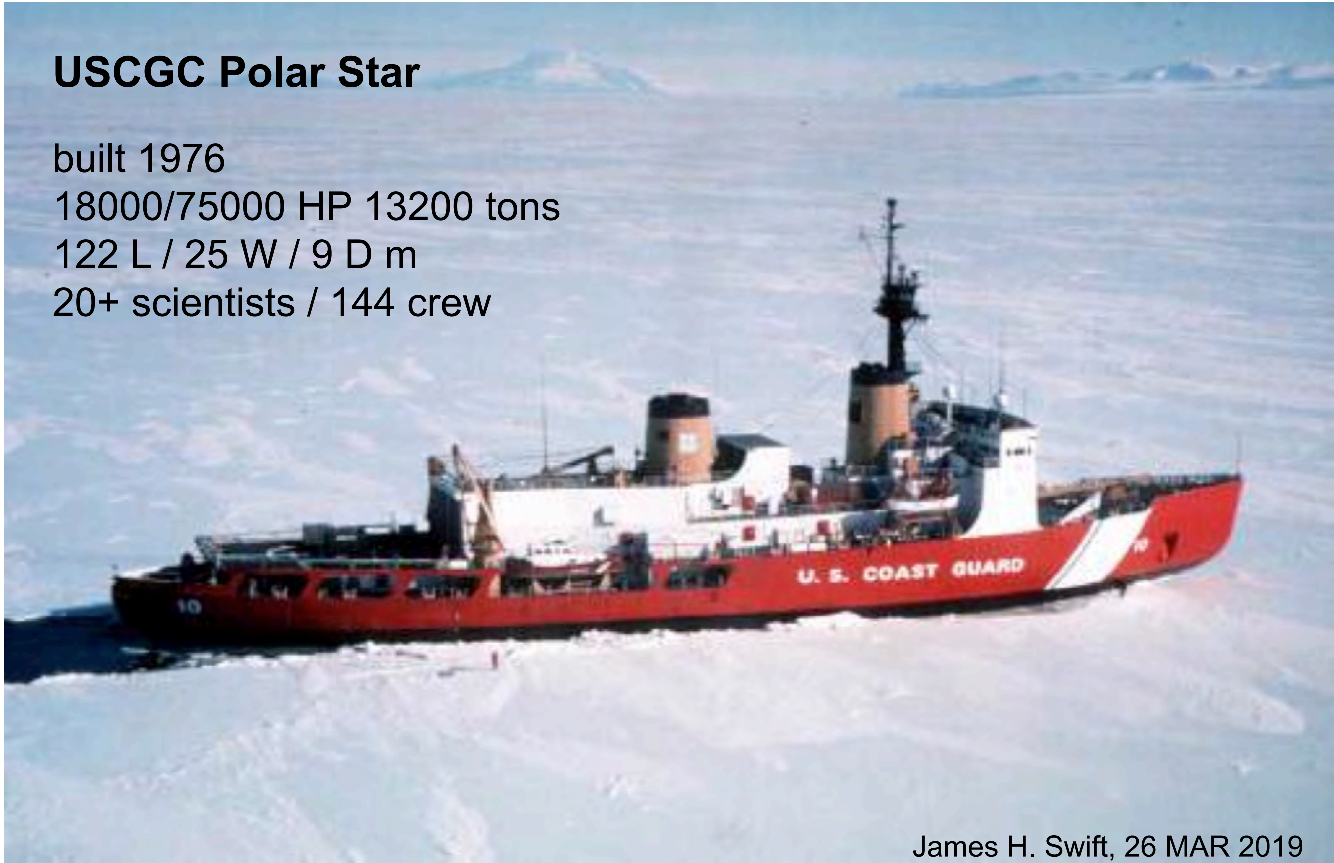
comments for UNOLS prepared by J. Swift
March 2019
(not vetted by or endorsed by NSF)

There is an ongoing need to (1) assess the capacity and capability of the fleet available for Antarctic (and Arctic) science and support missions and (2) evaluate options to adequately support the coming needs of the US research community. For example, future US polar marine research could potentially require improved icebreaking & science operations further into the shoulder seasons, and in winter; or require operation of scientific equipment not now feasible from today's polar ships.

Ship access to McMurdo Station is required for annual resupply, which supports McMurdo & South Pole stations and most US on-continent research. The resupply mission requires support from a heavy icebreaker. That icebreaker support is presently a US Coast Guard mission carried out by USCGC Polar Star. This is not a science mission, although some not-to-interfere science may take place. [A non-USAP US Arctic break-in requirement (Thule support) is currently met by Canada.]

The Polar Star's primary NSF-related mission is McMurdo break-in support. Historically the Polar Star has not proven to be robust during the heavy icebreaking for which it was intended, and is now a very old ship, kept in service due to lack of a replacement icebreaker.

