HYBRID BEARS: *A Consequence of Anthropogenic Climate Change*

HELLO HYBRIDS

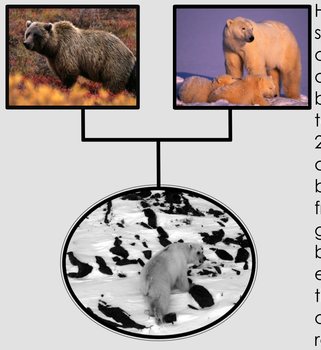


Figure 1. Hybrid pedigree. The pedigree displaying the hybrid offspring produced between a polar bear (*Ursus maritimus*) and brown bear (Ursus arctos).

Hybridization occurs when two different species or sub-species mate to produce an offspring. The hybridization between a polar bear *Ursus maritimus* and a grizzly bear *Ursus arctos* are unofficially referred to as grolar and pizzly bears (Preuß *et al*, 2009). The grolar bear is produced from a male grizzly bear and female polar bear, where as a pizzly bear is produced from a male polar bear and a female grizzly bear. In all observed cases of hybridization in both captive and natural environments, the hybrids have been fertile (Preuß *et al*, 2009). The ecological and genetic benefits and costs of natural hybrids must be considered for conservation and management policies. Species adaptation, genetic composition, competition with parent taxa, and invasion of novel habitat are all potential effects of hybrid species (Edmands, 2007). Competition with parent taxa can increase the susceptibility to pathogens, parasites, and other environmental threats (Vilà *et al*, 2000). Hybrids also have the potential to contribute to population adaptation, rescuing of

Changes in habitat, climate change, and anthropogenic factors threaten polar and brown bears populations (Derocher *et al*, 2013). New distribution overlaps between both species have also impacted food resources, mating, and territories of both bear species, resulting in an increased potential for hybridization (Preuß *et al*, 2009).

METHODS

Distributions of brown and polar bears were mapped in North America to establish the potential hybrid range. A variety of factors (biome distribution, sea surface temperature, sea ice distribution, polar bear denning sites, and oil reserves) were mapped to emphasize the effect of anthropogenic climate change in the Arctic region.

BROWN BEAR

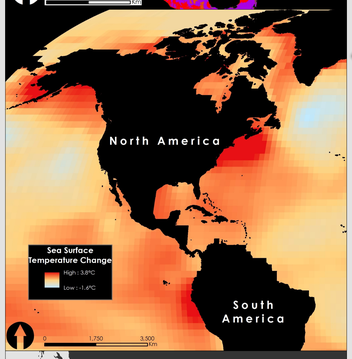
Current North American distribution of the brown bear (*Ursus arctos*)

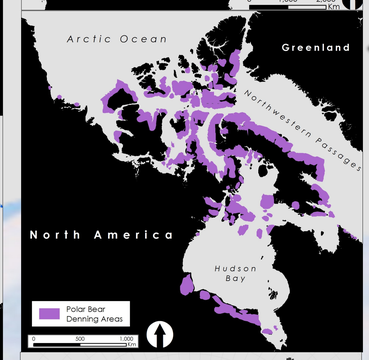
POLAR BEAR

Current North American distribution of the polar bear (*Ursus maritimus*)

HYBRID BEAR

Potential hybrid bear distribution was created using the overlapping range of both the polar bear and brown bear ranges in North America





Biome Distribution

Current biome distribution across North America. Suitable polar bear habitat occurs only in the Arctic tundra; Brown bears have a diverse range of suitable habitats with the majority including the Arctic tundra, boreal forest/taiga, conifer forests, and broadleaf/ mixed forest. The effects of climate warming intensify with increasing latitude. Arctic greening is a shift in biome type from tundra to boreal forests/taiga as a result of climate warming.

Sea Surface Temperature

Sea surface temperature change from 1996-2016. Changes in sea surface temperature has led to an overall decline in sea ice in the Arctic region resulting longer periods of open water throughout the year. These longer periods without ice directly impact polar bear distributions.

