



# Extending the North Pacific Continuous Plankton Recorder Survey pole-ward

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## SUMMARY

The Arctic Ocean is changing rapidly, particularly due to warming and changes in sea ice in recent years. These changes are likely to have ramifications for the ecosystem. In order to track these changes consistent monitoring is needed. By providing coverage of both the North Pacific (since 2000) and now the boundary conditions between the Bering Sea and the Arctic (since 2018), the Continuous Plankton Recorder (CPR) Survey is ideally suited to tracking these changes. Plankton underpin almost all marine food webs, which form the basis of much of the blue economy and contribute to the biological carbon cycle. The CPR has a proven track record historically, and was able to continue sampling throughout the COVID-19 pandemic due to its semi-autonomous nature (towed by volunteer ships, crew can deploy easily).

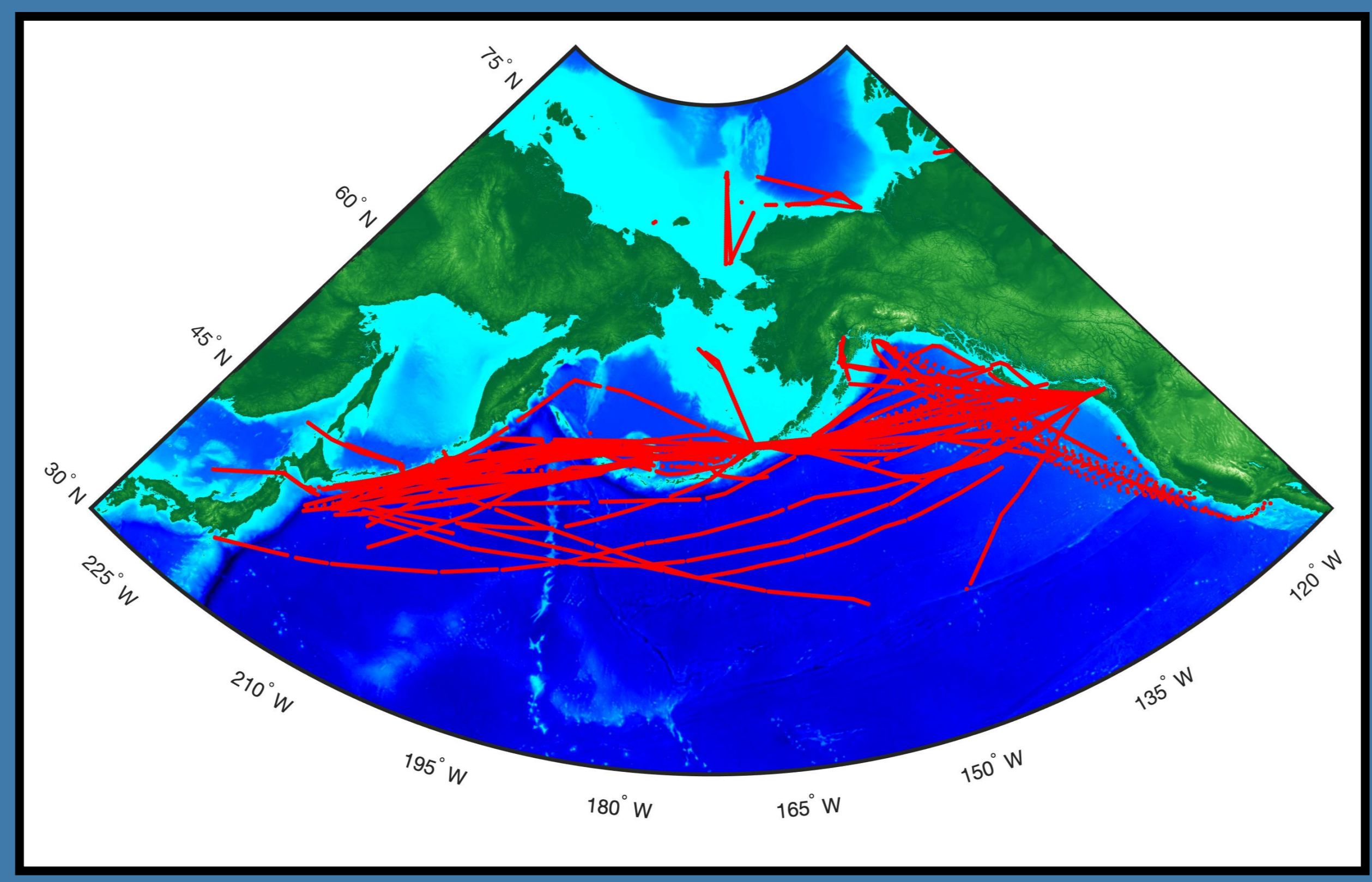
**Support is needed to maintain this CPR route in the Arctic, we are actively seeking collaborators and funders. All North Pacific CPR data are freely available on request - contact Clare at [claost@mba.ac.uk](mailto:claost@mba.ac.uk)**

