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The Conservation Implications of Climate Change on Predatory Mammal Distributions in North America and Europe: A Three Case Study

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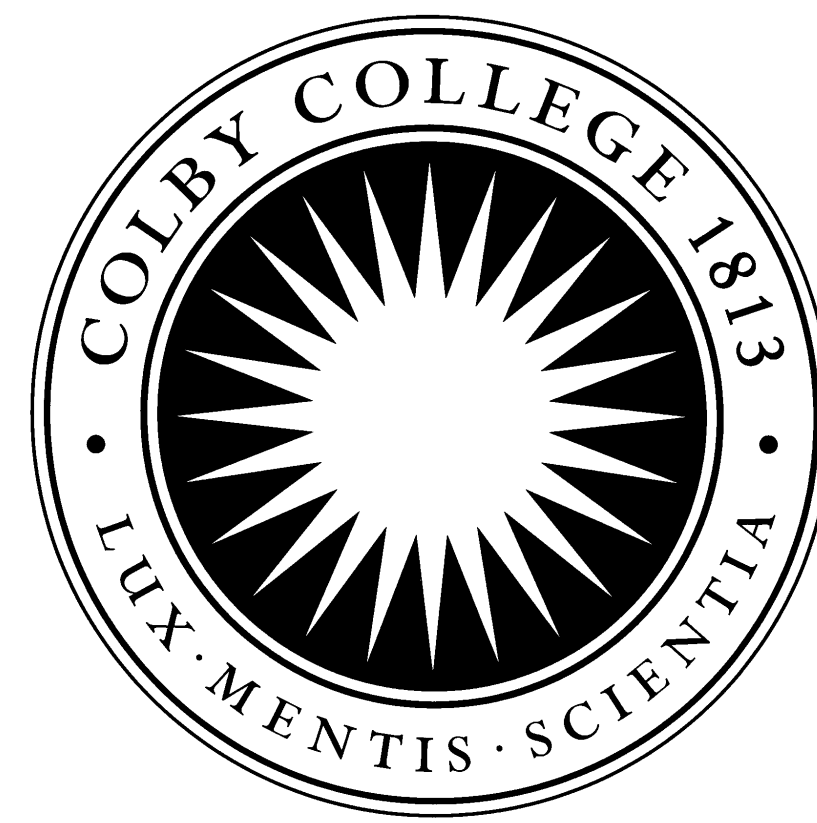
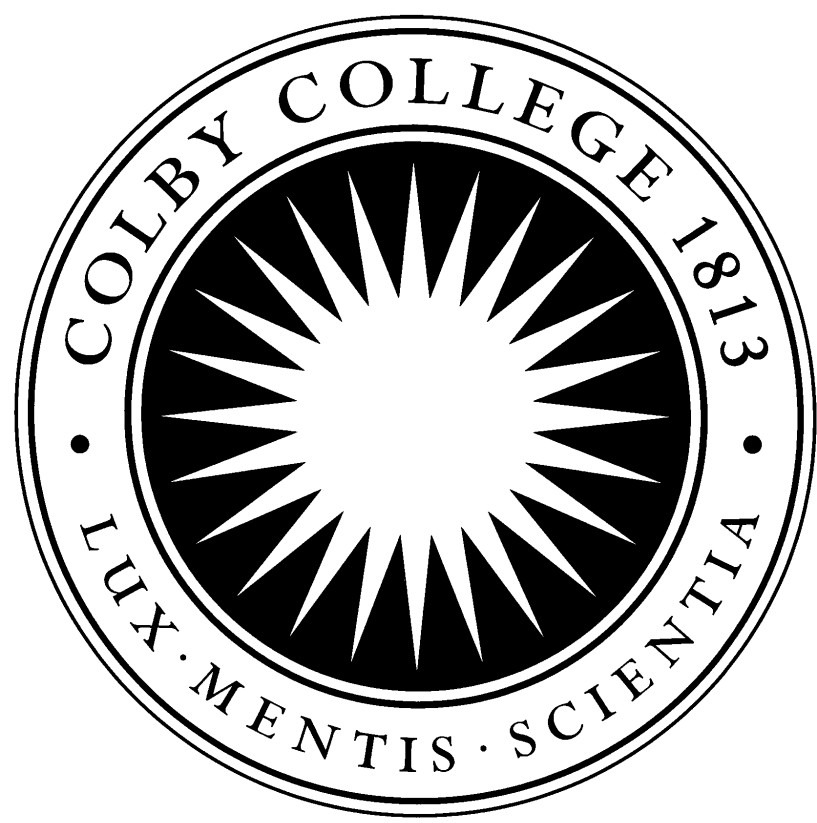
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The Conservation Implications of Climate Change on Predatory Mammal Distributions in North America and Europe:

