Northern Bering and eastern Chukchi Sea physics, nutrients, and chlorophyll in late summer 2012 and 2013

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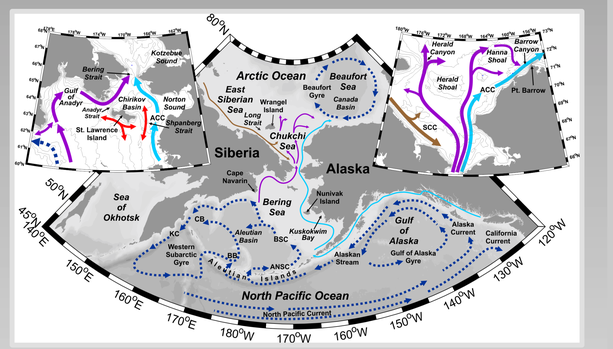

Fig. 1. Pacific-Arctic pressure head drives mean flow north through Bering Strait. Near-bottom waters from the Gulf of Anadyr are rich in nutrients.

Abstract

- Hydrography, nutrients, chlorophyll a (Chla, an estimation of phytoplankton biomass), were collected on Arctic Ecosystem Integrated Surveys (Arctic Eis) in the northern Bering and eastern Chukchi Seas from 7 August to 24 September, 2012 and 2013. Zooplankton (bongo tows), pelagic fish (surface/mid-water trawls and acoustics) and sea bird observations were collected concurrently.
- Oceanographic conditions varied between years with strongly contrasting wind, wave, and current fields during summer. The preceding winters also experienced different ice, winds and currents.
- 2012 Highlights: northern Bering Sea weakly stratified with an absence of Winter Water (WW); northern Chukchi Sea had a saltier subsurface layer (suggesting deeper arctic halocline ventilation), elevated total Chla, but a lower percentage of large phytoplankton, slightly higher surface nitrate and silicate, and eastward/northward near surface advection into Barrow Canyon.
- 2013 Highlights: warmer Alaska Coastal Water (ACW); northern Bering Sea had near-bottom WW south of Saint Lawrence Island; northeastern Chukchi Sea had more ice melt and extensive WW, a lack of ACW along the northeast coast, and westward near surface advection across the Chukchi Sea.
- Variations in oceanographic conditions likely influenced distribution and abundances of zooplankton, pelagic fish and marine birds in this region.

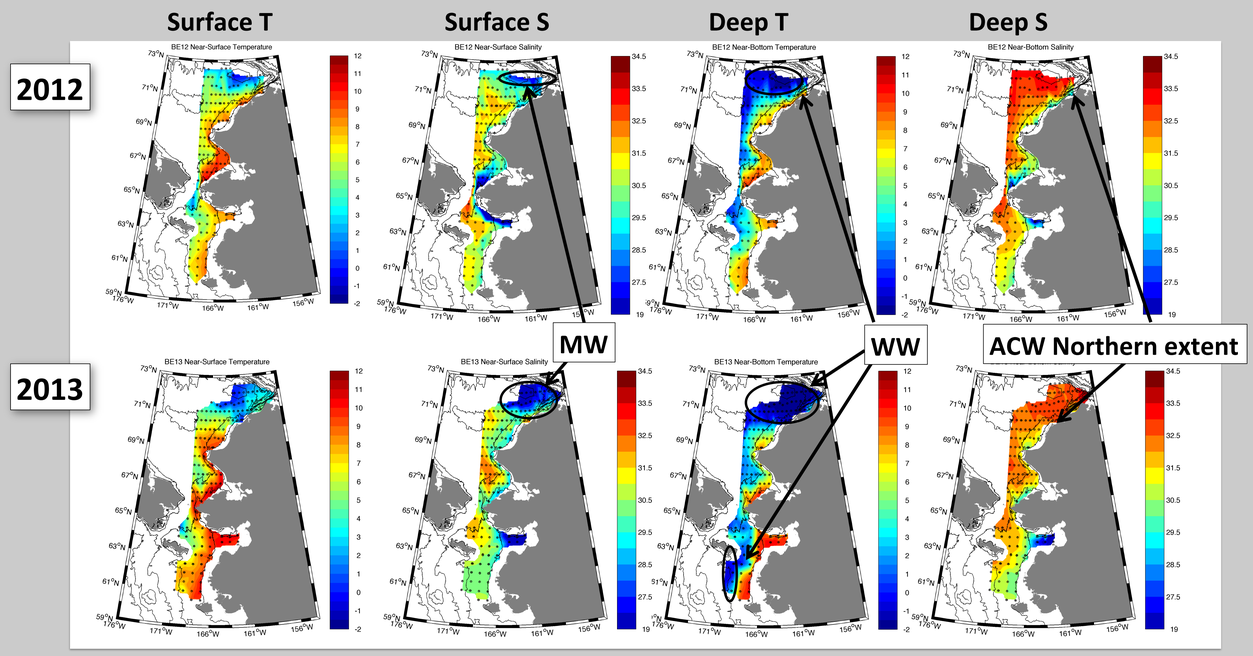

Fig. 2. Winter Water (WW): temperature (T) < 0 °C, salinity (S) = 30-33.5, Melt Water (MW): T < 7 and S = 25-30, Alaska Coastal Water (ACW): T = 7-12 °C, S <32, Anadyr Water (AW) Bering Shelf Water (BSW) and Chukchi Shelf Water (CSW): T = 0 -7 °C, S = 30-33.5.