## References

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 Espinasse et al., Defining isoscapes in the Northeast Pacific as an index of ocean productivity. (2019) Global Ecology and Biogeography.  
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 Timmermans, M. -L. and A. Proshutinsky, 2016: The Arctic Sea Surface Temperature in "State of the Climate in 2015". Bull. Amer. Meteor. Soc., 97 (8), S137-S138.  
 Vezzulli, L., et al., ((2015) gbpA as a Novel qPCR Target for the Species-Specific Detection of Vibrio cholerae O1, O139, Non-O1/Non-O139 in Environmental, Stool, and Historical Continuous Plankton Recorder Samples. PLoS ONE, 10, e0123983.

## North Pacific CPR Survey

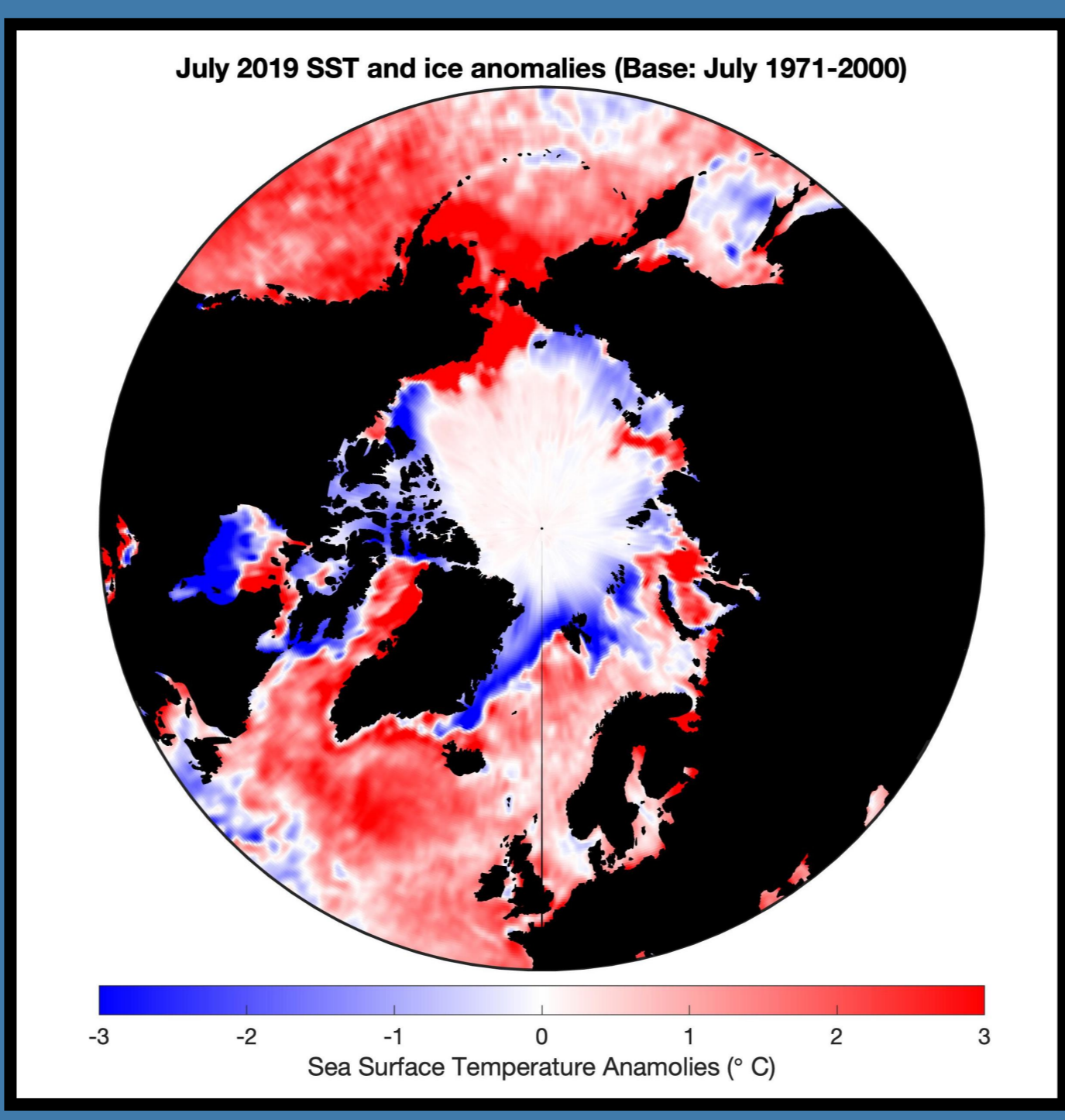
The 1998 annual meeting of the North Pacific Marine Science Organisation (PICES) recommended that the Continuous Plankton Recorder (CPR) be used to monitor the plankton populations of the North Pacific, to provide large scale coverage of the then poorly-sampled open ocean ecosystems. Thanks to support from a consortium of research councils and funders, 2020 marked the 21<sup>st</sup> year of seasonal plankton sampling in the eastern and western North Pacific, including the Southern Bering Sea