The Polar Star is a powerful icebreaker, and with science system upgrades was used as a polar research ship. The ship is not well suited for some open-water science operations (due to hull form).



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Icebreaking capability is needed to support both Arctic and Antarctic marine research.

US Arctic region oceanographic research currently uses R/V Sikuliaq, and the medium icebreaker USCGC Healy, plus several foreign science icebreakers.

R/V Sikuliaq

In service 2014
Ice-capable (up to 2.5 feet) research vessel designed for Arctic science missions.

8300 HP 3400 tons
80 L / 16 W / x 6 D m

26 scientists / 22 crew
ample labs
In service in the UNOLS fleet, used by NSF OCE & OPP, ONR, etc.

UNOLS Global-class.

USCGC Healy

built 2000
icebreaker / research vessel
30000 HP 16000 tons
128 L / 25 W / x 9 D m
35(50) scientists / ≈ 80+ crew
labs similar to UNOLS
over-winter *capability*

Annual total science days limited by crewing & shore maintenance (also by planned AA mission).

A capable polar research vessel. OK in open seas. Additional technical support at sea provided by the academic community (via an NSF tech support grant).

US Antarctic oceanographic research currently uses two ships:

(1) ARSV *Laurence M. Gould*

Built 1997; owned & operated by Edison Chouest Offshore for the USAP contractor.

L: 230 feet; W: 46 feet; D: 18 feet; 0.3 m ice; 75 days; 2975 ft^2. labs; ≈26 science party.

Avg. 235 days at sea per year 2010-2017, part marine science and part logistics support of USAP Palmer Station. (Some issues as an RV.)

In a flat budget environment with increasing ship operation costs, are there realistic alternatives to support critically important *LMG* USAP activities?

Specifically, if the USAP chartered a commercial vessel for logistics and resupply of Palmer Station, how would this impact science now done via the *LMG*?

(2) RVIB *Nathaniel B. Palmer*

Built 1992; owned & operated by Edison Chouest Offshore for the USAP contractor. Well maintained and operated.

Does not meet some present-day regulations and codes.

L: 308 feet; W: 60 feet; D: 22.5 feet; ≤1.0 m ice; 75 days; 6022 ft^2. labs; ≈39 science party.

NBP loading equipment at the McMurdo ice pier

Avg. 196 days at sea per year 2010-2017. Most cruises are for marine science support. Used for some open-ocean non-USAP science missions.

NBP has operational shortfalls related to present and future science support: **ice performance** plus winches, cranes, frames, lab facilities and network, as well as a number of vessel systems.

[*Occasional* work in heavier (multi-year) ice may be feasible with an escort icebreaker.]

A SLEP/refit could address some issues and lengthen service life, but would not improve ice performance or address some regulatory issues:

- Increase science berthing from 39 to 55
- Increase lab space by 15-20%
- Increase deck space by 10-15%
- Increase endurance to 90 days
- Improve acoustic "quietness"
- Extend total service life to 40+ years (2032 or beyond).

>$30M?

