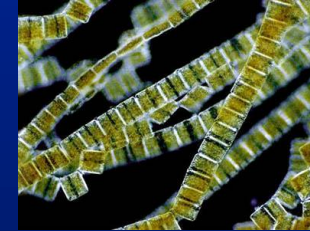


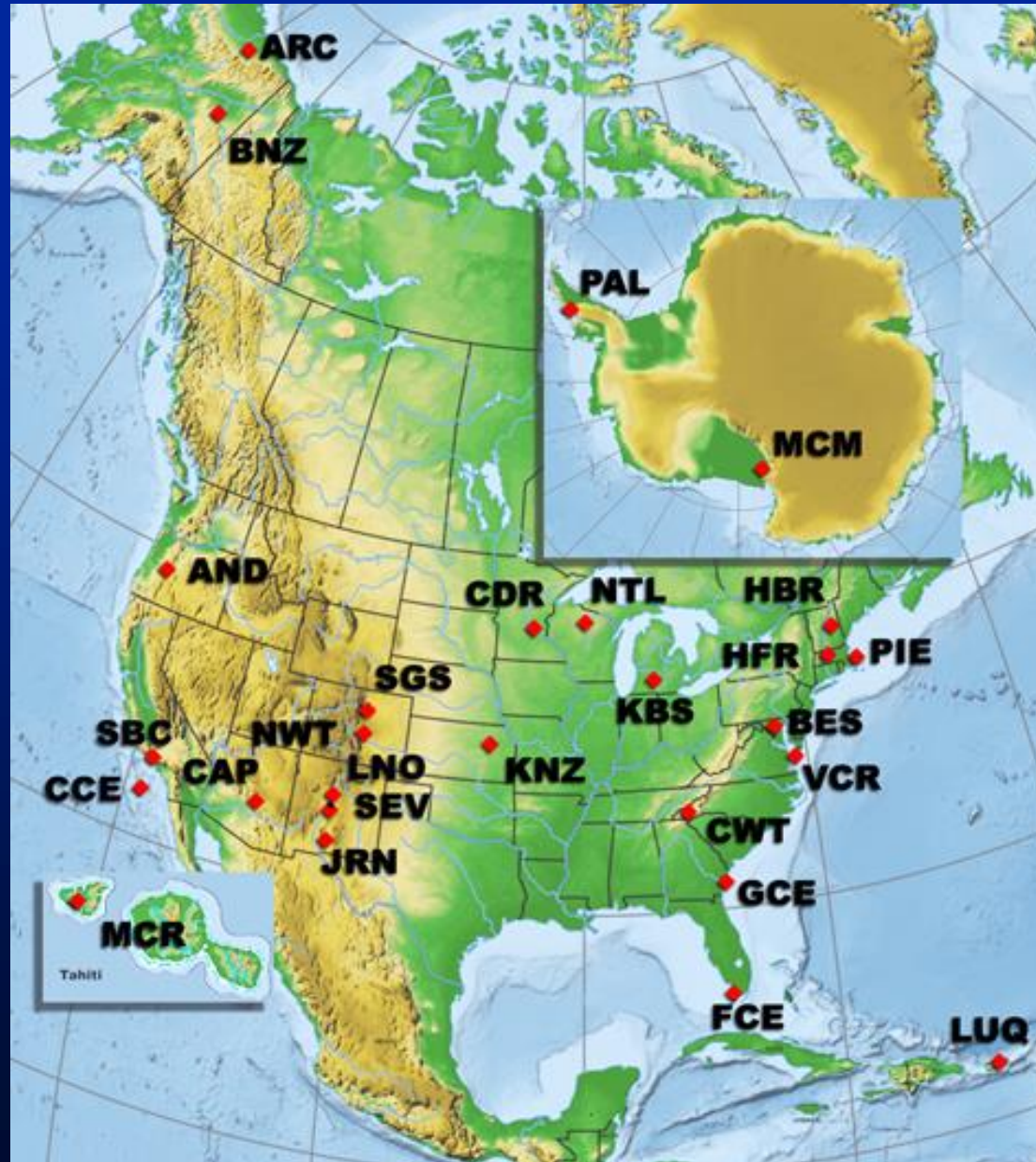
# Long-term changes in the Antarctic marine ecosystem



