The *R/V Sikuliaq* - A New U.S. Arctic Research Platform

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Introducing the *R/V Sikuliaq*

A technologically advanced, ice capable research vessel

Owner: National Science Foundation

Operator: University of Alaska Fairbanks

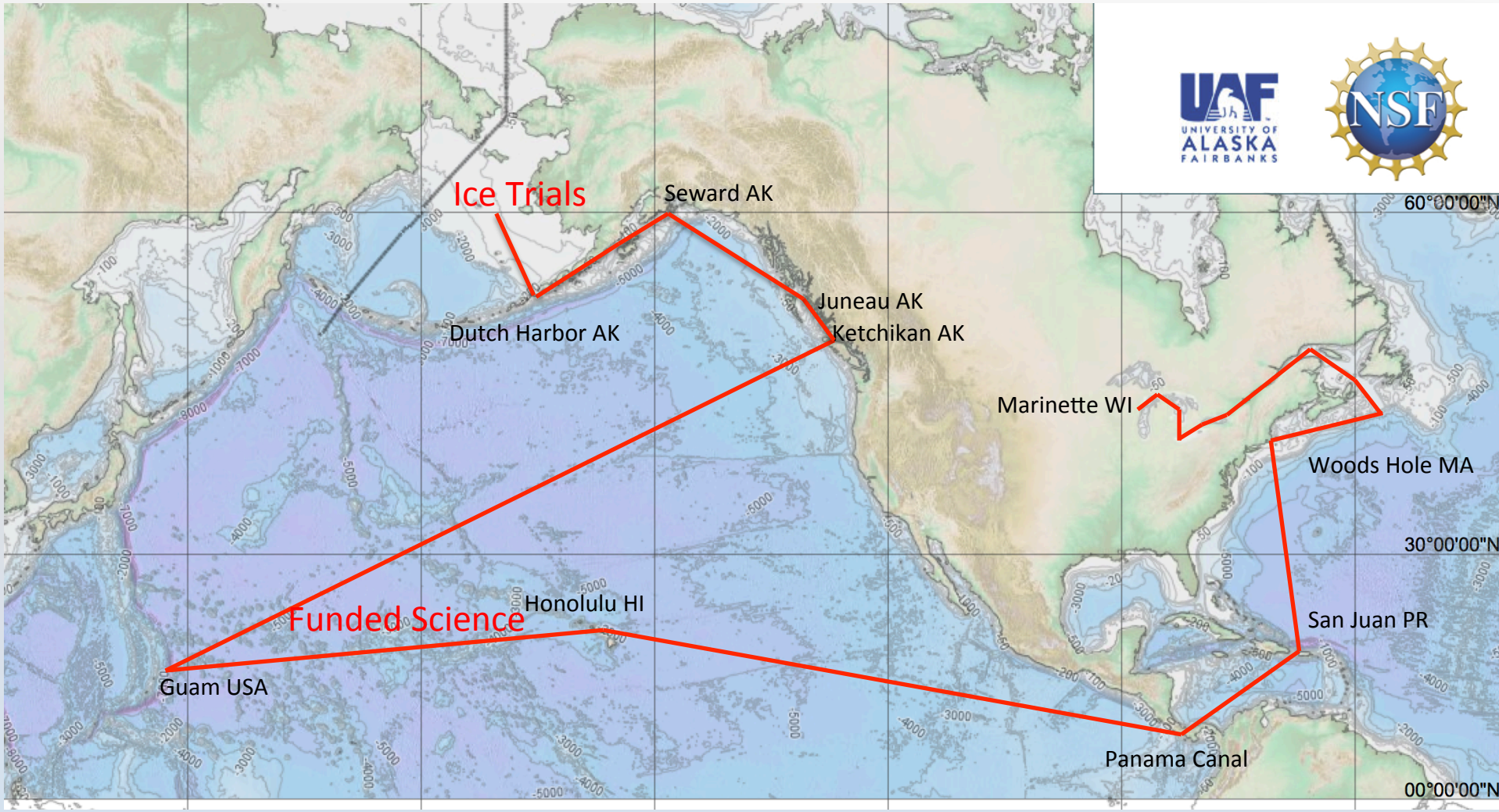
Global Class Vessel in the UNOLS Fleet

Length/Beam: 261’/48’
Draft/Freeboard: ~19’/9’
Endurance: 45 days
Speed
Calm/13ft seas: 14/12 kts
3’ level ice: 2 kts
Diesel Fuel: 170,000 gals.
Fresh Water: 13,150 gals.
Water making: 6,000 gals/day

Propulsion Power: 5750 BHP, 2- Z-Drives, Tractor Mount; Bow Thruster
Science Party: 24 + 2 techs
Crew: 20
Science deadweight: 100 tons
Science vans: 3
Science storage: 8000 cu. ft.
Science labs: 2250 sq. ft.
Deck working area: 4360 sq. ft.
Heated Aft Deck

Ice Breaking Specification: 3 feet of level ice at 2 knots

Sikuliaq's Long Trip to Alaska



Built by Marinette Marine in Marinette WI
Launched October 13, 2012
Delivered in June 2014

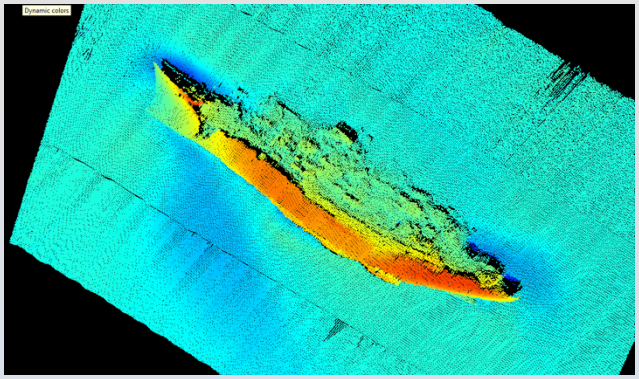
Science Support Capabilities

SIKULIAQ will provide the tools needed to support ocean research on emerging critical questions in high-latitude science

- Acoustically quiet, ice-capable vessel
- Acoustic systems for seafloor and water column surveys

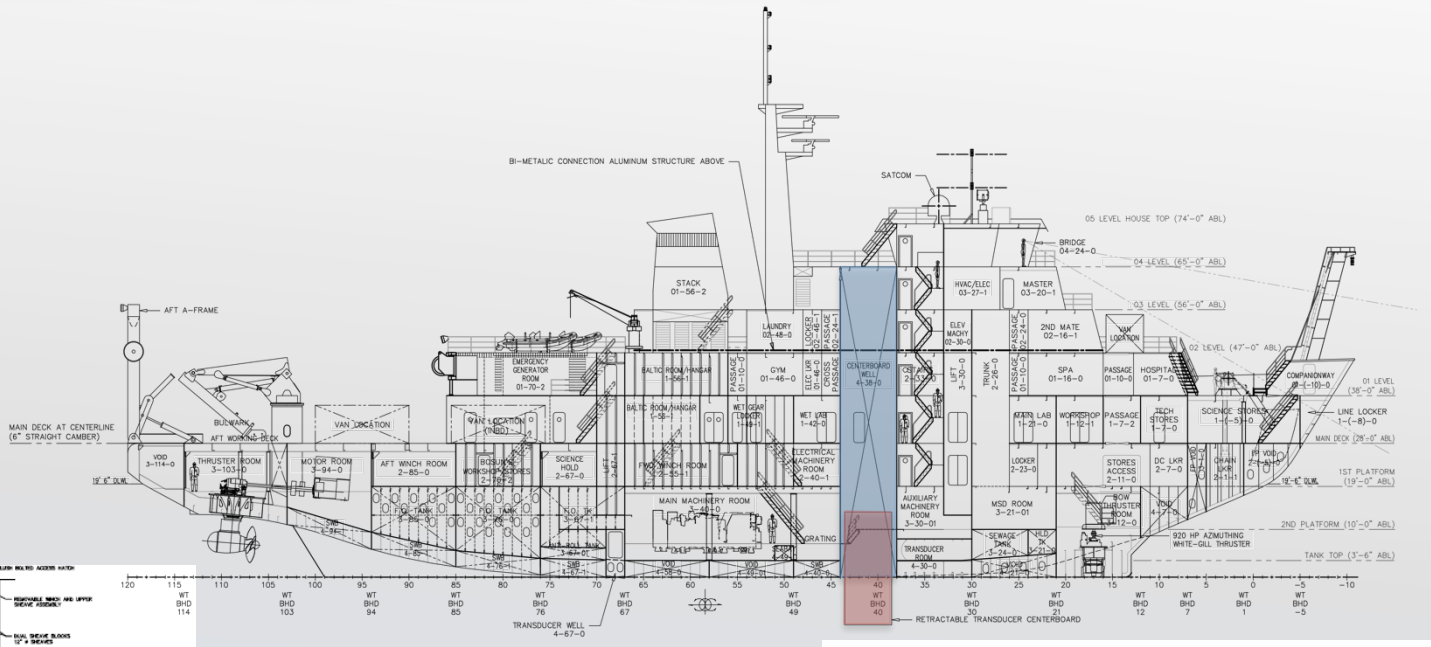
  EM710, EM302 Multibeams, 75 kHz and 150kHz ADCPs, TOPAS Sub-bottom profiler