Using commercial ships (ships of opportunity) towing a CPR along their regular routes the program cost-effectively samples across the North Pacific (above figure shows CPR sample locations). Over 30,000 plankton samples have been collected and archived, with taxonomically-resolved abundance data for several hundred plankton taxa available for over 8,000 samples. Data are freely available on request.

## Sampling in the Arctic

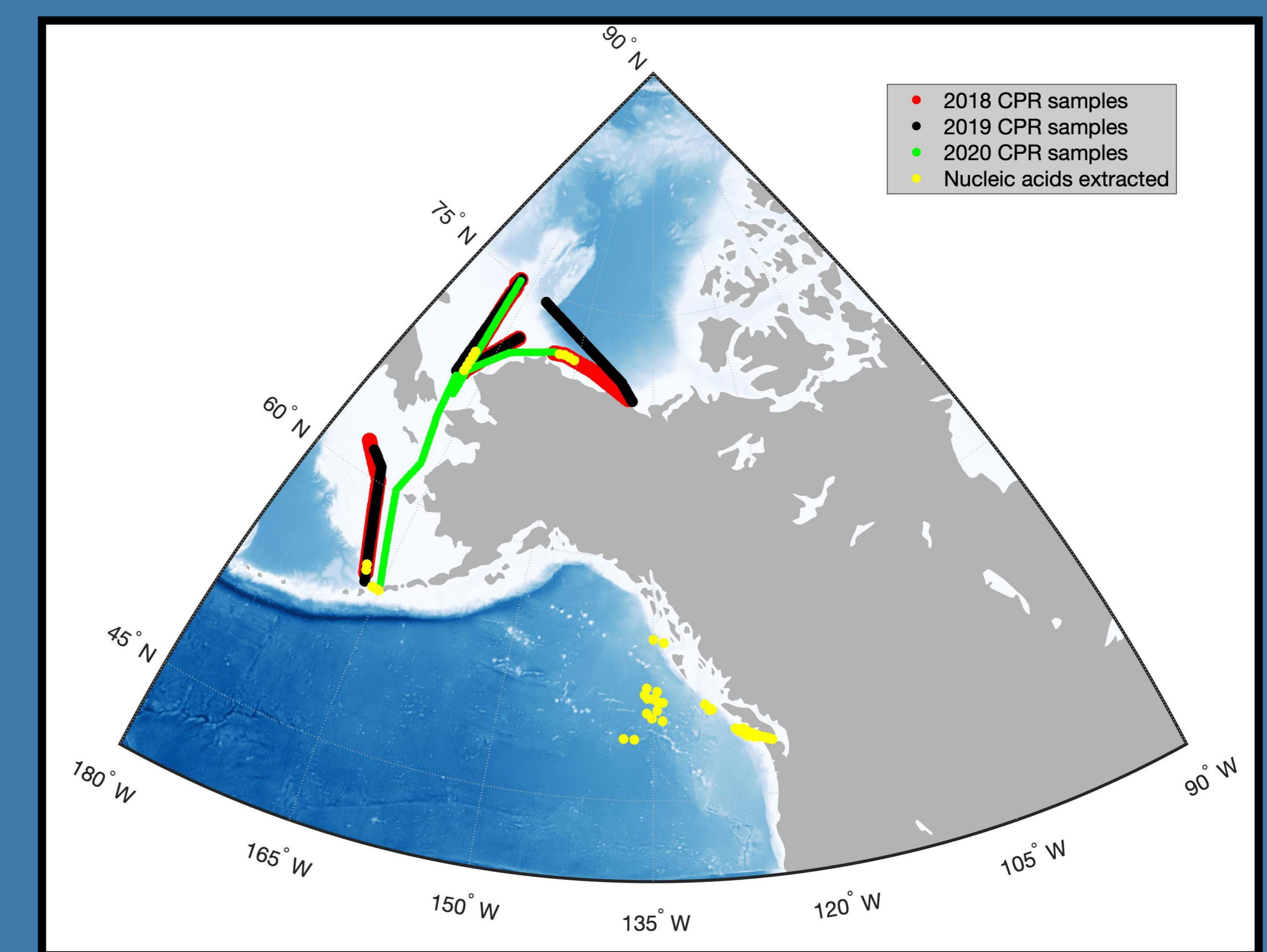
In recent years the Arctic Ocean has seen significant warming trends and changes in circulation, which are likely to have implications for the carbon pump and plankton community composition (Timmerman et al., 2016; DeVries et al., 2017). Trans-Arctic migrations are likely to become more prevalent as warming continues, and could have large impacts on the ecosystem and biodiversity. The northern boundary of the Pacific Ocean is likely to move pole-ward under climate change; this may cause areas of the Arctic Ocean to resemble North Pacific conditions (NOAA High Resolution SST data provided by NOAA/OAR/ESRL PSL, Boulder Colorado, USA).