Debbie Steinberg



# Long-Term Ecological Research (LTER) network

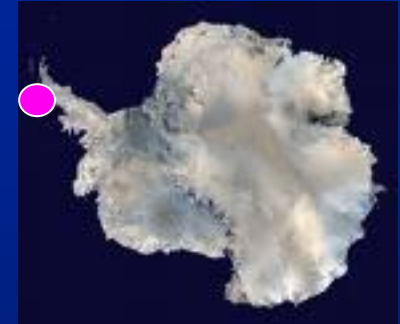
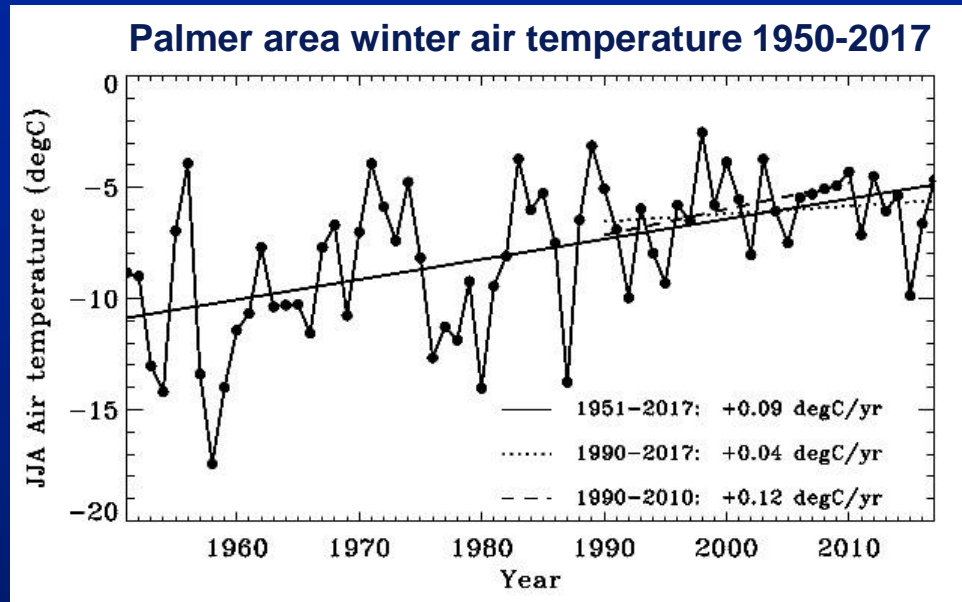


28 sites

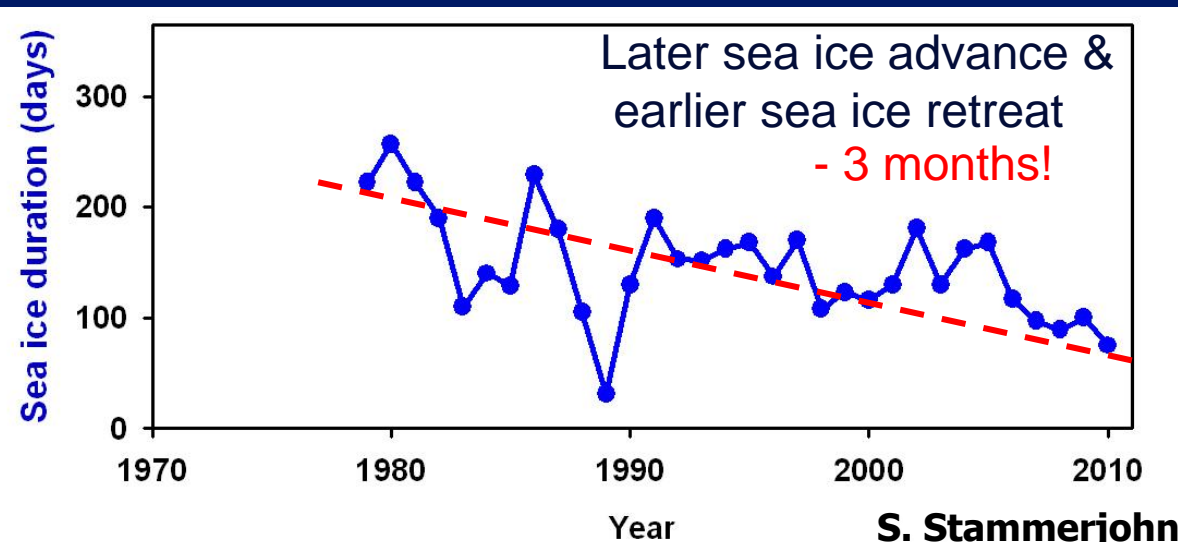
# Warming in the Western Antarctic Peninsula