A Three Case Study

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Environmental Studies Program, Colby College, Spring 2014

Introduction

- Climate change is having a profound effect on the world's ecosystems and is having a significant impact on the distributions of flora and fauna.
- Vegetation and animals are moving poleward, especially at higher latitudes. For example, tree lines in Siberia have shifted northward or upslope, and many of the distributions of terrestrial species have begun to follow this trend.
- Organisms living at higher latitudes will eventually run out of viable territory into which they can move, limiting future distributions.
- Determining the impacts of climate change on distributions of large terrestrial predators is critical to creating effective conservation plans.
- We considered future biome shifts, habitat preference, urban development, and locations of protected areas in North America and Europe to predict where the lynx (*Lynx spp.*), grey wolf (*Canis lupus spp.*), and brown bear (*Ursus arctos*) may be distributed in the future.
- We hypothesize that North American species will be better able to maintain stable populations compared to their European counterparts due to greater expanses of protected areas, less habitat fragmentation, lower human populations, and more established management plans.

Case Studies

GREY WOLF (*Canis lupus spp.*)

- Highly versatile species, once found all throughout North America and Europe.
- Distribution is highly limited due to anthropogenic development and conflict; human-wolf conflict is common throughout North America and Europe.
- Highly territorial and live in packs of 2-8 individuals
- Prefer ungulates, but they are known to eat beavers, rabbits, and other small prey.
- Most commonly found in northern forests, though they are also found in other environments including tundra, mountain areas, woodlands, and grasslands.
- Listed as least concern on IUCN Red List.

LYNX (*Lynx spp.*)

- Lynx canadensis* (Canada lynx) distributed throughout most of northern North America; *Lynx lynx* (Eurasian lynx) distributed in various regions of Europe.
- Mainly found in boreal forests but also live in temperate coniferous forests, mixed deciduous forests, and some shrubland biomes in the United States; distribution is correlated with snowfall on a regional scale.
- Canada lynx is a specialist predator of the snowshoe hare (*Lepus americanus*) and annual productivity is directly related to hare abundance; dominant prey of Eurasian lynx is medium sized ungulates.
- Have large home ranges and move over long distances; select home ranges at mid-elevations with low terrain variability and high canopy cover; movement decisions depend on forest vegetation, terrain variability and stand age.
- Eurasian lynx particularly vulnerable to factors affecting the genetic composition of its populations.
- Both Eurasian and Canada lynx listed as least concerned on IUCN Red List.

BROWN BEAR (*Ursus arctos*)

- Can live in boreal, coniferous, and deciduous forests, Arctic tundra, wetlands, arid conditions and various elevations
- Feed on fish (salmon & trout), moose, walruses, whales, deer, elk, ungulates, rodents, ants, fruit, roots, pine nuts, and herbaceous vegetation
- North American populations are mostly connected; European populations are very patchy due to specific managed areas and re-introduction efforts
- In North America have few human interactions and are aggressive because not adapted to living near humans; in Europe more frequent interactions because of small patches of heavily managed habitat with strong hunting pressures
- Both North American and European governments subsidized destruction of the species up until the early 1990's because of livestock destruction and safety; presently hunting includes managers and researchers, viewing the species as a harvestable-resource, which decreases illegal hunting
- Listed as least concern on IUCN Red List.