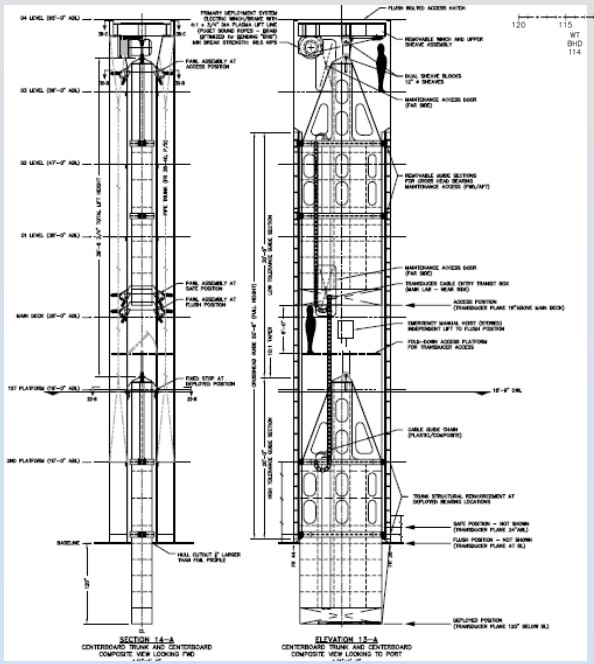
  EK60 Bioacoustics (plankton, fish) on Centerboard
- Full Suite of Meteorological and Underway Science Seawater Sensors
- Latest satellite communications systems
- ADA-friendly
- Four fume hoods
- Two environmental chambers
- Climate controlled analytical lab

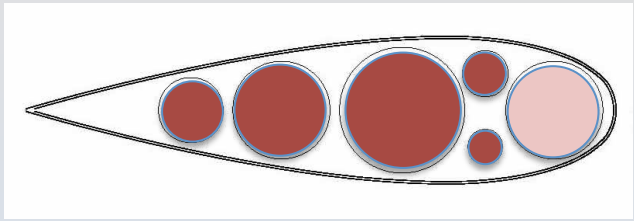


- Two winches with 0.322” electromechanical cable, one trawl winch with 9/16” wire rope, one trawl winch with 0.68” electromechanical cable
- Two cranes, A-Frame, CTD Load Handling System

Retractable Centerboard







- EK-60 Scientific Sounder System
- One spare mount for project use
  - Accessible from main deck for transducer installations