Average winter (June-Aug.) temperature

+1.1°C per decade: 7°C since 1950: 5x global ave.



Sea ice is declining



Webb & Martinson



# Palmer Station and the R/V *Laurence M. Gould*



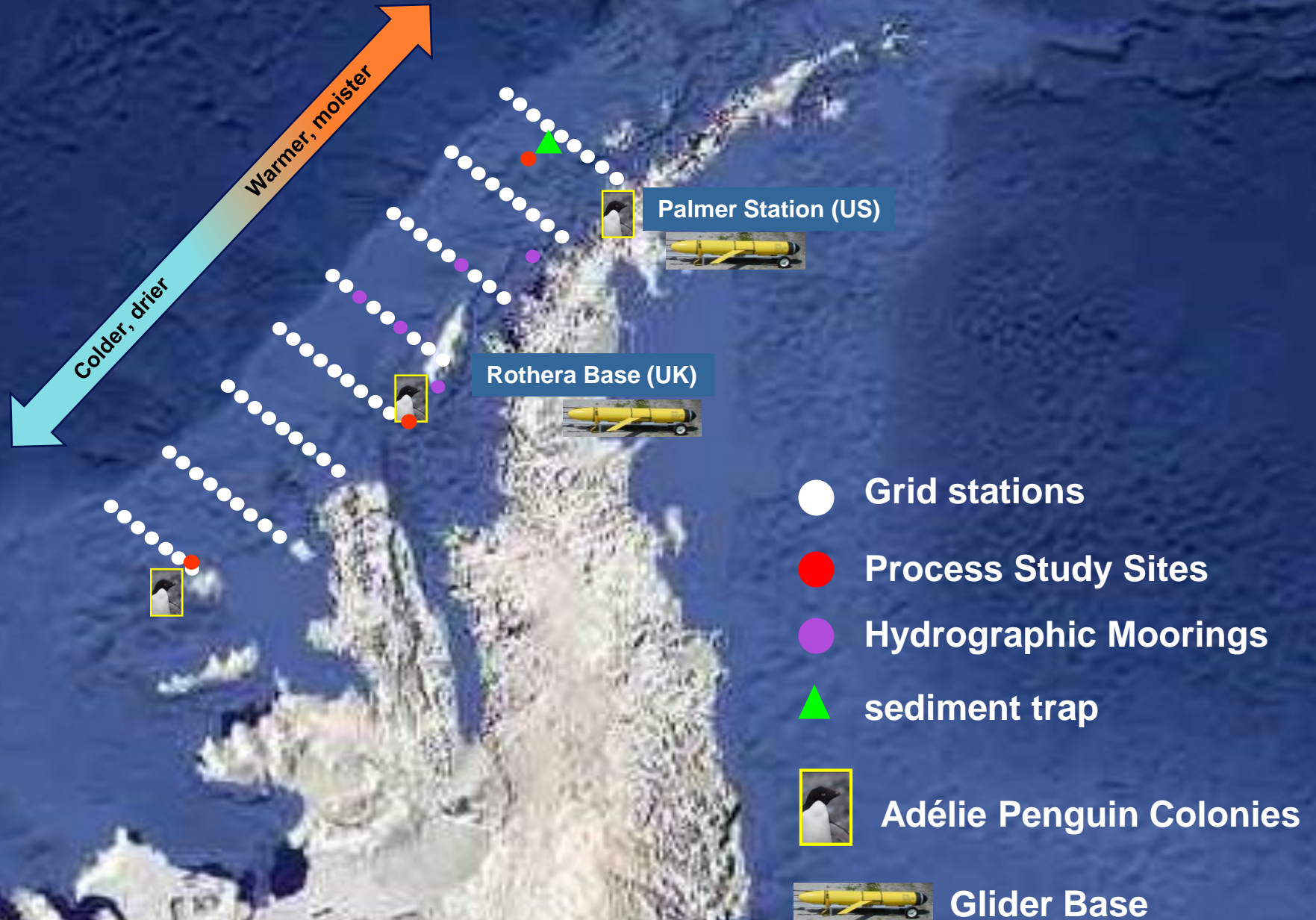








# Palmer Long-Term Ecological Research Study Region





# The W&M undergrads!



Caitlin Smoot '11



