Version 1

Local studies of habitat selection have identified that shorebird breeding densities are influenced by abiotic factors including elevation, geology, surface water, snow cover, temperature and precipitation, and biotic factors including vegetation community and presence of conspecifics (Gratto-Trevor 1996; Morrison 1997; Smith et al. 2007; Walpole et al. 2008; Saalfeld et al. 2013; Swift et al. Senner 2017; Lathrop et al. 2018; Cunningham et al. 2016). However, the process of habitat selection occurs at multiple spatial and temporal scales (McGarigal et al. 2016). I will examine the relative influence these factors on observed densities and richness of shorebird species across their Arctic breeding ranges, testing three hypotheses from recent literature about how the relative influence of abiotic and biotic factors depends on spatial scale. I will then use these relationships to develop detailed contemporary distribution maps for Arctic breeding shorebirds.

Hypothesis 1: Biotic interactions that influence species distribution are closely correlated with abiotic conditions across all spatial scales (Soberón and Nakamura 2009). I predict that I would observe abiotic predictors alone can sufficiently capture variation in shorebird nesting density and richness.

*Hypothesis 2:* The factors influencing species distribution are hierarchical. Biotic interactions are important at finer spatial scales, but their effects are averaged out at coarse spatial scales where abiotic factors are most important (Pearson and Dawson 2003; Soberón and Nakamura 2009). I predict that I would observe strong relationships between shorebird nesting density and vegetation or conspecifics at finer spatial scales, but not at coarser spatial scales.

*Hypothesis 3:* Biotic interactions and abiotic conditions can both potentially limit distribution at all spatial scales (Wisz et al. 2013). I predict that I would observe strong relationships between shorebird nest density and vegetation or conspecifics at coarse spatial scales for one or more shorebird species. However, I would not expect to detect this relationship in all species, as abiotic factors are recognized to be commonly important in defining species ranges, and are more likely to limit distribution and abundance at higher latitudes than at lower latitudes

Brainstorming

Idea 1: relative importance of abiotic and biotic variables

-Lenore keeps disagreeing with phrasing it that way. I have read other ways of describing – scenopoetic vs …?, the paper where they might have used different words but it was essentially density dependent or not

-most of the ways that people make inferences about this logically flawed. How could you do it better?

Idea 2: trying to identify what the most important predictors are for predicting climate change

-inspiration from how weather prediction works

Both of them relate to how species distribution model can be better used for making future predictions (I think)?

Idea 3: Are there time lags in associations between distribution and certain variables?

-relationship with generation time?

I’m really intrigued by willow’s description of shorebird species moving into different areas that she’s worked.

How stable are current statistical habitat associations?

Zero forecast skill = no better than random sample from observed distribution

What is the goal of a PhD/ my PhD?

-new knowledge

Look at Helene Genet proposal again? Jim Lyons said they decided not to do that project anymore, Paul said that’s good for me

What did Paul send me about the most recent Audubon paper? They had been improving their methods

-comparison to population dynamics – more general models vs more specific models. Their’s must be more general?

-How did IPCC decide on their methods?

What paper talked about 3 different ways to predict species response to climate change: mechanistic, statistical and hybrid? How did hybrid work?

OK lets try doing it this way:

I’m going to make species distribution models of breeding habitat associations

1. What are the different possible ways of doing this? Advantages/disadvantages?

* Dispersal barriers: community species pool
* Scale of effect: nested spatial scales, optimized spatial scales
* Algorithms: GLM, GAM, machine learning, maxent

-how do I account for regional/annual differences?

-how can you account for social attraction?

-does setting up the habitat data as a percent coverage per plot for each habitat type make sense? Should I use coarser habitat types or finer?

1. What are the different questions I have that could potentially be answered while looking at this data?

* Relative importance of abiotic vs biotic variables. If you just use climate, how much of a different answer do you get than if you use a more complex model?
* What is the best way to identify which predictors will be the best for predicting responses to climate change?
* What time frame do species respond to for annually variable predictor variables (climate, surface water, snowmelt)? Are there time lags?