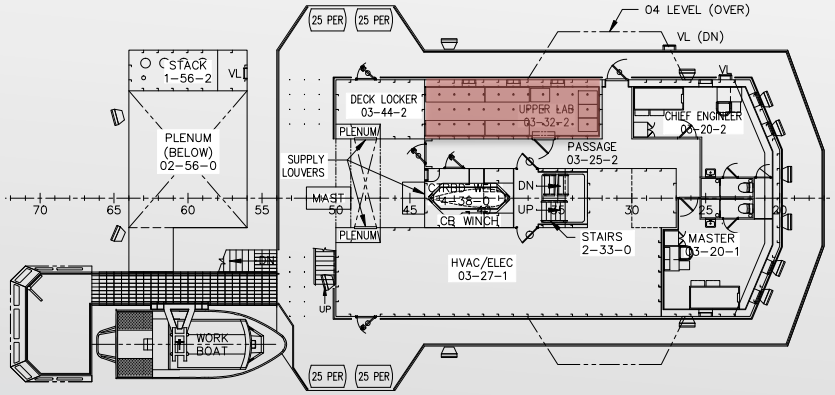
Laboratories and Science Work Areas

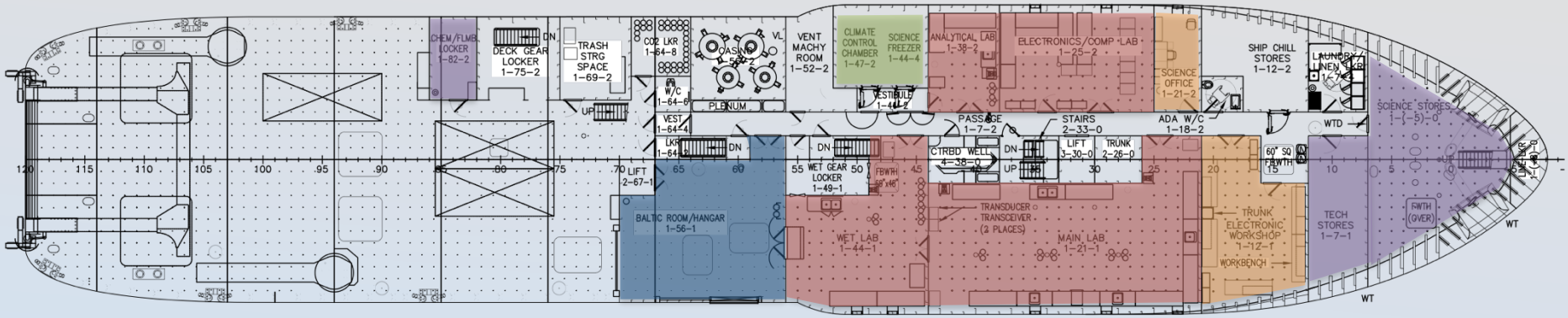
Labs *Reefers*

Baltic Room

Workshop/Office

Storage

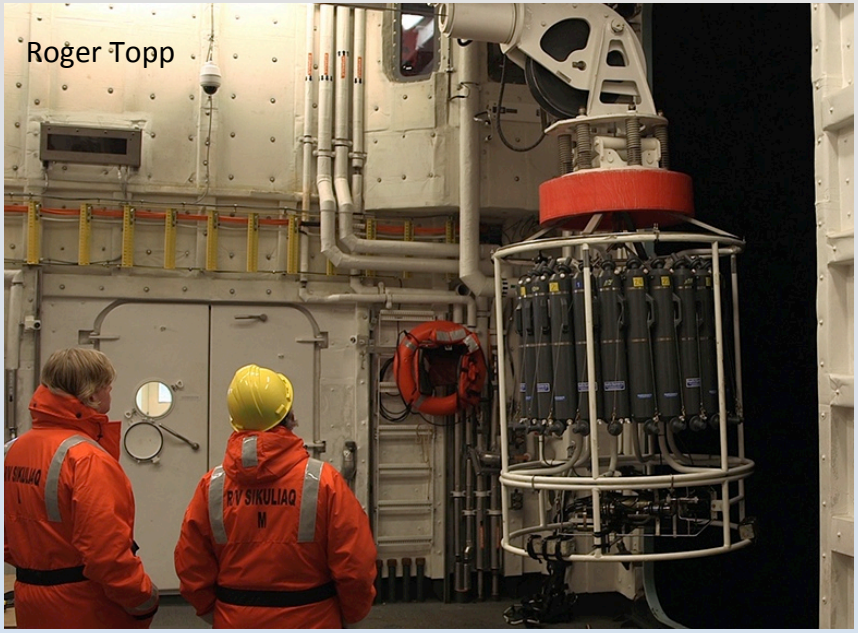





Carin Ashjian

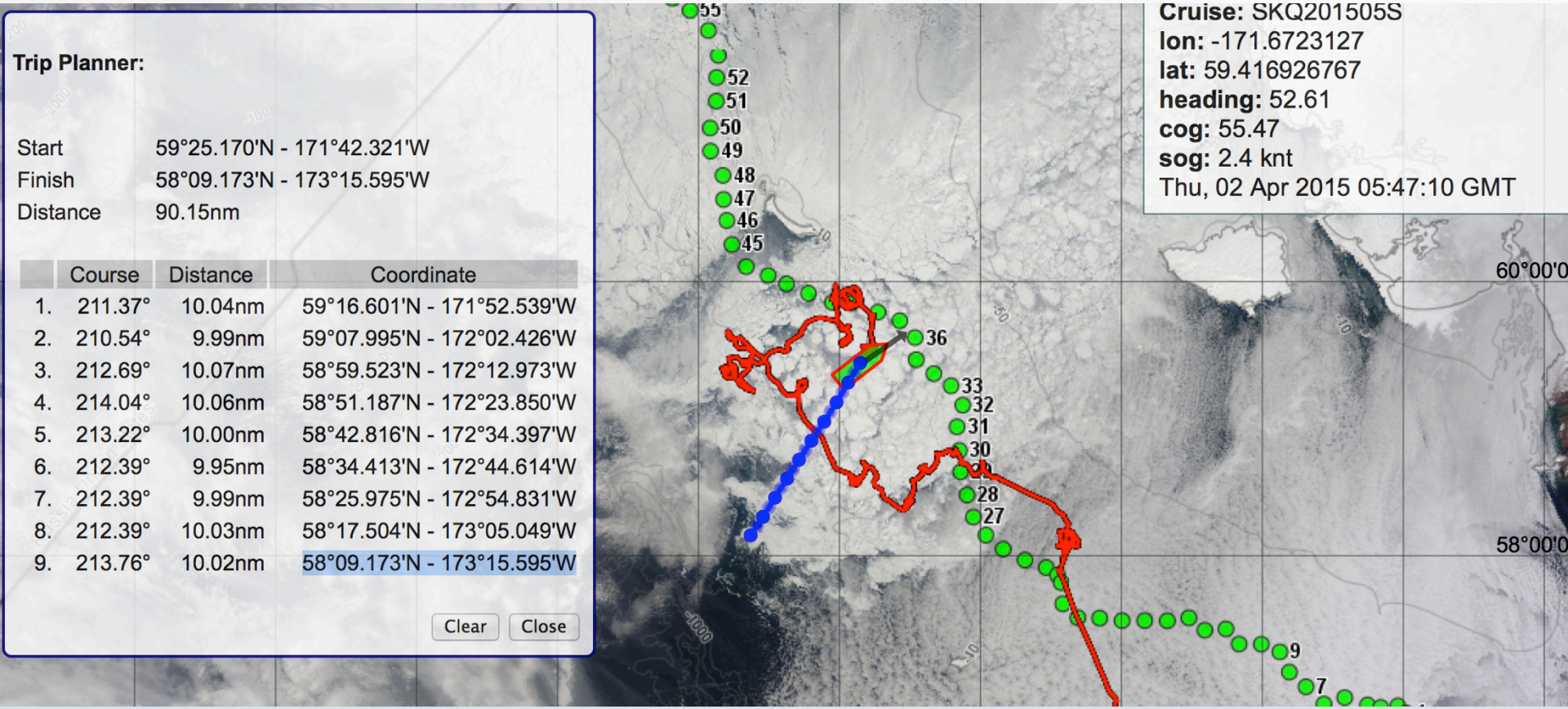

Roger Topp


ATTENTION
DO NOT SECURE CONTAINERS OR DECK EQUIPMENT IWO DOORS OR ESCAPE ROUTES
ATTENTION
LIFELINES WITH FULL SAFETY NETTING SHALL BE INSTALLED IN PLACE OF REMOVED BULWARKS
POTABLE WATER ONLY
Ann Knowlton


Roger Topp
F/V SIKULIAQ

Laboratory Spaces

Sikuliaq Mapserver - Developed by Steve Roberts



Displays

Satellite imagery – RADARSAT, MODIS, AMSR2 on this cruise

Ship position, heading, speed, and track

Ability to plan trips with multiple waypoints and distance between points

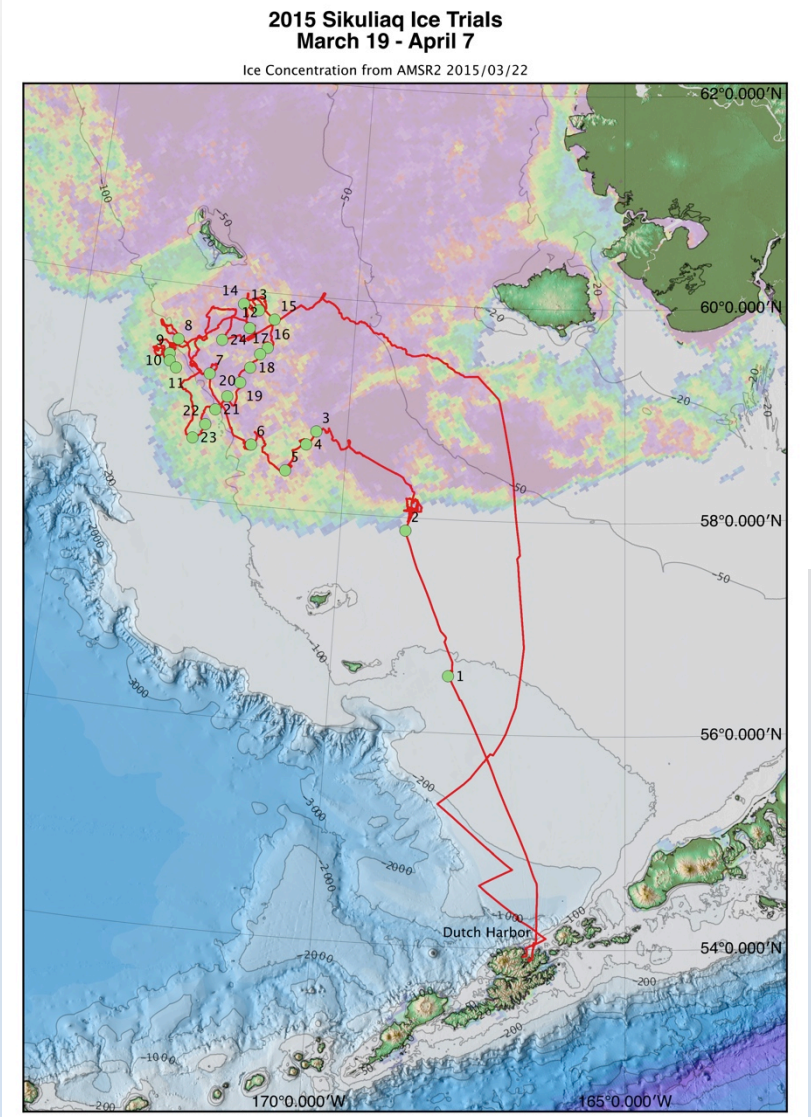
Mapserver is a work in progress

Ice Trials

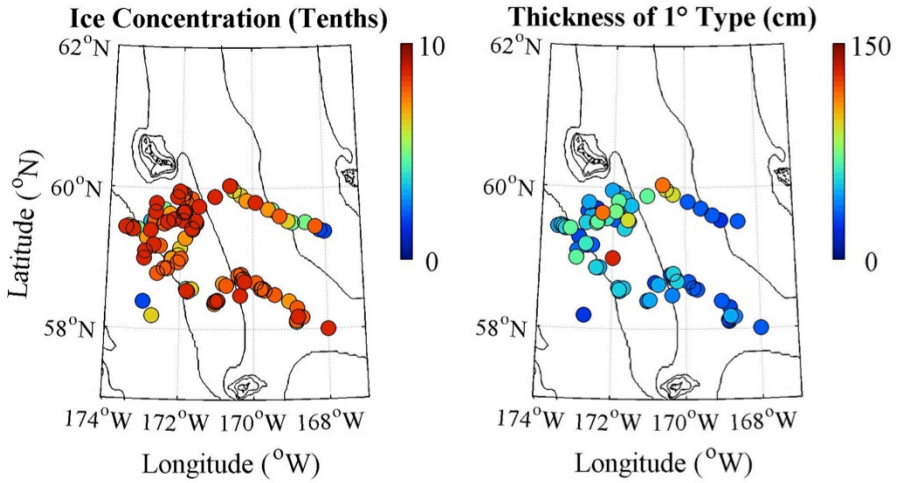
- Assess operational performance of ship in ice (AKAC Inc.)
- Training and practice in ice navigation and ship handling during all operations including science (AKAC Inc.)
  - Conducted by experienced master with 35 years experience on icebreakers, 19 years on similar vessels
- Assess ability of ship to conduct science in sea ice (Science Party)

Carin Ashjian

Ice Trials (March 19-April 7)