Miram Gleiber '09



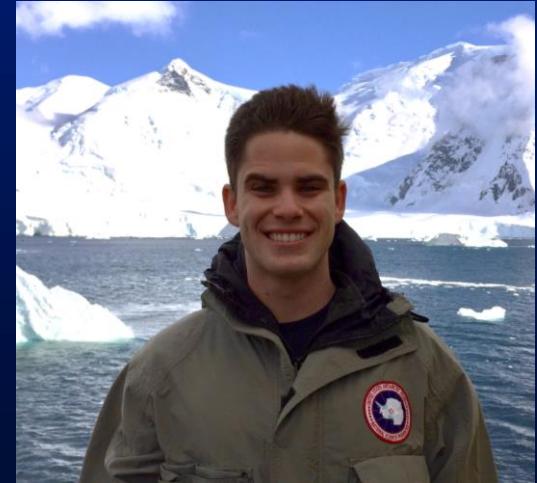
Domi Paxton '12 & '13



Sarah Giltz '10



Frances Armstrong '12



Josh Sacks '18



# Antarctic krill & salps

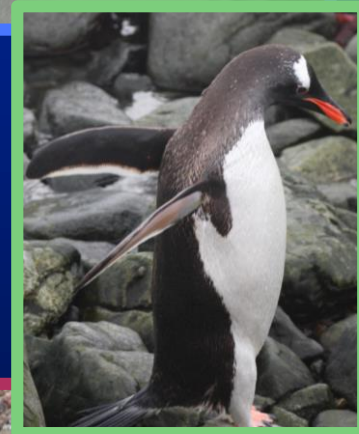
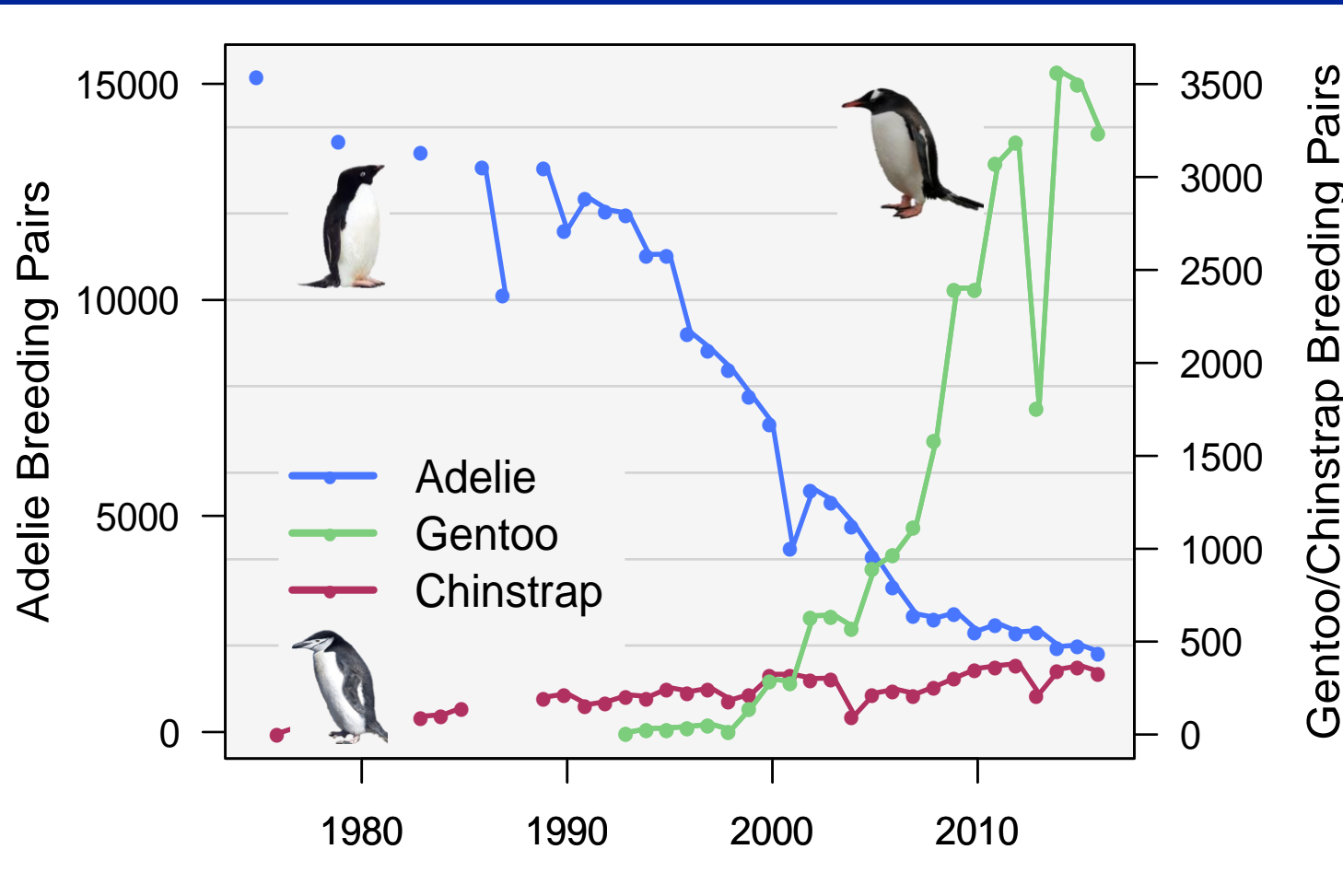