In 2017 the CPR was successfully towed in the Labrador Sea and through the North West Passage by Jon Fisher and his team. Since 2018 a CPR has been towed by the DFO ship the Sir Wilfrid Laurier (SWL) during summer research cruises that traverse the Bering and Chukchi Sea and the Arctic Ocean. This sampling has continued for the years 2018, 2019, and 2020 using a bursary scheme provided by the NERC Arctic office.

## Active Research: DNA extraction

Targeted genetic analysis of harmful species and bacteria, such as *Vibrio cholerae* (*V. cholerae*) and *Psuedo-nitzchia* are currently being carried out in the region using a validated method for DNA extraction of formalin-preserved CPR samples (Stern et al., 2018, Vezzulli et al., 2015). *V. cholerae* is a marine bacteria that attaches itself to the surfaces of zooplankton and fish eggs, it is passed to humans through bathing and seafood contamination and proliferates when temperatures increase, while *Psuedo-nitzchia* is responsible for amnesic shellfish poisoning (Stern et al., 2018).



## Active Research: Stable Isotopes

Stable isotopes can provide detailed information on food web dynamics, and can identify at which trophic level targeted species are feeding. Brian Hunt's team at the University of British Columbia are investigating isoscapes (Espinasse et al., 2019) within the region using samples collected from the CPR samples. This method of zooplankton stable isotope analysis has been successfully carried out on CPR samples from the Pacific region (Espinasse et al., 2019).

## Active Research: Plastics

Microplastics are categorized and counted on all CPR samples, however in this study area these microplastics are yet to be formally identified (eg. using FT-IR). In 2018 within the Arctic Ocean, the SWL Chief Scientist noted that the "CPR wears a shroud of fishing net, 4" mesh, about 2 m long." This was in conjunction with a number of blue microplastic fibers that were reported in the CPR samples. Entanglement by macroplastics is a threat to marine mammals and birds in the area, and can also cause 'ghost fishing' (Ostle et al., (2019).