Map by Steve Roberts



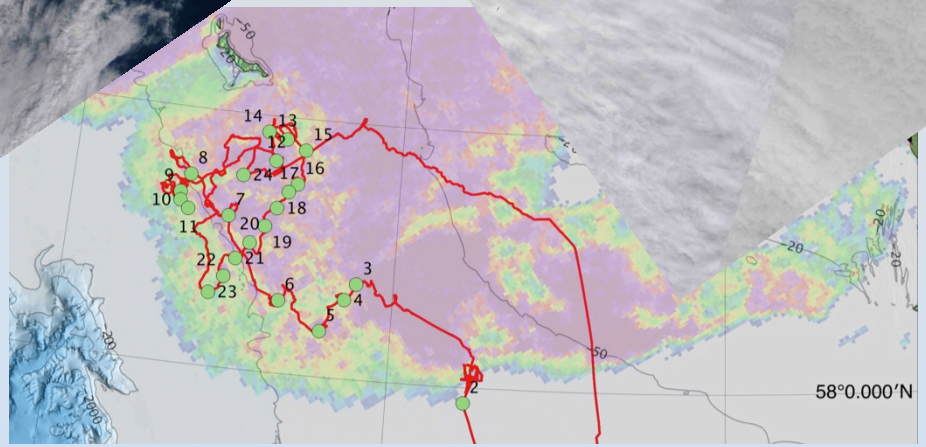
Data Collected by Alice Orlich

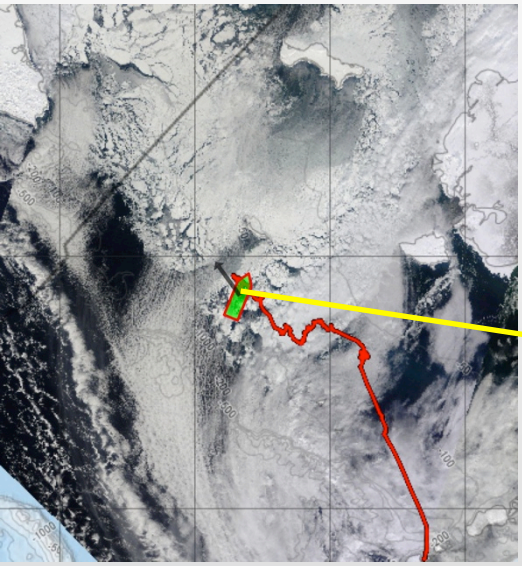
- Most ice concentrations > 7/10s
- Ice thickness was usually <50 cm (based on visual observations)

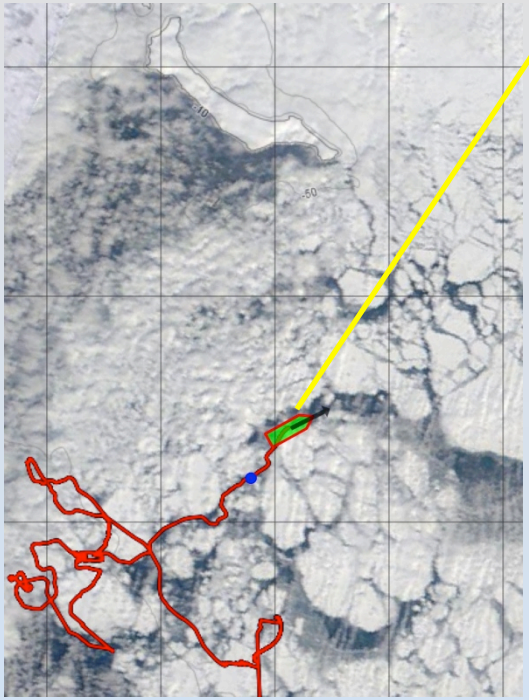
Ice Conditions

March 21

April 2

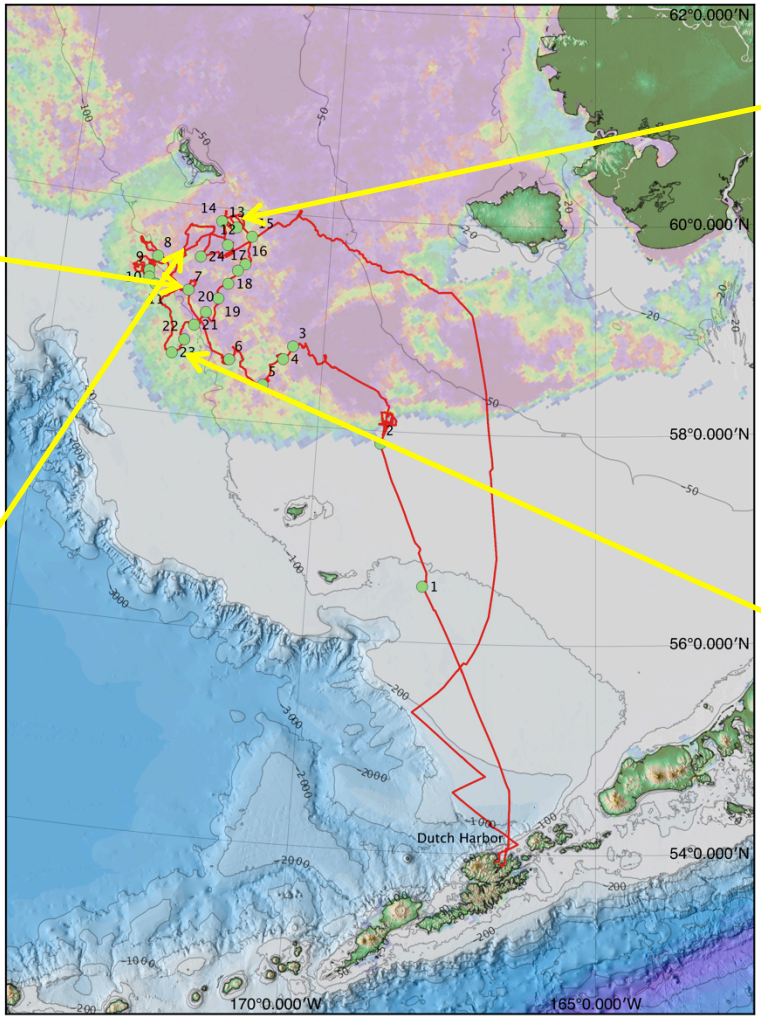


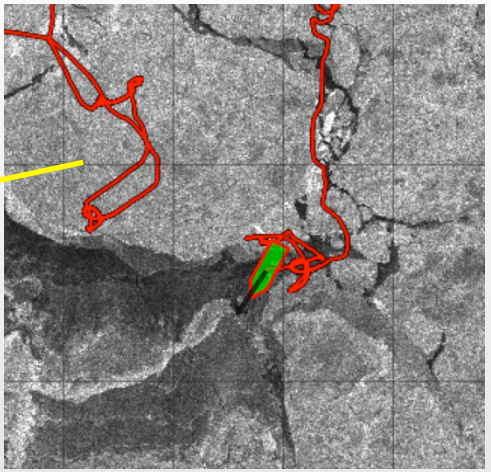


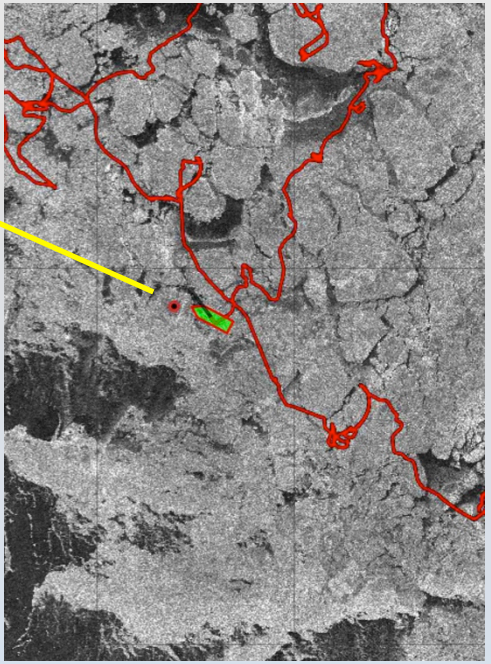


2015 Sikuliaq Ice Trials
March 19 - April 7

Ice Concentration from AMSR2 2015/03/22







Sikuliaq Performance in Ice

By: AKAC Inc.