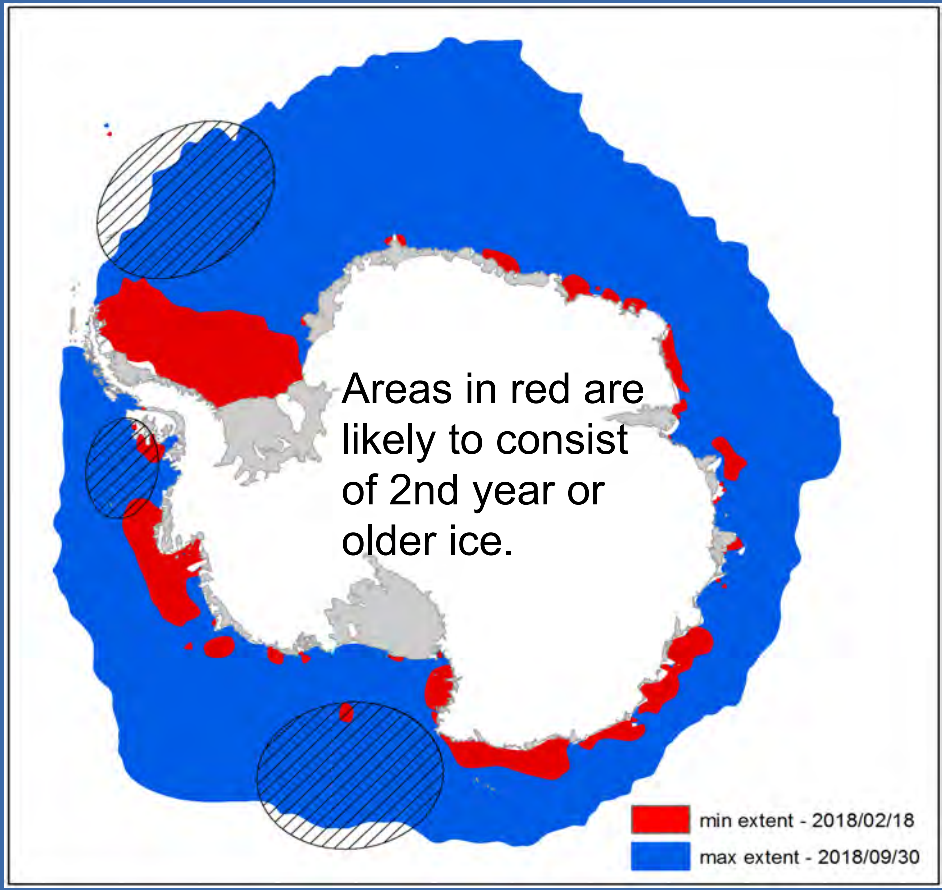
Ship Access to Antarctic Waters

Marine support – presently from the *LMG* and *NBP* – is crucial for USAP science, past, present, and future.

The *NBP* was not constructed to support missions in areas of multiyear ice.

Experience has shown there are significant areas, ice conditions, and times of year the *NBP* cannot operate well in support of science and logistics missions.

(Example: Hatched areas show where *NBP* operations have been shown to be problematic during some science cruises.)



The *NBP* cannot access large areas of high scientific importance. Should a new vessel be capable of working farther into the ice and be able to support year-round science operations in most of the Southern Ocean? An increase in icebreaking capacity over the *NBP* would require a larger, heavier vessel, and it would be more expensive to operate.

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Community studies consistently conclude that innovative and transformative research – including deployment of new technologies – requires ship access to polar seas over much of the year. A review of science drivers and mission requirements leads to fundamental ship science support specifications.

NSF perspective:

- The *Palmer* is nearing end of contract and is being considered for replacement (or SLEP?). Antarctic Peninsula research support issues are also at hand. There are many uncertainties. NSF is engaging the science and technical communities for input to make decisions on the path ahead.
- NSF/OPP is faced with many of the same future ship issues now facing the UNOLS academic fleet, such as increasing ship construction and operating costs in an era of flat federal science and infrastructure support budgets. [The UNOLS fleet is shrinking.]
- The NSF/OPP Advisory Committee formed a subcommittee to examine, update as needed, and prioritize science mission requirements for US polar marine science ships, and to also consider issues attending to some operational options (and possible future hard choices).

[There is useful overlap with the UNOLS Fleet Improvement Committee's examination of Science Mission Requirements for future US Global-class research ships.]

OPP Advisory Committee Ad Hoc Subcommittee on the U.S. Antarctic Program's Research Vessel Procurement

Members:

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Tim McGovern, OPP oversight and assistance


ARSV *Laurence M. Gould* &
RVIB *Nathaniel B. Palmer*

Subcommittee initiated March 2018; report draft to be presented to the OPP/AC 01 May 2019. (Current draft is 157 pages, final expected to be 200+ pages.)

The committee carries out weekly telecons at a standard day and time. These are short in duration and focused. The committee is working diligently and well.

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Specific tasks assigned to the subcommittee and progress on these tasks (page 1 of 2):

1. "Review and verify the continued validity of the University-National Oceanographic Laboratory System (UNOLS) 2012 Polar Research Vessel Science Mission Requirements, the 2016 NSF/OPP Antarctic Vessels Request for Information, and the 2018 ASC-provided Vessel Studies Reports."

The Science Mission Requirements (SMRs) review is complete. The subcommittee has approved revised recommendations for each SMR. The report contains an appendix with a recommendation-only list (without the evaluation and discussion of each SMR). [Not yet approved for distribution. But a redacted copy of the recommendation-only list has been shared with the FIC Global-class SMR subcommittee for its private use.]

2. "Prioritize each proposed vessel's capabilities and operational requirements."

The subcommittee has completed its prioritization. (Some priority decisions may be unintentionally controversial. There is also a tendency to rate everything highly.) [Not yet approved for distribution.]

Specific tasks assigned to the subcommittee and progress on these tasks (page 2 of 2):

3. "Consider the two-ship operational model of the US Antarctic Program, and evaluate the advantages and disadvantages of moving to a one-ship operating model."

The subcommittee has prepared its recommendations. [Not yet approved for distribution.]

4. "Engage the broader scientific community to ensure vessel capabilities and characteristics are able to meet a majority of anticipated needs for the duration of the 10-year charter, and possibly for the lives of the vessels (~ 30 years). Elements of the recommended prioritized vessel capabilities should be provided in sufficient detail to enable NSF to make subsequent appropriate adjustments in response to available funding."