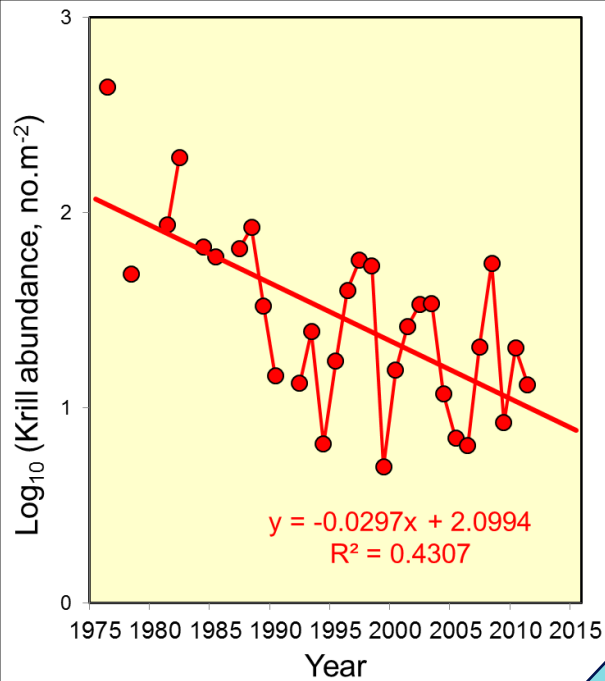
# Penguin populations near Palmer Station