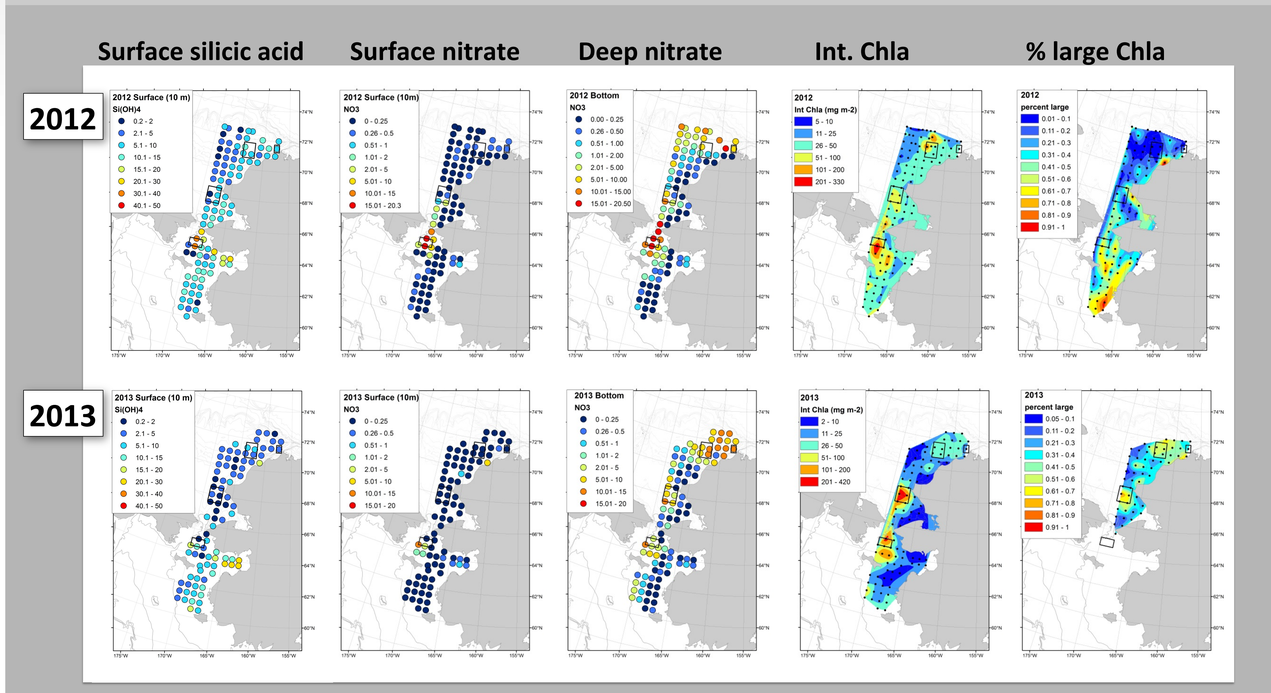

Fig. 3. Higher nutrients (µM) and Chla were observed in the Distributed Biological Observatory (DBO) stations (shown with boxes), areas of historically high production. For example, the high integrated Chla and nutrients north of Saint Lawrence Island (64-65 °N) and at 68 °N were due to inflow of nutrient-rich water from the Gulf of Anadyr. In the northern Chukchi Sea in 2013, the greater large-size phytoplankton fractions (> 10 µm Chla/ total Chla) and lower surface silicic acid and salinity suggests diatoms were present in the melt water.