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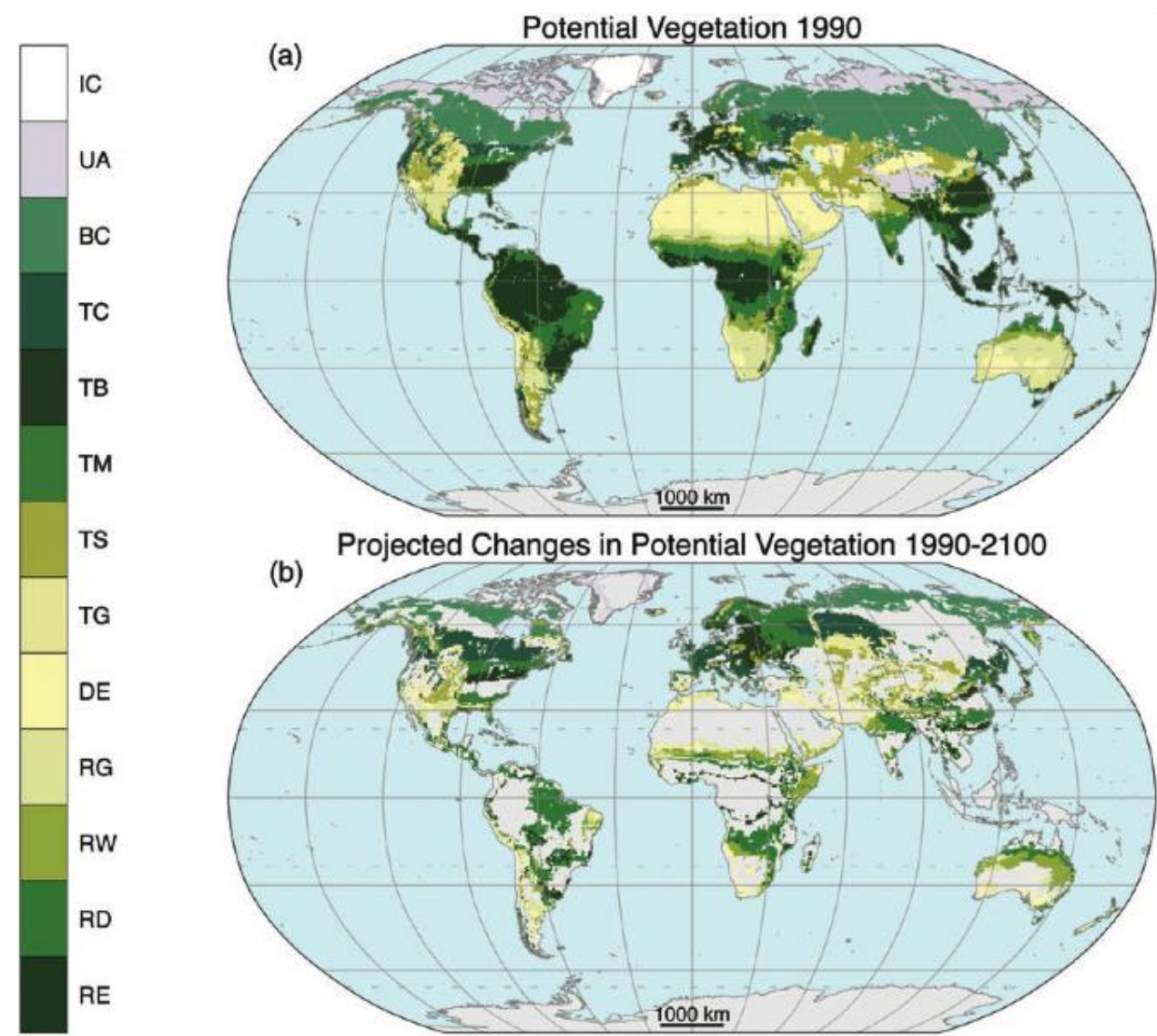


Figure 1. The current and projected global vegetation distributions. Biomes, in (a) and (b), from poles to equator: ice (IC), tundra and alpine (UA), boreal conifer forest (BC), temperate conifer forest (TC), temperate broadleaf forest (TB), temperate mixed forest (TM), temperate shrubland (TS), temperate grassland (TG), desert (DE), tropical grassland (RG), tropical woodland (RW), tropical deciduous broadleaf forest (RD), tropical evergreen broadleaf forest (RE) (Modified from Gonzalez et al. 2010).

