

Here Today, Gone Tomorrow:
Climate-Based Niche Modeling of
C. lupus, *C. elaphus*, *P.*
tremuloides, and *M. californicum*

Background

- Three-tiered predator-prey food chain
- Parasite-host relationship



Hypothesis: Significant Bioclimatic Variables

- *C. lupus*: BIO1 (Annual Mean Temperature)
- *C. elaphus*: BIO11 (Mean Temperature of the Coldest Quarter)
- *P. tremuloides*: BIO17 & BIO18 (Precipitation and Mean Temperature of the Warmest Quarter)
- *M. californicum*: BIO1 (Annual Mean Temperature)

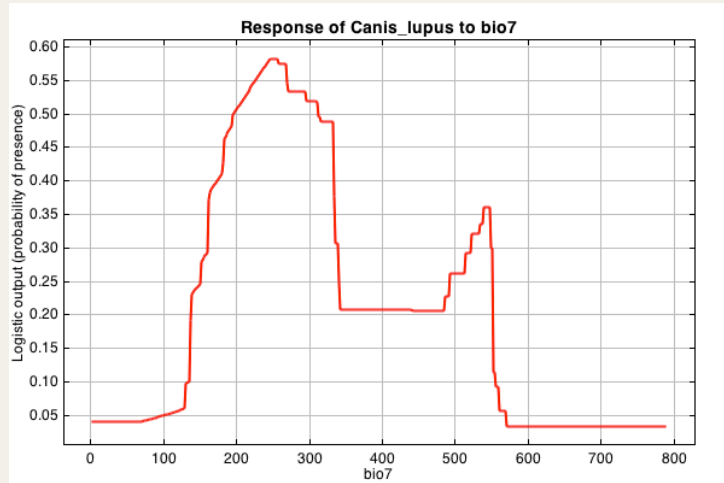
Hypothesis: Range Shifts

- *C. lupus*: decreased range size, moving towards the poles
- *C. elaphus*: decreased range size, moving northwards
- *P. tremuloides*: increased range size, shifting to areas less susceptible to drought
- *M. californicum*: decreased range size, moving northwards

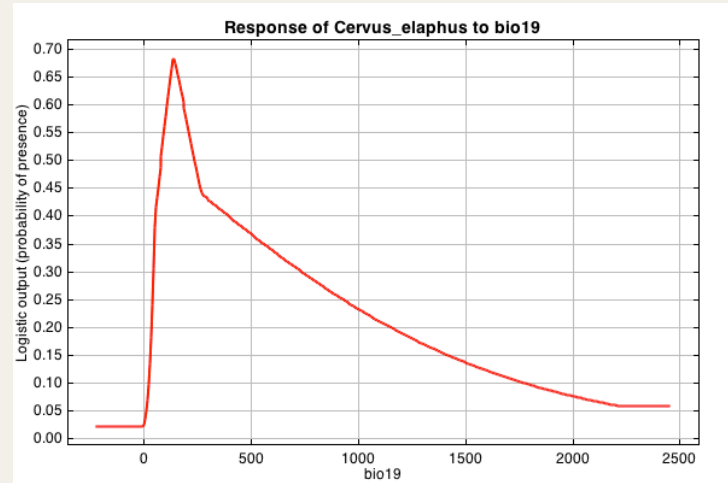
Hypothesis: Niche Overlap

- *C. lupus* and *C. elaphus*: decreased overlap due to decreased respective range sizes
- *P. tremuloides* and *M. californicum*: decreased overlap due to the sensitivity of *M. californicum* to temperature changes