5. "Include a summary of the outreach efforts and input received from the science community in the final, submitted report."

The subcommittee is well along on these two tasks, including text in the draft report.

Science Mission Requirements Addressed by the Subcommittee:

Accommodations
Habitability
Icebreaking
Endurance & Range
Speed
Sea keeping
Station keeping
Track line following
Ship control
Underwater radiated noise
Helicopter support
Over the side handling
Winches & Wire
Cranes
Towing, trawls, ice-clearing stern
ROV support
Unmanned aerial vehicle support
Working deck area
Laboratories
- Type, number, & size
- Layout & construction
- Electrical
- Water and air

Vans
Storage
Science load
Workboats
Masts
Geotechnical drilling
On deck incubations
Marine mammal & bird observations
Navigation
Data network and onboard computing
Real time data acquisition system
Communications – internal
Communications – external
U/W data collection & sampling
Scientific seawater system
Acoustic systems
Support for seismics
Project science system installation and power
Discharges
Green ship considerations
ADA considerations
Support of Antarctic science stations (permanent and temporary)

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There are conundrums continually faced by the subcommittee.

For example, take ”discharges”. In some ice conditions and locations, a ship may not discharge grey water (non-sewage water wastes). For a *NBP*-like ship to work in such areas for four days (not very long) would require a 10,000 gallon tank (a large tank).

Add more berths = larger tank needed
Add more days in the ice = yet larger tank needed
Bigger tank implies larger ship. Larger ship implies higher cost to build and operate.

Or take icebreaking capacity:
Stronger, heavier hull and more powerful engines imply higher cost to build & operate.

Or take ship support of improved support of permanent and temporary science stations:
Increased bulk cargo and 20-foot container capacity requires larger ship.
Larger ship implies higher cost to build and operate.

It should not come as a surprise that the new polar ships now being built by other nations are large research and supply ships.

The subcommittee is prioritizing, but even with that and an operational shift, some increases in size, power, and cost over *NBP* (+*LMG*) seem inevitable for a new ship.

Examples of Desired Polar RV Science Features from Past (2012) and Recent Community Input

- Bottom mapping during icebreaking
- Geotechnical drilling capability
- Moon pool (completely enclosed)
  - AUV/ROV
  - Diving
  - CTD rosette
  - Ocean-Bottom Seismograph (OBS)
- Advanced A-frames, winches, cranes
- Enhanced towing in ice
- Accommodation for 50 scientists
- Helicopter complex (deck, hangar, elevator)
- Clear view aft from starboard pilot house control station
- Inter-deck science/cargo elevator
- Box keel with size suitable for growth in sensors

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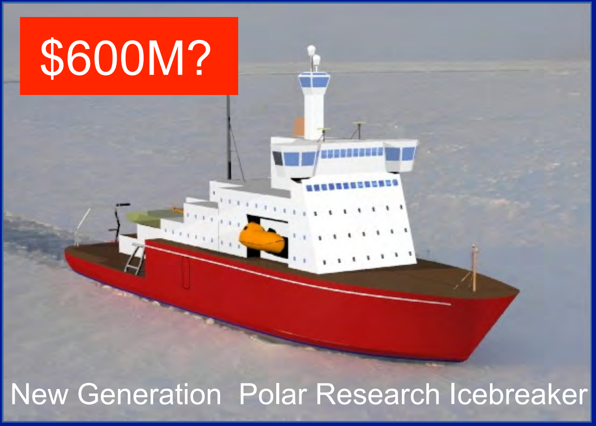
Examples of Enhanced Capability and Features of a New Generation Icebreaking Polar Research Ship (2012)

- 62% increase in displacement
- 79% increase in shaft power
- 50% increase in icebreaking capability
- 128% increase in space available for laboratories
- 32% increase in accommodations for scientists
- 33% increase in endurance
- 50% increase in design service life of vessel
- 69% increase in construction cost



This also would drive a significant increase in annual operating costs, more than *LMG* + *NBP*.

Future plans for the subcommittee:

Complete a draft report (by mid-April 2019). Edit to make a clean copy. Submit clean draft to the Advisory Committee for discussion at the next AC meeting, 01 May 2019. Revise/edit as needed; submit for AC and OPP approval.

A final note: It is clear that there is significant US scientific community interest in Antarctic (and Arctic) science that would best be supported via an icebreaking research ship with enhanced operational and science capabilities over those of the NBP. Should the USAP "build/refit low" and seek partnerships with more capable polar ships (USA or other nations), or, instead, find a way to "join the Bigger Ship club"? Ultimately NSF, working with the community, Congress, and the executive branch, faces that decision.