

## Northwest Passage Project Science Summary

The Northwest Passage Project (NPP) is a U.S. National Science Foundation funded program to explore the changing Arctic through an innovative expedition that will engage diverse audiences through real time interactions from sea, a high definition 2-hour documentary, and related community events. The expedition will be conducted onboard the *Akademik Ioffe*, operated by One Ocean Expeditions. Telepresence technologies will allow for shore-based participation in the project. Expedition participants include undergraduate and graduate students, scientists, historians, journalists, and a documentary film crew.

The NPP *Akademik Ioffe* expedition will depart Resolute Bay August 23, 2018, arriving in Iqaluit on September 13 (Fig. 1). Science activities will be primarily ship-based and occur continuously or on an event basis throughout the expedition. Conductivity, Temperature, Depth rosette (CTD) casts and zooplankton net tows will occur every 100 nm or approximately daily, whichever comes first. Other activities, including air sampling, flowing seawater analysis, and seabird census counts will occur throughout.

**The main science goal is to understand how waters of the Canadian Arctic Archipelago (CAA) have changed as a consequence of the secular warming trend over the Arctic Circle,** using an interdisciplinary ocean-based research program to explore the changes in four (4) thematic areas.

### **Theme 1: Water mass properties and circulation inside CAA**

Scientists will investigate the increased freshwater storage in and export from the upper Arctic Ocean due to a warming Arctic. Increased melting, river discharge, as well as changing wind patterns have led to increased freshwater accumulation in the western Arctic. The CAA, and particularly the Northwest Passage, is one of the principle conduits for freshwater transport from the Arctic Ocean to the North Atlantic, however, there are uncertainties in the magnitude of transport and water properties. The currents in the CAA will be studied with Acoustic Doppler Current Profiler (ADCP) data, an autonomous glider (Fig. 2), and the CTD.

### **Theme 2: Microscopic Communities in Transition**

As Arctic waters warm and sea ice cover decreases, the surface ocean ecosystem is changing, and species distributions and abundances may change rapidly. To examine habitats along the cruise track, zooplankton nets will be periodically towed in the upper water column ( $\leq 100\text{m}$ ). Net contents will be catalogued. This data will be augmented by a laboratory bench-top FlowCam, which can identify and quantify 'particles' in seawater (Fig. 3). These particles can be sediments, phytoplankton, or zooplankton. We will re-occupy the long time series station in Lancaster Sound (Station 323: Lancaster Sound, 74.2, -79.75).

### **Theme 3: Distributions of Marine Birds in Canadian Arctic Waters**

Marine bird abundance and distribution can be used to monitor changes and variability in marine ecosystems. NPP will characterize the distribution and abundance of marine birds along the survey route. Associations between the marine bird community and the physical and biological properties of their marine environment will be identified and compared to past results. The cruise will use a standard non-invasive, observational method to perform seabird counts.



#### **Theme 4: Water Column Chemistry Affecting Greenhouse Gas Fluxes**

The concentration and isotopic composition of methane and carbon dioxide in the Arctic Ocean and atmosphere are of great interest as both are greenhouse gases, and the sources and flux of both between the ocean and atmosphere are important components of the climate system.

Measuring carbon dioxide and its isotopic composition can provide information about the carbon system sources and fluxes of carbon to the atmosphere. The Arctic appears to be an ever growing source of methane to the atmosphere. Some microbes in ocean water use methane as a food source. If microbial breakdown of methane is rapid enough, it may serve to offset the methane that escapes to the atmosphere. The NPP will study the concentrations and isotopes of carbon dioxide and methane by analyzing samples of the air and water with onboard laser spectroscopy instruments, as well as incubation of water to study microbial activity.

#### **Open Data Policy**

We will disseminate scientific data and results through the NPP website. All processed measurements will be stored in the NSF-supported Arctic Data Portal (<https://arcticdata.io>) and all appropriate Canadian and Inuit science databases, such as the Canadian Wildlife Service seabird database.