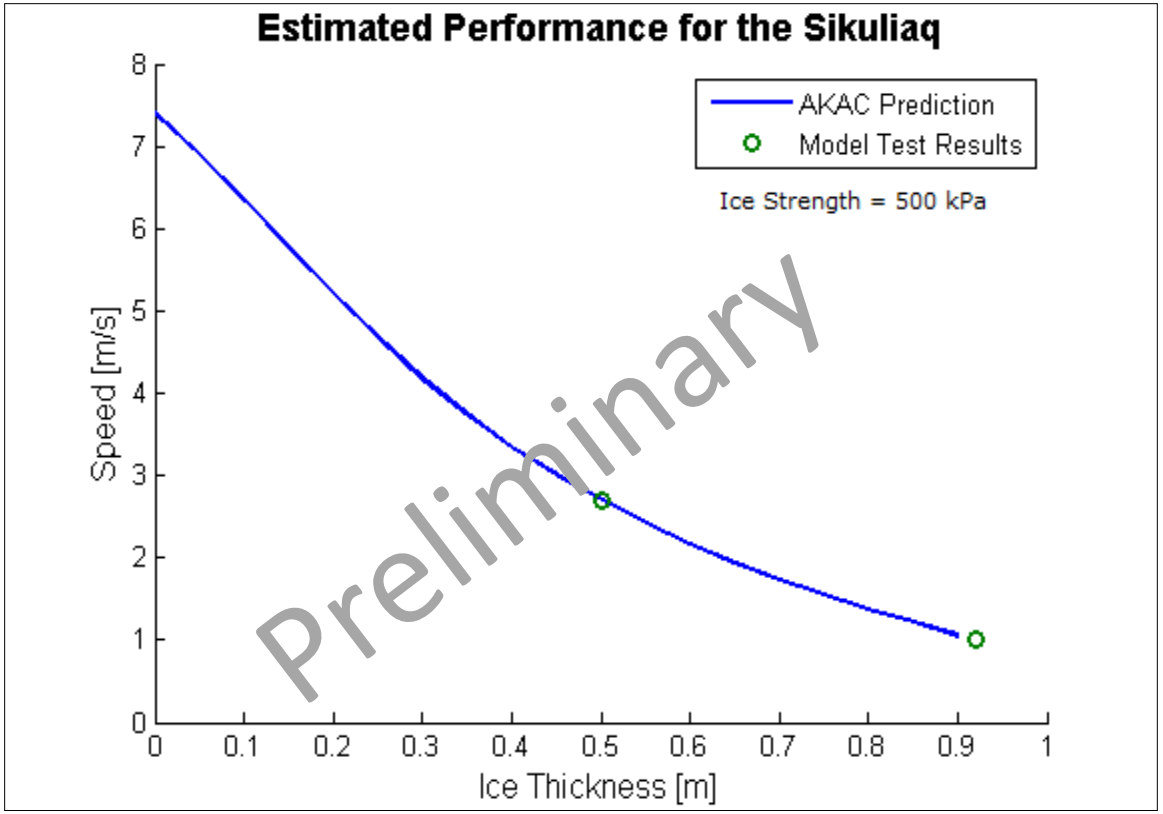
July 9th, 2015

Intended Operability of the Sikuliaq

- Year round in Bering Sea, seasonal in Chukchi and Beaufort Seas
- Prudent ice navigation is essential
- Avoid thickest ice features, and make use of open water leads where possible

Level Ice Breaking Performance

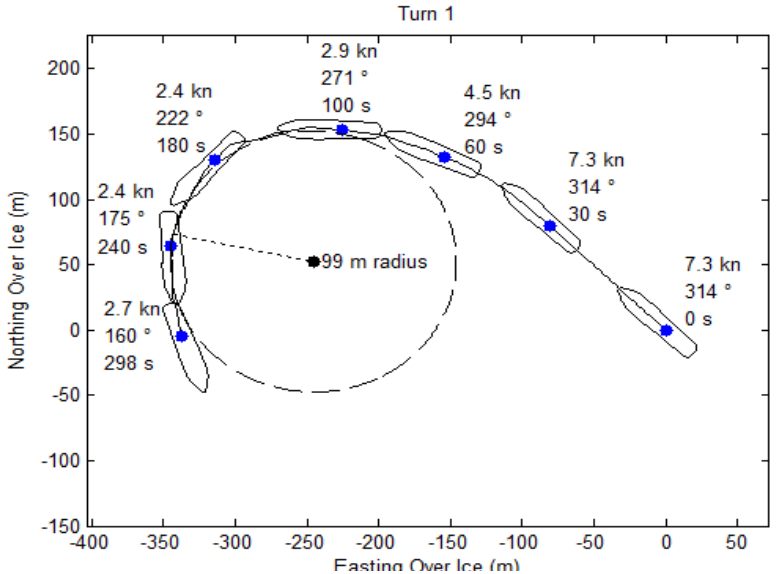
- Model Test Predictions suggest:
  - Sikuliaq can break 60cm thick ice @ 4 knots at 100% power
  - Expected to break target 90 cm thick ice continuously at 100% power

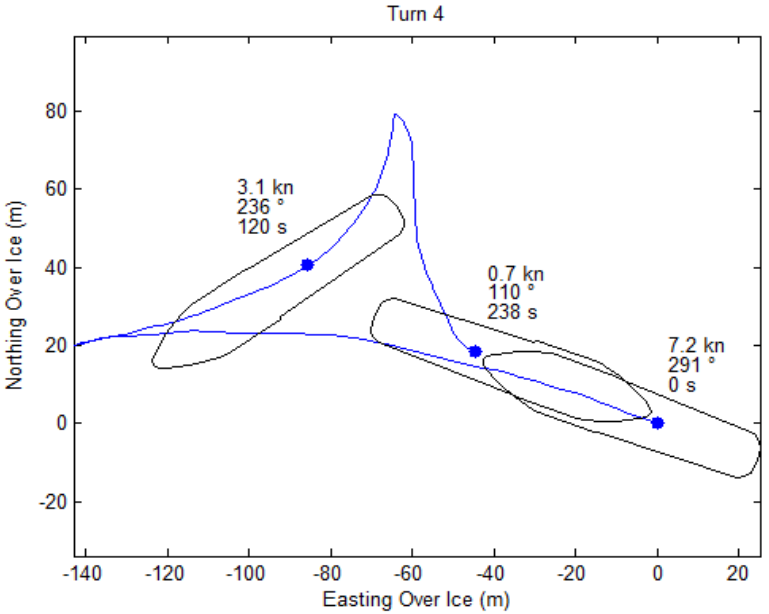


Maneuvering Performance

Azimuth thrusters and reamers make the Sikuliaq very maneuverable.

- Various maneuvers can be used to turn the ship.
- Turning Radius is approximately 100m (325 feet) in ~25cm (10”) thick level ice
- Using “Captain’s Turn” in ~25cm (10”) thick level ice, the ship can come to a full stop and make a 180 degree turn in its original track in less than 4 minutes, from an initial speed of ~7.5 knots.
- In thick ice, rather than backing down a channel full of ice, the Sikuliaq can turn on the spot and transit back its channel in ahead mode.



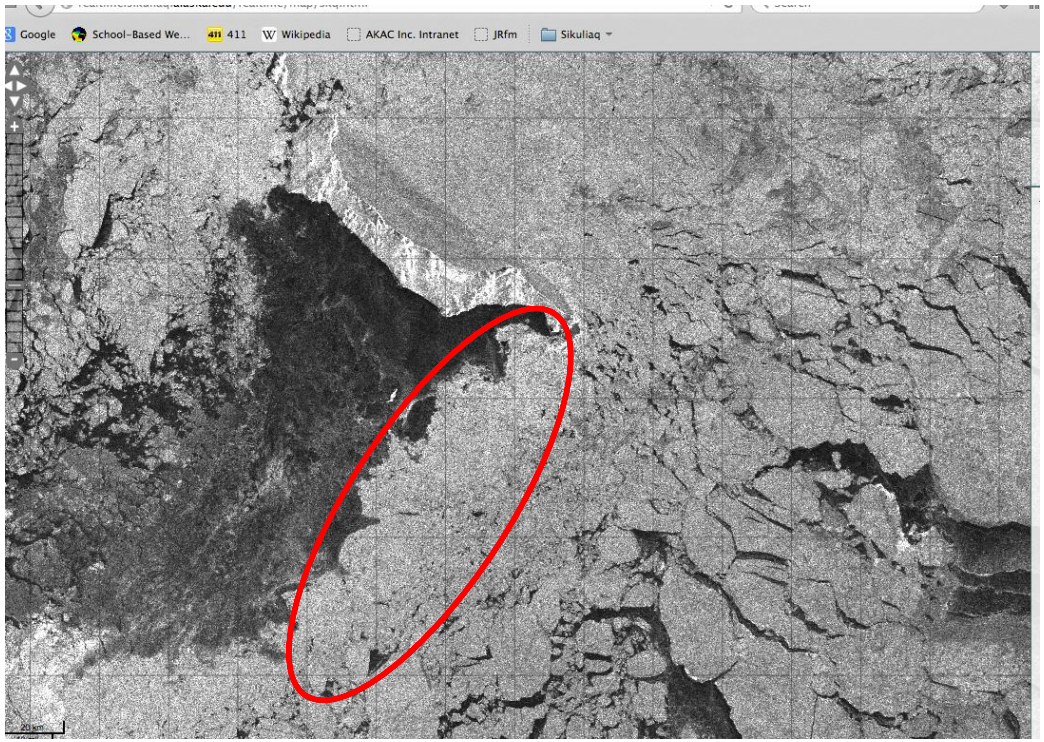


Ridge Ramming Performance

- Very challenging to find suitable ridges for testing
- 1 ridge/rubble field was surveyed and tested
- Total maximum ridge thickness ~3.5 meters, ~ 250m long
- Ramming speed upon impact with ridge between 8-11 knots
- Good penetration, nearly 150 m with first ram
- Efficient extraction from ridge with low power
- Backing up channel to start new ram experienced significant propeller ice interaction, which can be mitigated by effective operation of the thrusters