Ice-dependant Adélies declining, subpolar species invading & increasing

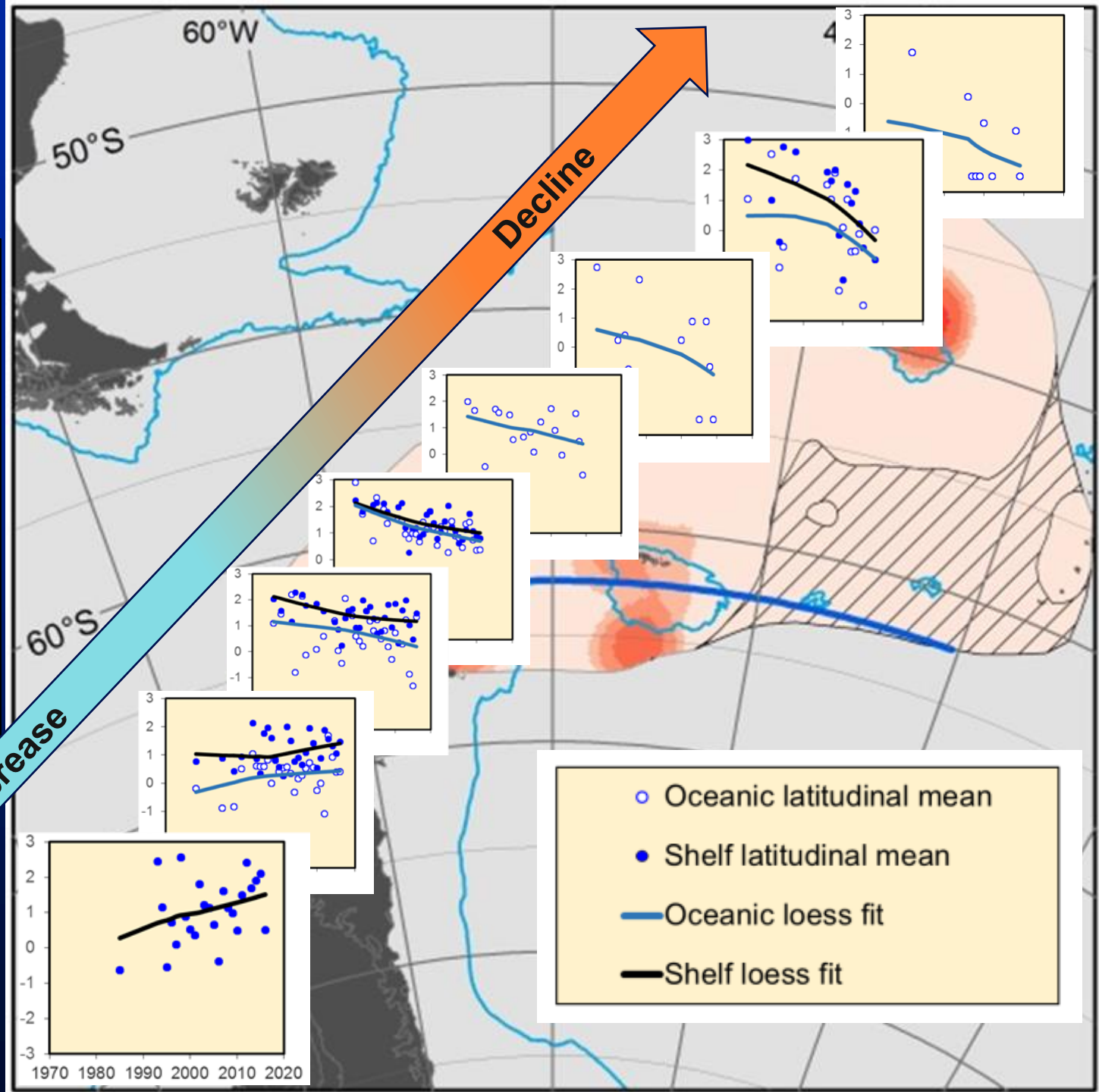


Larger regional context  
*E. superba*  
1970's to present

Overall trend- SW Atlantic sector



Atkinson et al. *in press*





# Consequences of shifts in plankton

Effects on higher trophic levels

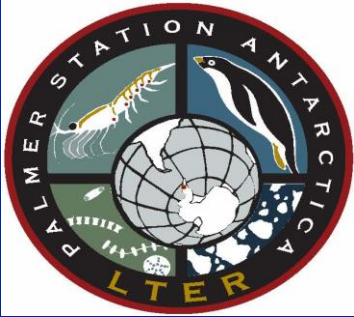


**Krill from one penguin stomach!**





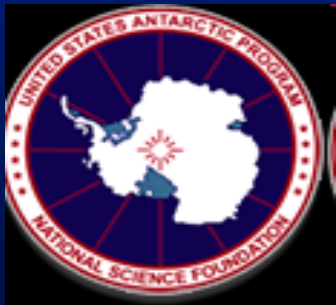
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technicians, students, & volunteers



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Antarctic support services  
teams



C. Duplantier and First Advantage