Appendix 2 – Additional details concerning quantification of site and host population attributes for use in the species-habitat model

Here we describe the explanatory variables and procedures applied to estimating ecological correlates of Avian Cholera outbreak risk at Common Eider colonies in the Hudson Strait region of the Canadian Arctic

Explanatory variables

The first category of potential explanatory variable that we considered was the biophysical attributes of the island. Freshwater melt ponds are a potentially important source of Avian Cholera transmission and prospective focal point of management intervention. However, there is considerable variation among islands with respect to pond presence (*pPOND*) and number (*nPOND*), as well as other site characteristics, including percent vegetative cover (*VEG*), island size (*AREA*), and elevation (*ELEV*). These variables potentially influence site drainage and the way host species access and move through the habitat.

We quantified pond presence, pond number and vegetative cover directly using visual assessments made by field personnel. Island size and elevation were derived by querying digital thematic maps (CanVec 1:50,000 scale topographic) in ArcGIS (Version 10.1 (Environmental Systems Research Institute Inc., Redlands, CA, USA).

The second category of explanatory variable that we evaluated was focal host quantities. In our model, we included measurements of Common Eider abundance (*nCOEI*: nests per island) and density (*dCOEI*: nests per ha) on each island, as well as a quadratic feature quantifying pond abundance in relation to the number of nesting eiders present $(P/100E)^2$. Inclusion of $(P/100E)^2$ variable allowed us to consider differences among colonies on which a large number of birds shared a common water source independent of nest density.

The final category of explanatory variable was potential disease dispersers. Our interest was to assess evidence for different species or populations acting as disease vectors or reservoirs. Variables included the presence and number co-nesting gulls, gulls in the surrounding area more generally, and the migration paths of eiders and snow geese converging in Hudson Strait from different wintering grounds. Gull variables encompassed the presence and number of nesting herring gulls (*pHERG, nHERG*), the presence and number of nesting glaucous gulls (*pGLGU, nGLGU*), and all gulls within a 5 km radius of the island irrespective of species and nesting status (*aGull*).

To evaluate the location of colonies in relation to Common Eider migratory flyways we used information from satellite tracking studies conducted by Mosbech et al. (2006), Savard et al. (2011), and G. Gilchrist, Environment Canada (*unpublished data*). The aforementioned studies were designed to delineate eider movements between wintering and breeding areas and the authors provided us with raw location estimates for birds breeding in the Hudson Strait region.

We processed these data to determine the single highest quality location estimate received during each 2.5 d duty cycle (i.e., the interval when the transmitter unit was programmed to be active) during spring migration (15 Apr – 1 Jul). We specified an inclusion threshold of ±1 km accuracy (i.e., Argos location class ≥1) and used the first estimate received per duty cycle when multiple estimates of identical accuracy were obtained. The resulting data yielded directional migration paths for 9 eiders (7 female and 2 male) tracked from wintering areas in Atlantic Canada into Hudson Strait and 20 eiders (16 female and 4 male) tracked from west Greenland into Hudson Strait over a 9 yr span (2000-2004, 2006-2007 and 2012-2013).

We then analyzed the data in Spatial Analyst using the line density tool. Our objective was to calculate track densities within 0.01 degree grid cells throughout the study area (summed migration path length [km] per unit of area [km^2]. This enabled us to extract indices of coastline usage by birds affiliated with wintering areas in Atlantic Canada (*COEI-CF*) or west Greenland (*COEI-GF*) in the neighborhood of each colony using a search radius buffer of 25 km^2 from each island center.

For lesser snow geese, satellite transmitter data was not available; however, patterns of migratory connectivity are well quantified on the basis of harvest recoveries. For our purpose, we overlaid a migration map for mid-Continent lesser snow geese (U.S. Fish and Wildlife Service 2007) onto our study area and again applied a 25 km^2 buffer around each island to extract a binary estimate of intersection between eider nesting colonies and lesser snow goose summer distributions (*SNGO*).

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