Sea Ice Distribution

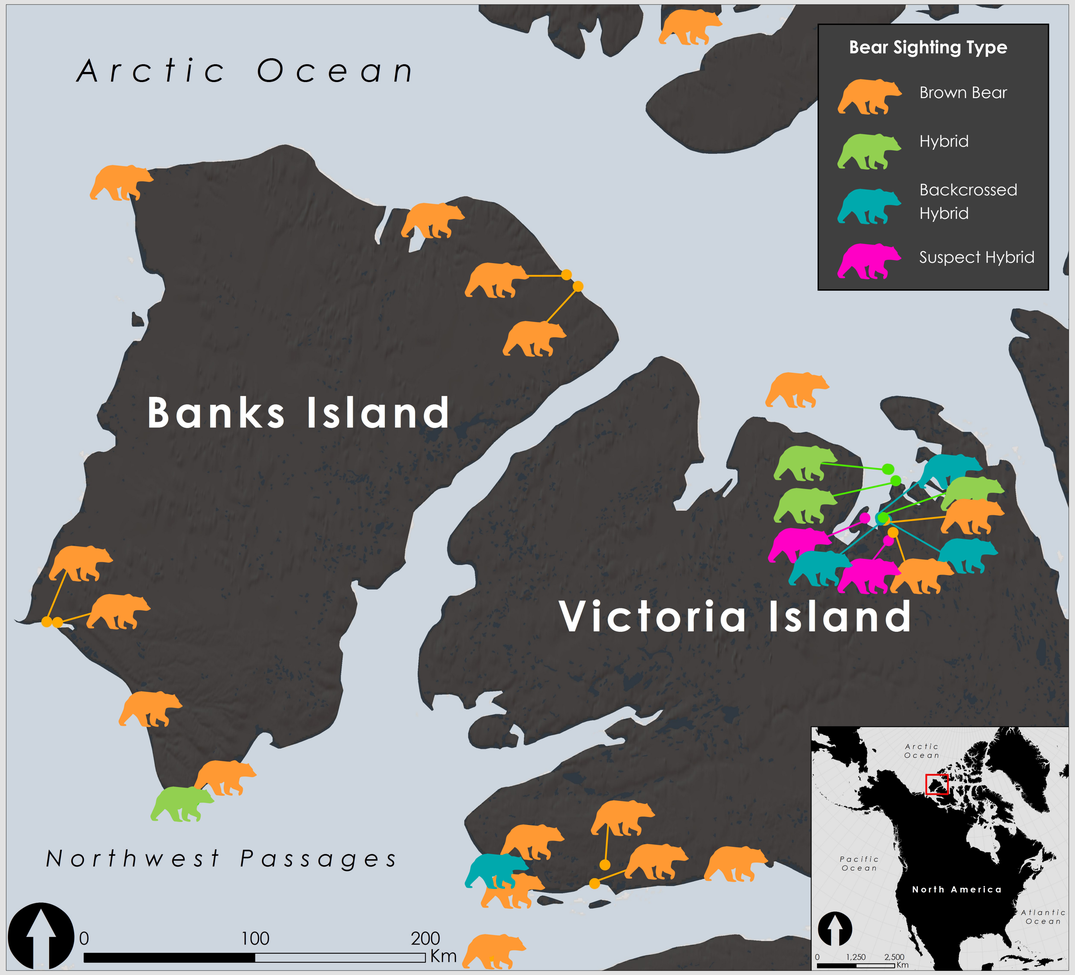
Sea ice change from 2014-2017. Declines in sea ice in Hudson Bay and in the Arctic Ocean has had a significant impact on food availability of polar bears. Sea ice is used by polar bears to hunt seals. Longer periods without ice has forced polar bears to hunt/ forage terrestrially for longer periods. Foraging terrestrially is nutritionally insufficient and not sustainable for polar bears long term.

Polar Bear Denning Areas

Polar Bear Denning Areas. Pregnant females are the only polar bears that den. Dens are dug into frozen peat banks along the edges of water bodies (Clark et al, 1997). Females will give birth between December and January and mothers and cubs will emerge from their dens around March or April. The decline in sea ice can reduce the ability of females to establish or find proper denning areas, which can lead to reduced cub survival (Derocher et al, 2011).

Oil & Gas Reserves

Oil & Gas Reserves. Greenhouse gases (GHG) include: carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). GHGs are released through the production, transportation, and burning of fossil fuels and natural gas. The solar radiation is reflected off the surface of the earth in the form of infrared radiation (IR). With the "greenhouse effect", GHGs trap IR and results in increased warming of the lower atmosphere and Earth's surface temperature.



Hybrid locations were georeferenced from harvests, captures, and sightings documented in the Arctic Islands in the Inuvialuit Region (seen above) from the Richardson et al paper published in May of 2017, *Recent Hybridization between a Polar Bear and Grizzly Bears in the Canadian Arctic*. First generation hybrids are labeled as 'Hybrid' (green), hybrids that are the backcrossed generation between a hybrid bear and a grizzly bear are labeled as 'Backcrossed Hybrid' (blue), suspected hybrids that have not been confirmed are labeled 'Suspect Hybrid' (pink) and observed grizzly bears in the region are labeled as 'Brown Bear' (orange).

CONCLUSION

The potential ecological ramifications of hybrid bears in the Arctic region are unknown. With increasing global temperatures (Figure 2), the various impacts on the Arctic region discussed previously are expected to amplify. The increasing pressures for polar bear survival on land combined with brown bear range expansion further north will ultimately increase the likelihood of hybridization in the future. It is a possibility that hybrid bears will be better adapted to the changing climate and eventually replace the declining polar bear population. There are several research opportunities in these novel hybrid occurrences and theoretical ecological outcomes. Establishment of the current knowledge on hybrids, parent species, and climate impacts are the first steps in addressing hybrid research.

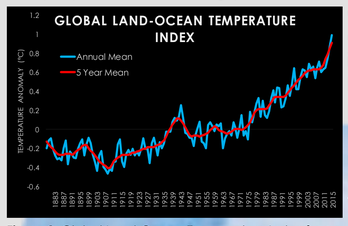


Figure 2. Global Land-Ocean Temperature Index from 1880-2016. The annual mean and 5-year mean have both increased significantly, with 16 of the 17 warmest years on record occurring since 2001. This emphasizes the anthropogenic global warming trends that contribute to the decline in sea ice, arctic greening, and changes in distributions in polar and brown bears.

SARA COLIN
M.S. Conservation Medicine
Candidate 2018

MCM 591 | December 2017

Data Sources: ESRI, ICUN, NASA/GISS,: NCDC/ NOAA

NGA Arctic Open Data Application , WWF GLOBIL

Photo Sources: Paul Nicklen, John Eastcott & Yva Momatiuk, Jodie Pongracz

Citations & map projections are on a separate document

Tufts UNIVERSITY
Cummings School of Veterinary Medicine