#### **Acoustic Instrumentation**

The NPP science team will use two scientific Acoustic Doppler Current Profiler (ADCP) sonar systems: a hull mounted ADCP operating at 38kHz and an ADCP operating at 300kHz, attached to the CTD.

The 38kHz sonar will be operating when the ship is underway, except under these conditions when the sonar will be off when:

- 1) marine mammals are detected within 500m of the ship.
- 2) within 5 km of any Nunavut community.
- 3) East of Bylot Island. The sonar will only be used when greater than 5km from land and will not be used in any harbor, bay, fjord, or channel.
- 4) in Navy Board Inlet, Eclipse Sound, and Pond Inlet, out of respect for concerns about the sonar in regard to a group of narwhals that moves between the Arctic Bay and Pond Inlet areas.
- 5) in restricted waters of the Bylot Island Migratory Bird Sanctuaries or Parks Canada Waters.



## Appendix I: Figures

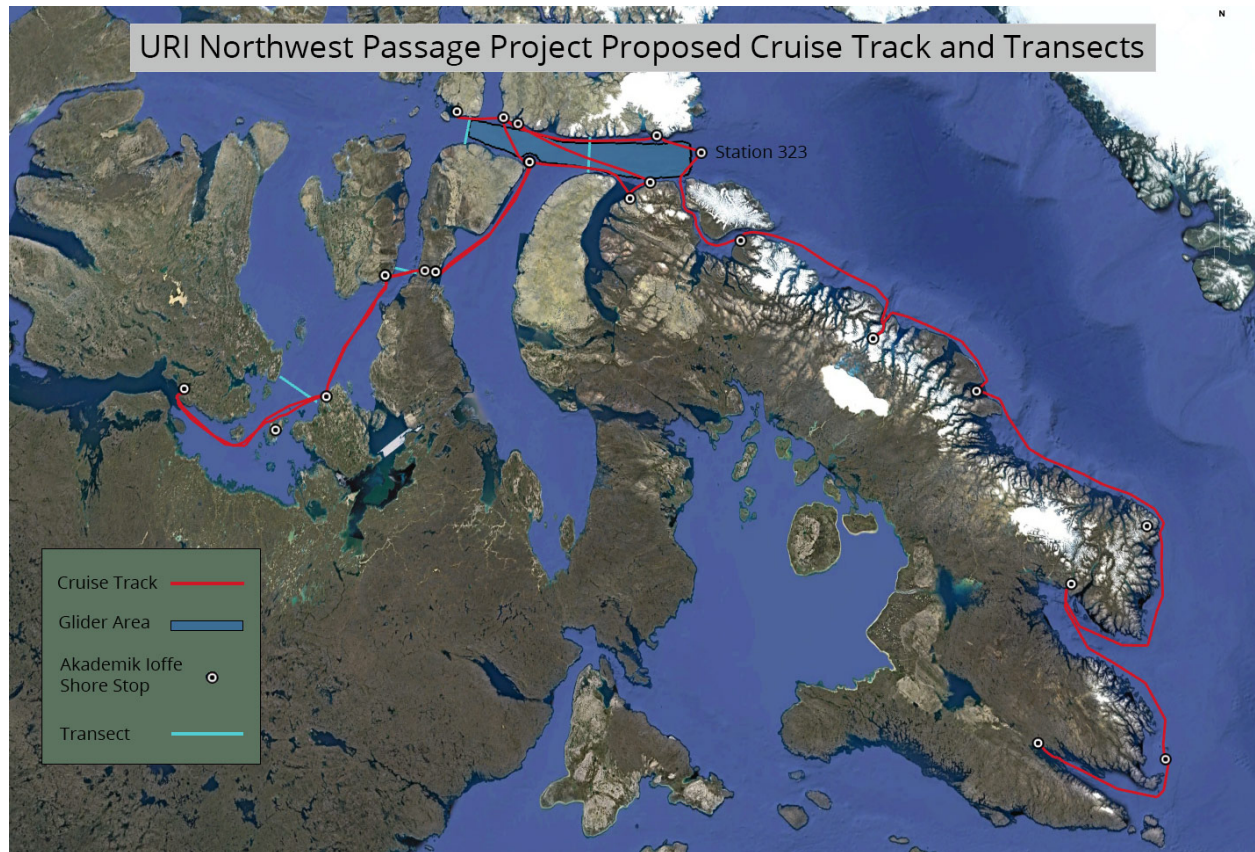


Figure 1: Proposed cruise track.

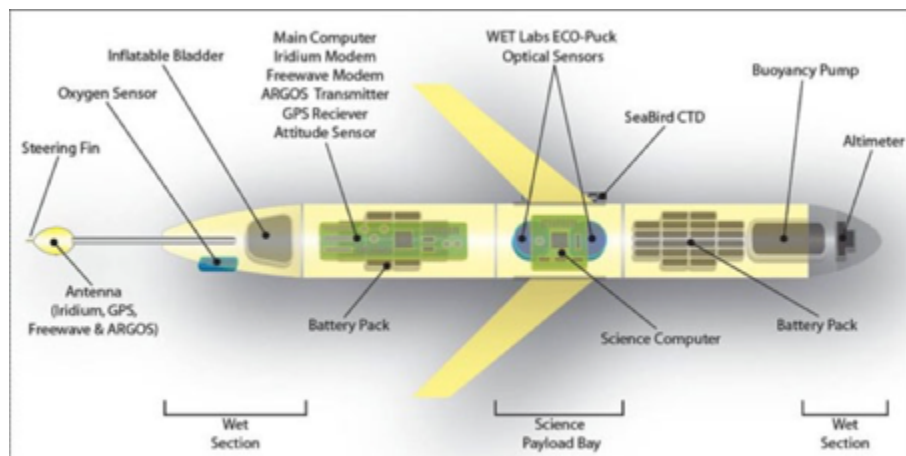


Figure 2. Slocum Glider.



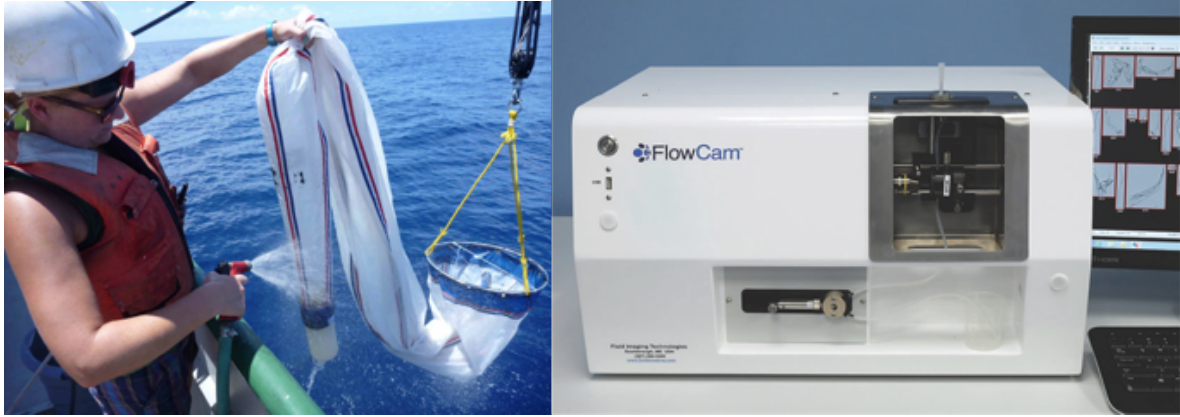


Figure 3. Left panel: Plankton net tows. Right panel: An imaging microscope known as the FlowCam™.