Limiting Ice Conditions

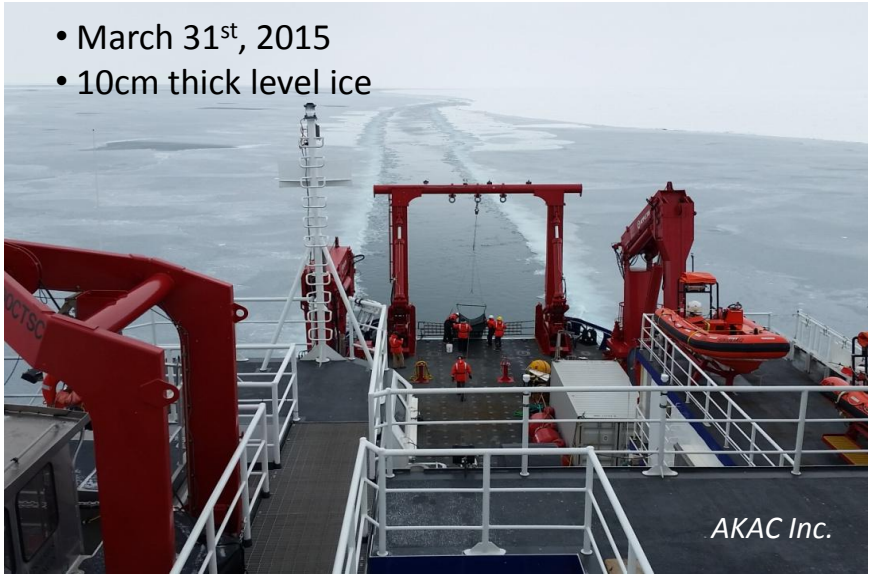
- Highly deformed and consolidated pack ice under pressure
  - Transit through compacted ice toward St. Matthew Island during night of March 27th
- Backing in thick ice >~30cm, including broken ice
  - Significant vibrations as a result of propeller ice interactions
  - Ship should be operated in ahead mode if possible

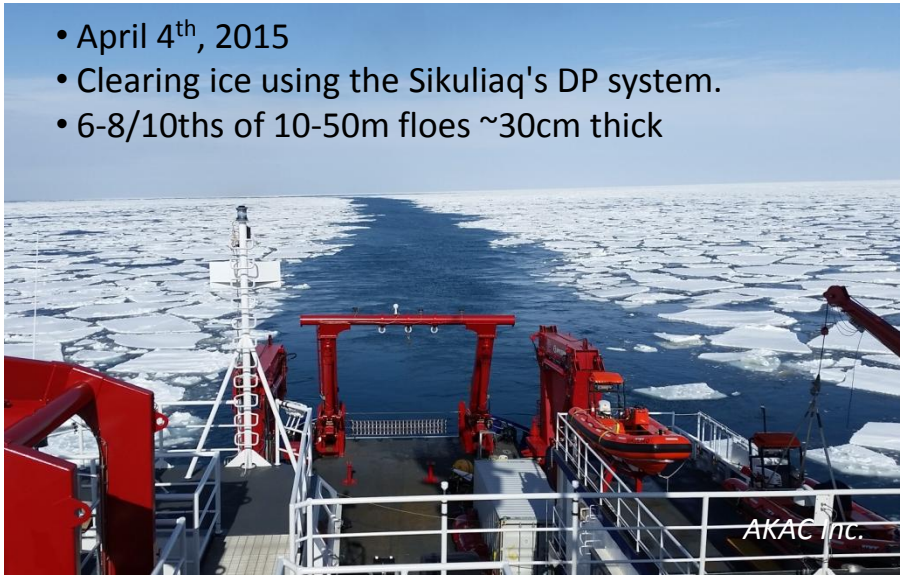


Towing Performance in Ice

- Numerous towing demonstrations and actual tows were performed successfully
- Thrusters can be used to create an ice free channel with minimal ice interference
- Procedures for effective deployment and retrieval of towing equipment with no ice interaction

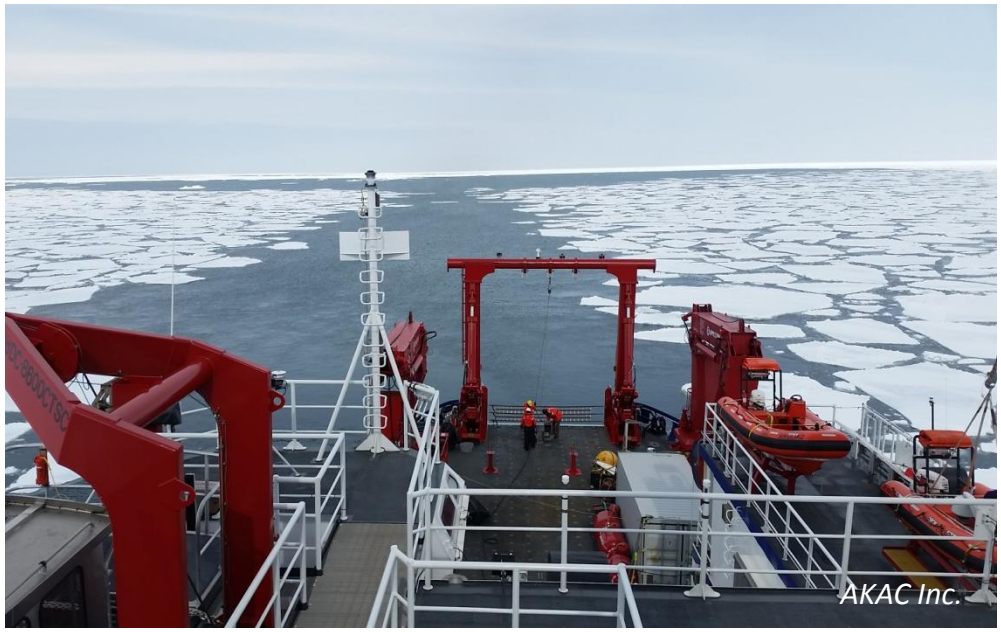
Examples of towing in ice free channel in while maintaining a tow speed of 3.5-4 knots:





Deployment over the Stern

- Using a low power, the propeller wake can maintain an area of open water at the stern while leaning up against the ice at the bow,
  - results in a very stable configuration for deployment of equipment over the stern
- Van Veen Grabs and Haps Corers performed in full ice cover over the stern in various ice conditions, with no ice interference.