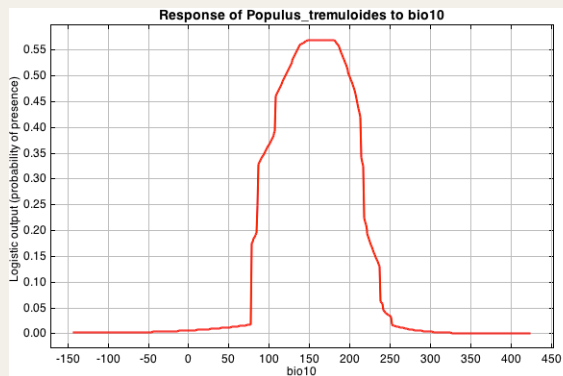
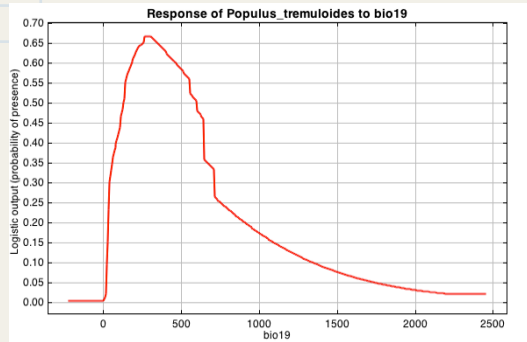
Results: Response Curves (Significant Bioclimatic Variables)



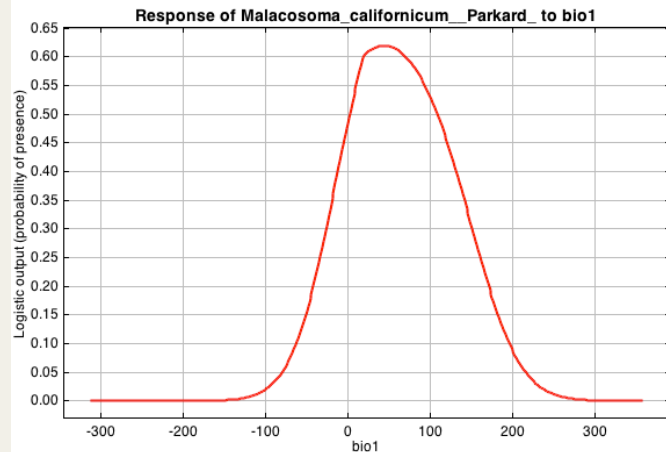
C. lupus
C. elaphus



Results: Response Curves (Significant Bioclimatic Variables)