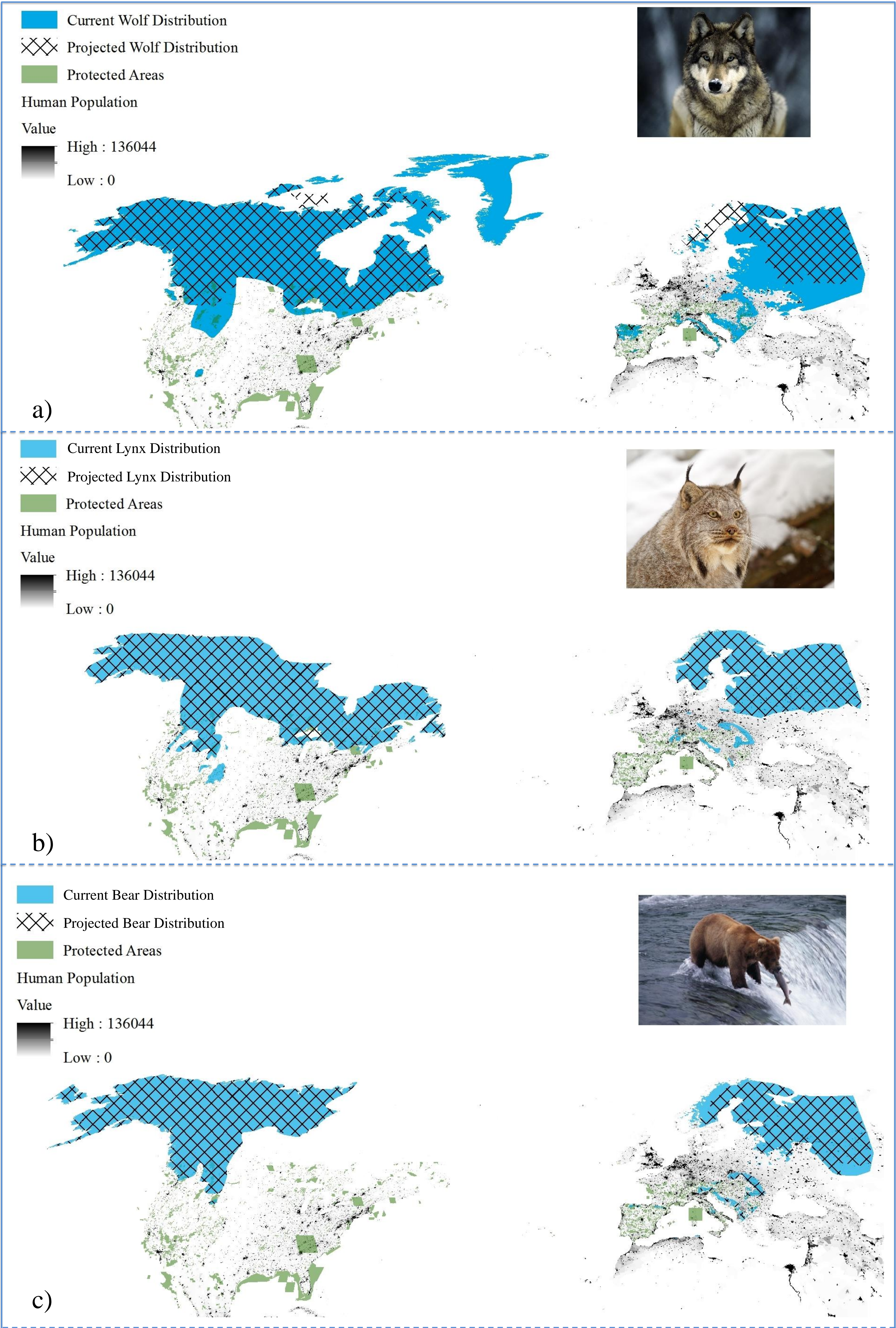


Figure 2. The current and projected distributions of the Grey Wolf (a), Lynx (b) and Brown Bear (c), taking into account biome shifts, protected areas, and human population.

Discussion

Overall, our predictions showed greater reductions in distribution size in Europe compared to North America due to:

- Higher population density
- Recent recovery from species decline has required re-introduction and translocation actions, resulting in patchy distributions
- Smaller, more fragmented protected areas
- More pronounced biome changes
- Greater need for international cooperation to manage species

We predict that wolves will suffer the greatest decrease in distribution, with lynx distributions changing slightly and bear populations remaining mostly intact because:

- Wolves reside in packs and are highly territorial, therefore requiring large home-ranges; distributions currently only found in coniferous forest and will therefore most likely follow the shift of this biome; they also are found in higher and lower latitudes than the lynx and bear, making them more susceptible.
- Lynx and wolves both feed on livestock, creating large tensions with human populations.
- Lynx feed mostly on snowshoe hare in North America and medium-sized ungulates in Europe, making their populations extremely dependent on these prey; they are also dependent on snow cover, although they are forest generalists.
- Bears are generalists both in terms of diet and habitat, resulting in the least amount of predicted change in terms of their distribution; they are also well managed by human populations.

Our predictions demonstrate how northern terrestrial mammals will be significantly affected by biome shift due to climate change, although the degree to which they will be affected will differ based on human interactions and whether they are generalists or specialists in terms of their habitat and diet.

Conservation

- More protected areas should be established in the northern extents of all three mammals, especially where human populations are high.
- The establishment of habitat corridors is essential to prevent conflict with and threats from humans as well as facilitate and ensure the successful movement of each mammal out of their unsuitable southern ranges to more northern areas in both North America and Europe; this is particularly important where distributions are patchy resulting in low gene flow.
- Due to its larger and denser human populations as well as historical conflicts with large predatory mammals, Europe will require stronger management plans and stricter enforcement of their laws to sustain populations of all three mammals.
- Effective international law will be crucial since these mammals travel across national borders, especially in Europe.

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