- April 4th, 2015
- 6-8/10ths of 10-50m floes ~30cm thick

- March 23rd, 2015
- ~20cm thick level ice

Deploying Equipment Through Baltic Room

- Numerous CTDs were performed in various ice conditions
  - Azimuth thrusters and a setup procedure used to create an open water “pocket” in the ice on the starboard side
  - Thrusters used to allow the ship to “lean” against the ice on the port side to maintain a stable heading and position
  - This configuration allows CTD to be deployed in virtually open water

Science Trials

- Physical oceanography
- Sea floor bathymetry
- Sea ice type and topography
- Sea ice microbes
- Trace metals in sea ice
- Meteorological data (heat flux)
- Seabird distributions
- Phytoplankton associated viruses
- Phytoplankton abundance, composition, production
- Zooplankton abundance and respiration
- Midwater fish abundance
- Marine mammal occurrence

Science Party Composition:

Mix of non-UAF and UAF scientists

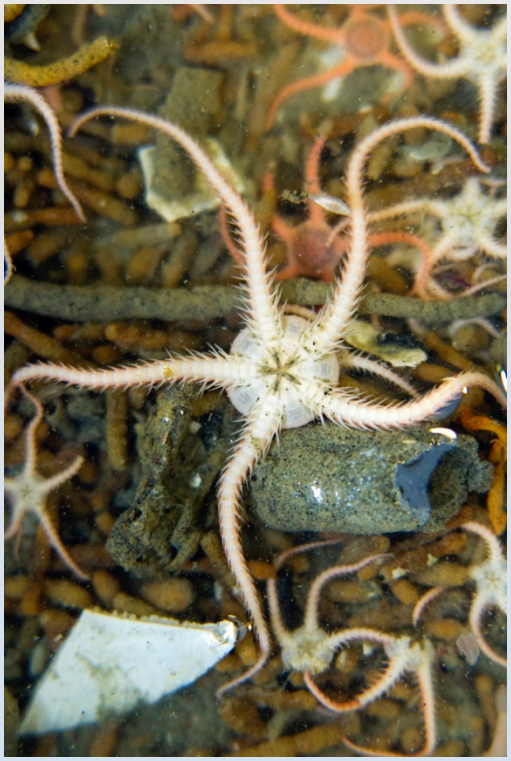
Three graduate students

Early, mid-, and late career PIs

Technical experts

Science Sampling

Activity	#
CTD	25
Bongo Nets	2
HAPS Corer	14
Isaacs-Kidd Midwater Trawl	6
Aluette Midwater Trawl	4
Ring Net	6
Sea Otter ROV	2
Van Veen Grab	26
Ice Station	5
Ice Cores from Manbasket	3-4
Ice Net	10
Copepod Respiration Experiments	5



Ice Stations

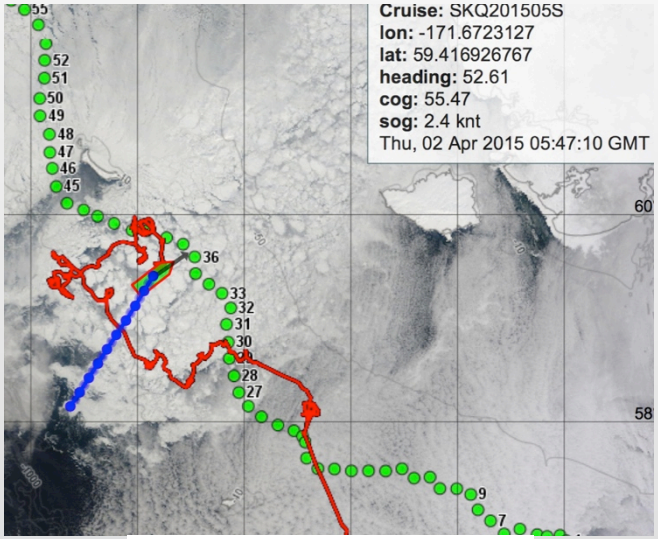
Liz Labunski


Carin Ashjian

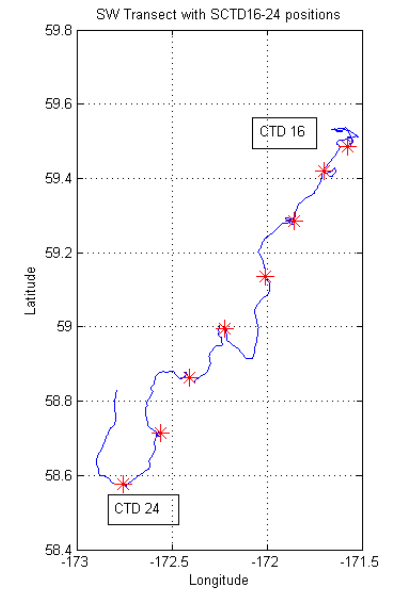

Roger Topp


Carin Ashjian

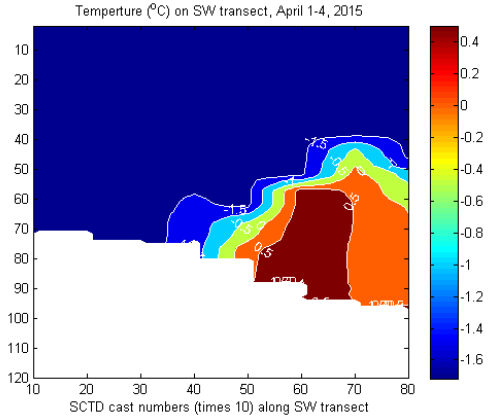
Hydrography



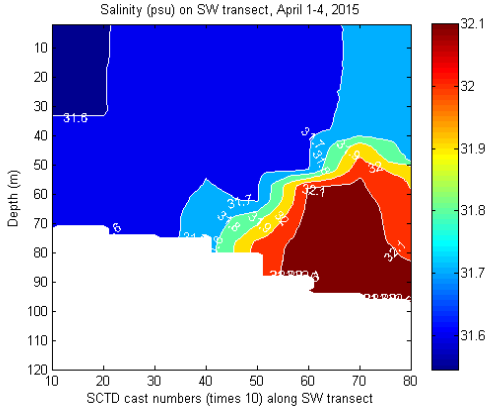
- Planned CTD Transect, stations 10 miles apart
- Ship accomplished this in ~10 hours
- Ice comprised floes with leads between so transit time was relatively fast
- Data showed warm, salty Bering Sea basin water at depth at offshore end of transect