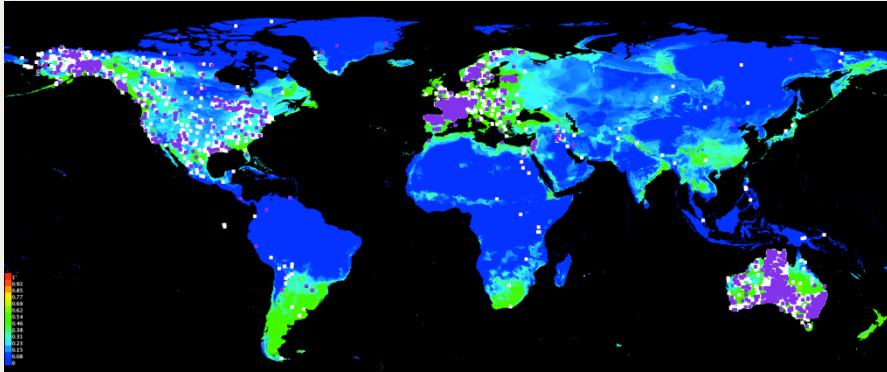
P. tremuloides



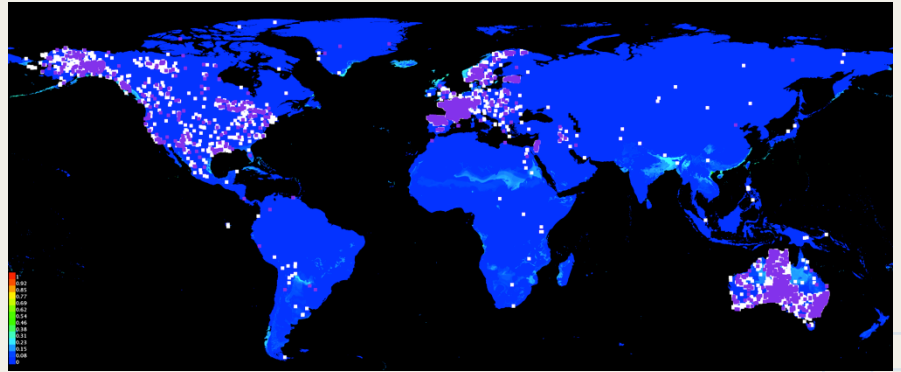
M. californicum

Results: Pictures of Model

C. lupus



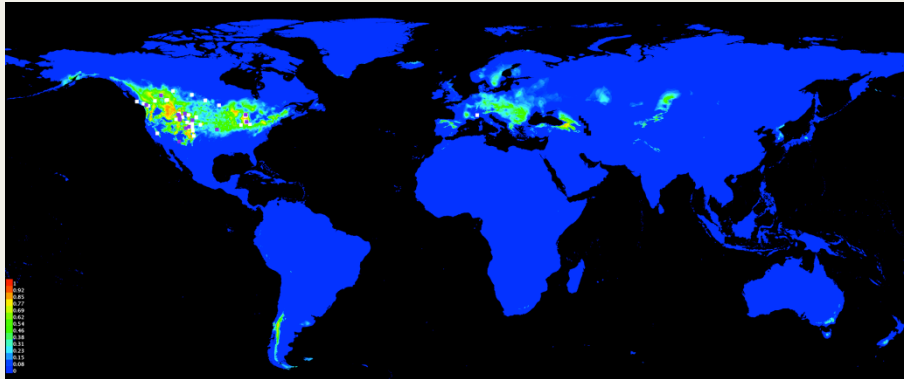
Present



Future

Results: Pictures of Model

C. elaphus



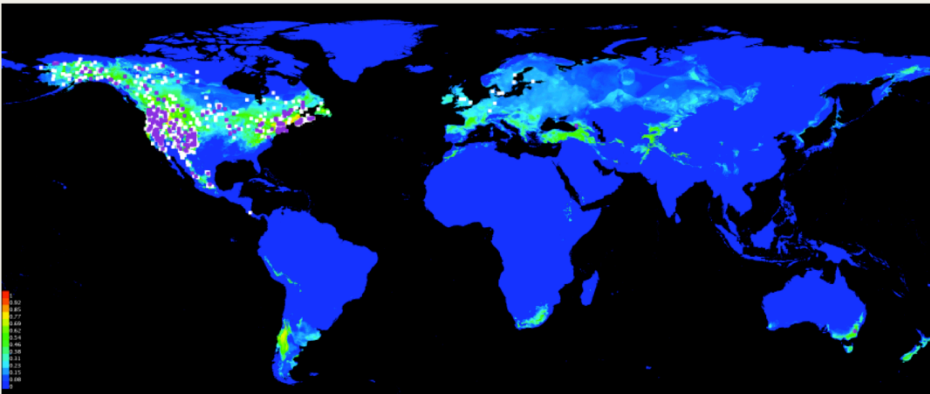
Present



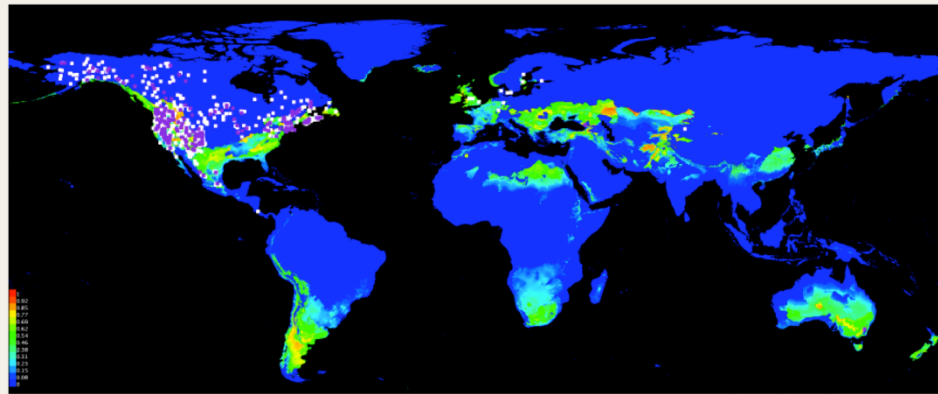
Future

Results: Pictures of Model

P. tremuloides



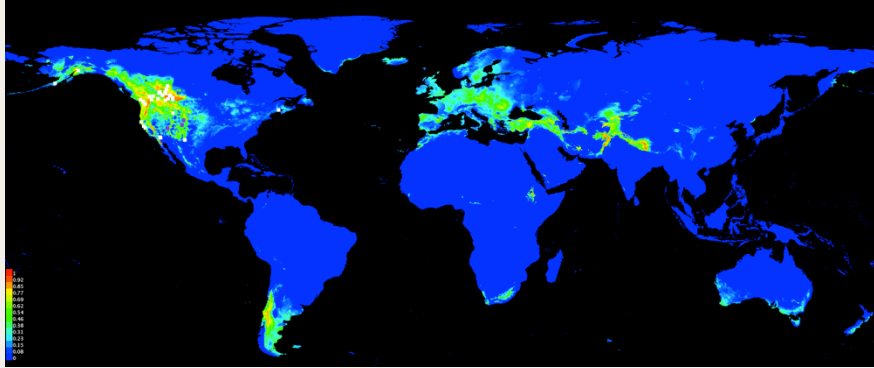
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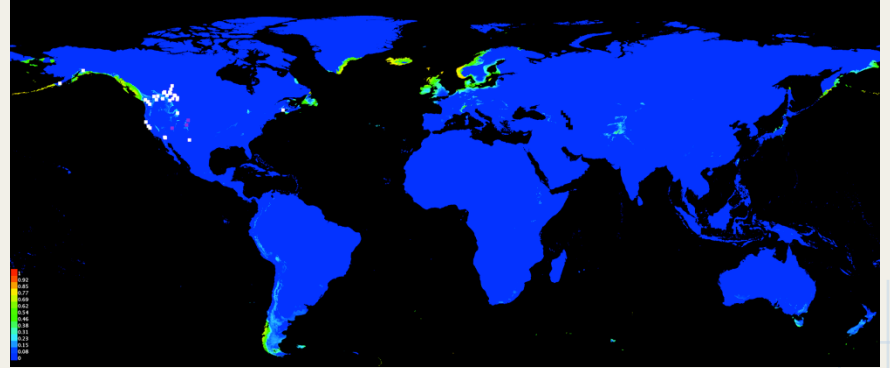
Future

Results: Pictures of Model

M. californicum



Present



Future

Results: Current and Future Range Size & % Land Cover

| Species | Current range size (km ²) | Current percentage of land cover (%) | Future range size (km ²) | Future percentage of land cover (%) |
|--------------------------------|---------------------------------------|--------------------------------------|--------------------------------------|-------------------------------------|
| <i>Canis lupus</i> | 3,982,770 | 2.66 | 1,860 | 0.00124 |
| <i>Cervus elaphus</i> | 735,920 | 0.49 | 119,340 | 0.080 |
| <i>Populus tremuloides</i> | 1,446,820 | 0.96 | 2,606,270 | 1.73 |
| <i>Malacosoma californicum</i> | 1,260,290 | 0.84 | 297,270 | 0.198 |

Results: Niche Overlap

P. tremuloides and M. californicum

| | Current | Future |
|--------|---------|--------|
| D Test | 0.6021 | 0.3627 |
| I Test | 0.8513 | 0.6533 |

C. lupus and C. elaphus

| | Current | Future |
|--------|---------|--------|
| D Test | 0.3098 | 0.1079 |
| I Test | 0.5737 | 0.2766 |

Take-Home Message