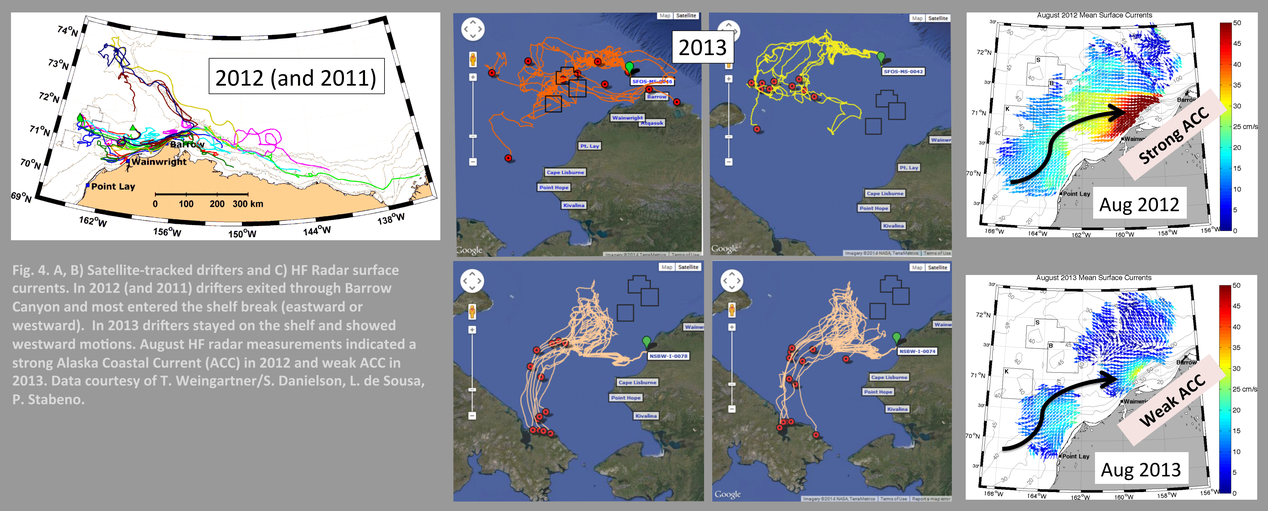

Fig. 4. A, B) Satellite-tracked drifters and C) HF Radar surface currents. In 2012 (and 2011) drifters exited through Barrow Canyon and most entered the shelf break (eastward or westward). In 2013 drifters stayed on the shelf and showed westward motions. August HF radar measurements indicated a strong Alaska Coastal Current (ACC) in 2012 and weak ACC in 2013. Data courtesy of T. Weingartner/S. Danielson, L. de Sousa, P. Stabeno.

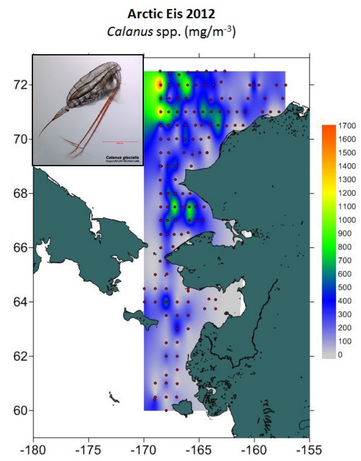

Fig. 5. *Calanus* spp. (*C. marshallae* and *C. glacialis*) copepods were found in colder saltier water masses (e.g. AW, BSW, CSW, Fig.2) similar to 2007 (Eisner et al. 2011). More stations in the northern Chukchi had Arctic taxa in 2013 than in 2012, which could be interpreted as extensive penetration of Arctic water onto the shelf in 2013. Data courtesy of A. Pinchuk.

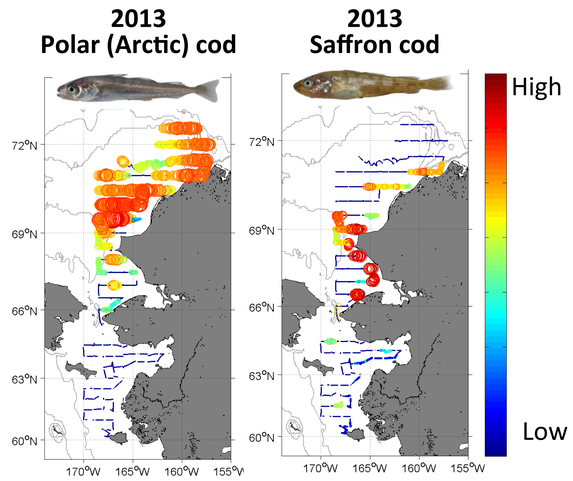

Fig. 6. Distributions of polar cod and saffron cod from acoustic measurements (A. De Robertis, unpublished preliminary data). Polar cod were more abundant in colder water and saffron cod more abundant in warmer water (Fig 2). Optimal water temperatures are higher for saffron cod than polar cold (Laurel, *In Review*). Acoustic data suggest that polar cod and saffron cod had ~ 3X higher abundances in 2013 than 2012.

References

Eisner, L., Hillgruber N., Martinson E., Maselko J. 2013. Pelagic fish and zooplankton species assemblages in relation to water mass characteristics in the northern Bering and southeast Chukchi Seas. Polar Biology, DOI 10.1007/s00300-012-1241-0

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BOEM Bureau of Ocean Energy Management

CIAP Coastal Impact Assistance Program

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