Temperature

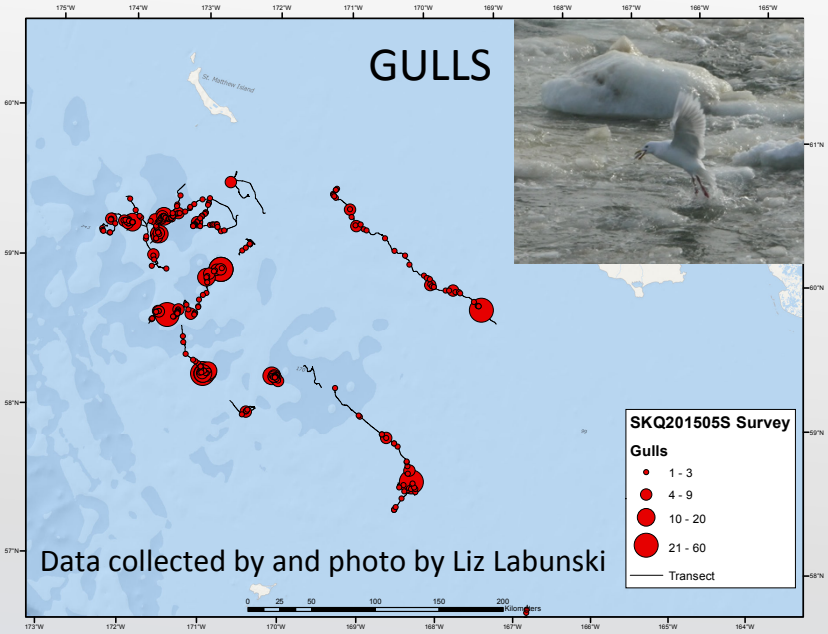


Salinity



Plots by R. Beardsley

Seabirds


GULLS
SKQ201505S Survey
Gulls
1 - 3
4 - 9
10 - 20
21 - 60
Transect
Data collected by and photo by Liz Labunski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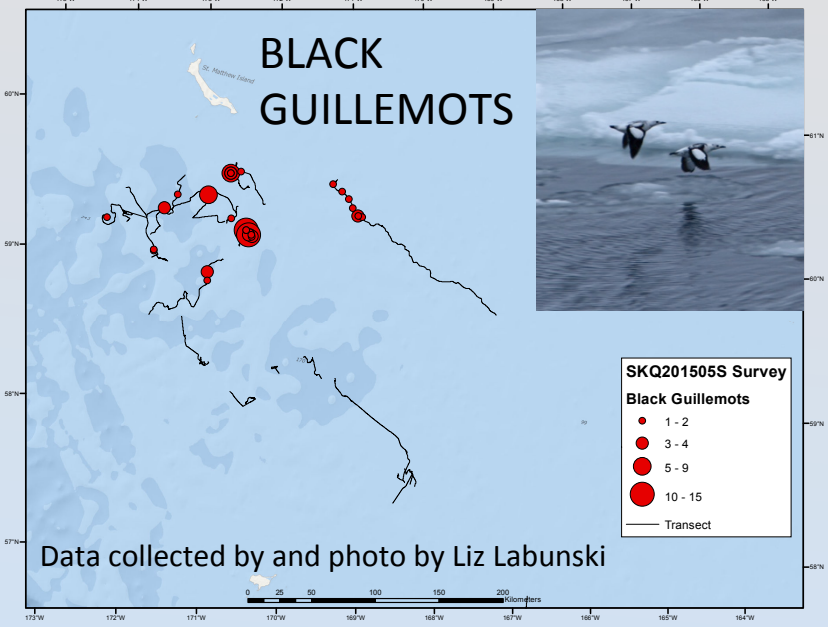
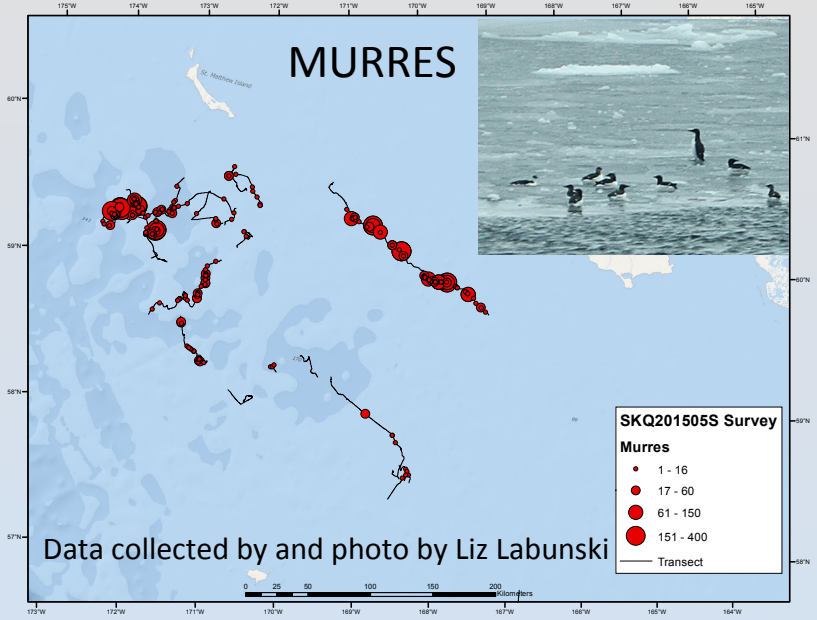
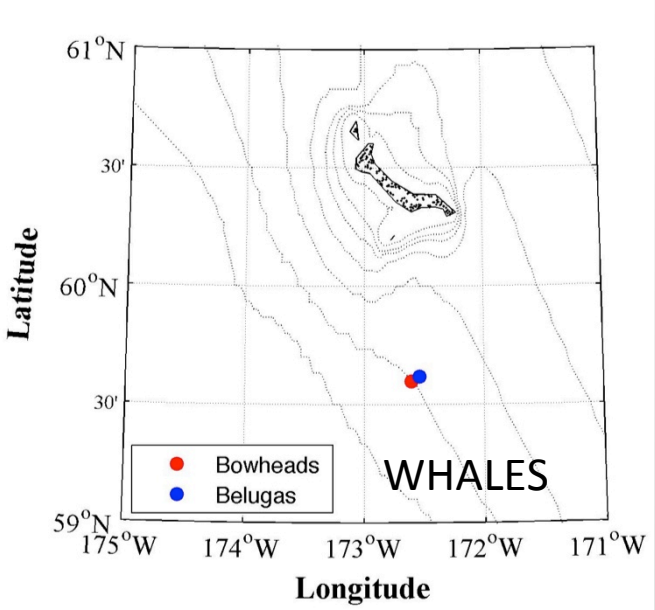
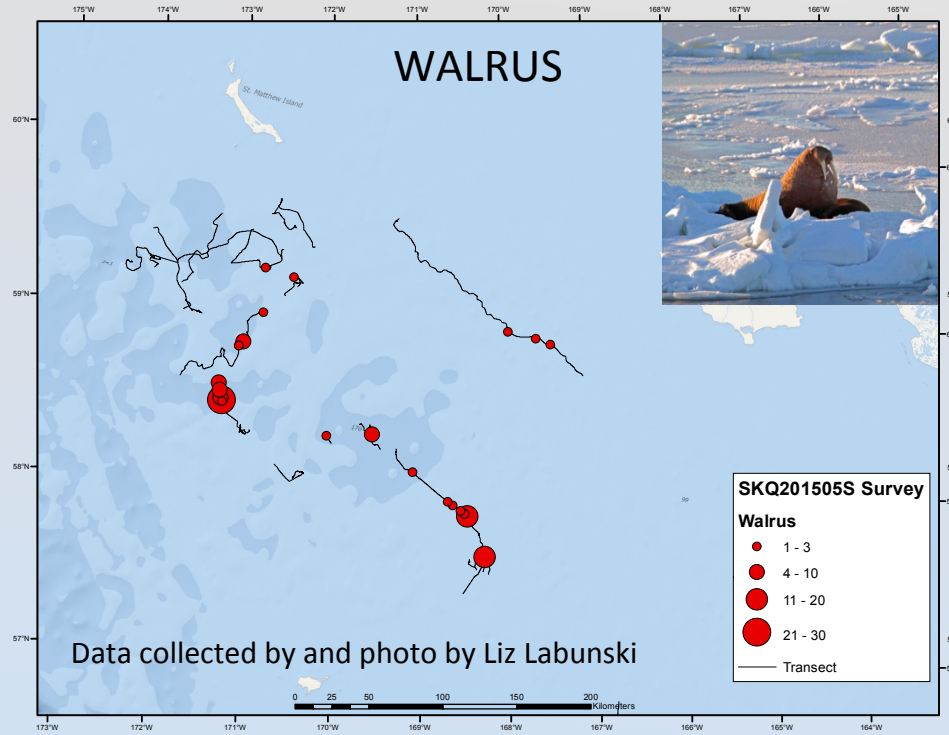

BLACK GUILLEMOTS
SKQ201505S Survey
Black Guillemots
1 - 2
3 - 4
5 - 9
10 - 15
Transect
Data collected by and photo by Liz Labunski


MURRES
SKQ201505S Survey
Murres
1 - 16
17 - 60
61 - 150
151 - 400
Transect
Data collected by and photo by Liz Labunski

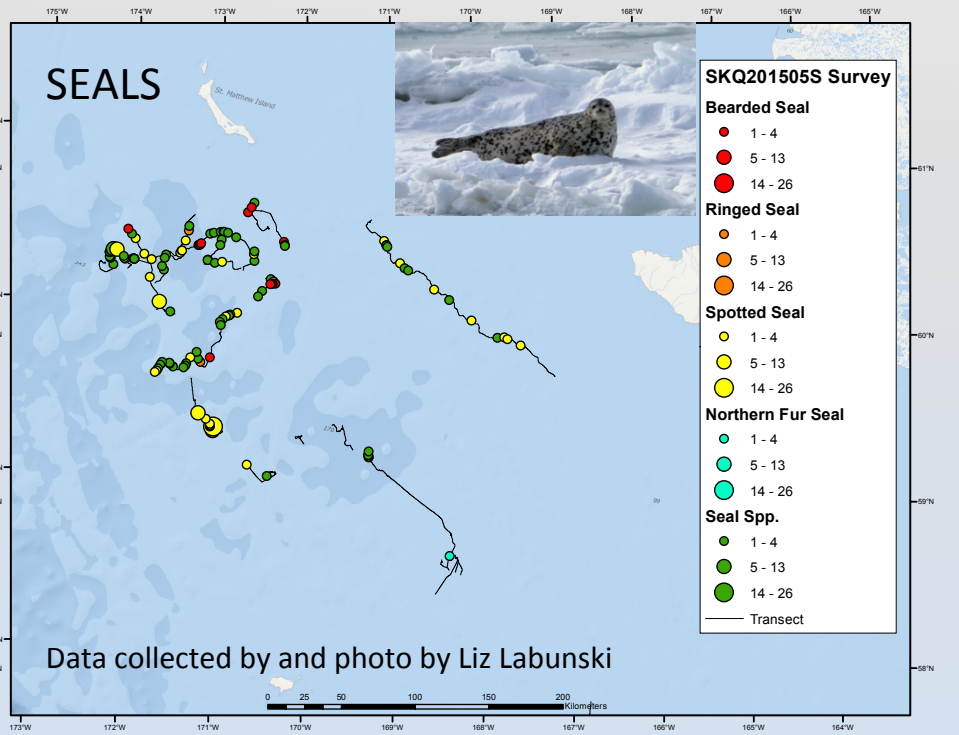
Marine Mammals

Data collected by Sue Moore





Data collected by and photo by Liz Labunski



Data collected by and photo by Liz Labunski

The “New” Sikuliaq

Questions?

www.sikuliaq.alaska.edu

Photo by Val Ihde