Using discrete choice modeling to generate resource selection functions for female polar bears in the Beaufort Sea

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Abstract

Polar bears (Ursus maritimus) depend on ice-covered seas to satisfy life history requirements. Modern threats to polar bears include oil spills in the marine environment and changes in ice composition resulting from climate change. Managers need practical models that explain the distribution of bears in order to assess the impacts of these threats. We explored the use of discrete choice models to describe habitat selection by female polar bears in the Beaufort Sea. Using stepwise procedures we generated resource selection models of habitat use. Sea ice characteristics and ocean depths at known polar bear locations were compared to the same features at randomly selected locations. Models generated for each of four seasons confirmed complexities of habitat use by polar bears and their response to numerous factors. Bears preferred shallow water areas where different ice types intersected. Variation among seasons was reflected mainly in differential selection of total ice concentration, ice stages, floe sizes, and their interactions. Distance to the nearest ice interface was a significant term in models for three seasons. Water depth was selected as a significant term in all seasons, possibly reflecting higher productivity in shallow water areas. Preliminary tests indicate seasonal models can predict polar bear distribution based on prior sea ice data.
Polar bears are neither evenly distributed throughout the Arctic, nor do they comprise a single nomadic population, but rather occur in 19 relatively discrete subpopulations (Figure 1). There is uncertainty about the discreteness of the less studied subpopulations, particularly in the Russian Arctic and neighbouring areas, due to restricted capture and genetic data. The IUCN/SSC Polar Bear Specialist Group (PBSG) provided its first global population estimate in 1993: 21,470-28,370 polar bears (PBSG 1995). Although this was based on scientifically-derived estimates of abundance for most subpop Discrete Choice Models (DCM). • The modern literature goes back to the work by Daniel McFadden in the seventies and eighties (McFadden 1973, 1981, 1982, 1984). • Usual Notation: n = decision maker i,j = choice options y = decision outcome x = explanatory variables/covariates \( \beta \) = parameters \( \varepsilon \) = error term \( I[.] \) = indicator function: equal to 1 if expression within brackets is true, 0 otherwise. Example: \( I[y=j|x] = 1 \) if \( j \) was selected (given \( x \)) = 0 otherwise. DCM – What Can we Learn from the Data? A one standard deviation change in the argument of a standard Normal distribution function is usually called a “Probability Unit” or Probit for short. “Probit” graph papers have a normal probability scales on one axis. The Normal qualitative choice model became known as the Probit model. Two other female polar bears with collars were observed but not captured, their collars continue to transmit. The trends in available habitat analysis is complete and publication nearing completion. Significant losses of preferred polar bear habitat were found in Foxe Basin, Hudson Strait and Hudson, particularly during freezeup, spring and breakup. Inuit Qaujimajaujngit In the Foxe Basin Polar Bear Project we are using Inuit knowledge, Inuit Qaujimajaujngit (IQ), in several important ways. Generally and informally, we use local knowledge and IQ to design our studies, implement fieldwork and interpret results. The available habitat choice sets will be generated by intersecting random points on the sea ice charts within a selected radius around the actual bear location.