

RangeMaps

2025-01-08

Location of files originally: <https://github.com/wpetry/USTreeAtlas> (<https://github.com/wpetry/USTreeAtlas>)

```
library(sp)
library(raster)
library(sf)
```

```
## Linking to GEOS 3.13.0, GDAL 3.10.0, PROJ 9.5.1; sf_use_s2() is TRUE
```

```
library(maps)
library(tidyverse)
```

```
## — Attaching core tidyverse packages —————— tidyverse 2.0.0 —
## ✓ dplyr     1.1.4      ✓ readr     2.1.5
## ✓forcats    1.0.0      ✓ stringr   1.5.1
## ✓ ggplot2   3.5.1      ✓ tibble    3.2.1
## ✓ lubridate 1.9.2      ✓ tidyverse  1.3.0
## ✓ purrr     1.0.2
```

```
## — Conflicts —————— tidyverse_conflicts() —
## ✘ tidyr::extract() masks raster::extract()
## ✘ dplyr::filter()  masks stats::filter()
## ✘ dplyr::lag()     masks stats::lag()
## ✘ purrr::map()     masks maps::map()
## ✘ dplyr::select()  masks raster::select()
## i Use the conflicted package (<http://conflicted.r-lib.org/>) to force all conflicts
to become errors
```

```
library(tigris)
```

```
## To enable caching of data, set `options(tigris_use_cache = TRUE)`
## in your R script or .Rprofile.
```

```
options(tigris_use_cache = TRUE)
library(CoordinateCleaner)
library(BIEN)
```

```
## Loading required package: RPostgreSQL
## Loading required package: DBI
## Type vignette("BIEN") or vignette("BIEN_tutorial") to get started
```

Read in the GBIF data points

```
gbif = read.csv("../Formatted.Data/gbif.filtered.csv")
```

Subset for Abies balsamea

```
ABBA.occ = gbif %>%
  filter(species == "Abies balsamea") %>%
  select(species,decimalLatitude,decimalLongitude)
```

Read in range map

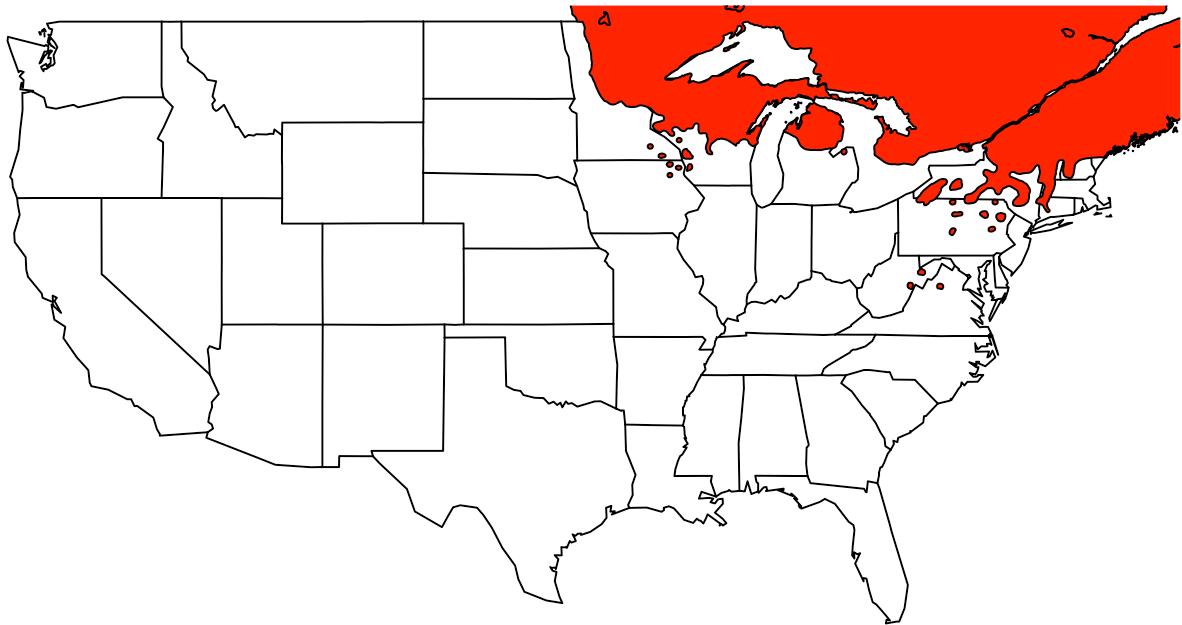
```
ABBA.range = st_read("../USTreeAtlas/shp/abiebals/")
```

```
## Reading layer `abiebals' from data source
##   `/Users/samanthaworthy/Documents/GitHub/USTreeAtlas/shp/abiebals'
##   using driver `ESRI Shapefile'
## Simple feature collection with 442 features and 5 fields
## Geometry type: POLYGON
## Dimension:      XY
## Bounding box:  xmin: -116.6732 ymin: 38.40429 xmax: -52.61445 ymax: 58.79789
## CRS:           NA
```

The projection is geographic with latitude and longitude. The datum is NAD27 which is EPSG:4267. The ellipsoid is Clarke 1866, and the transformation parameters

```
st_crs(ABBA.range) <- 4267
```

```
maps::map(database = "state")
plot(ABBA.range$geometry, col="red", add=T)
```



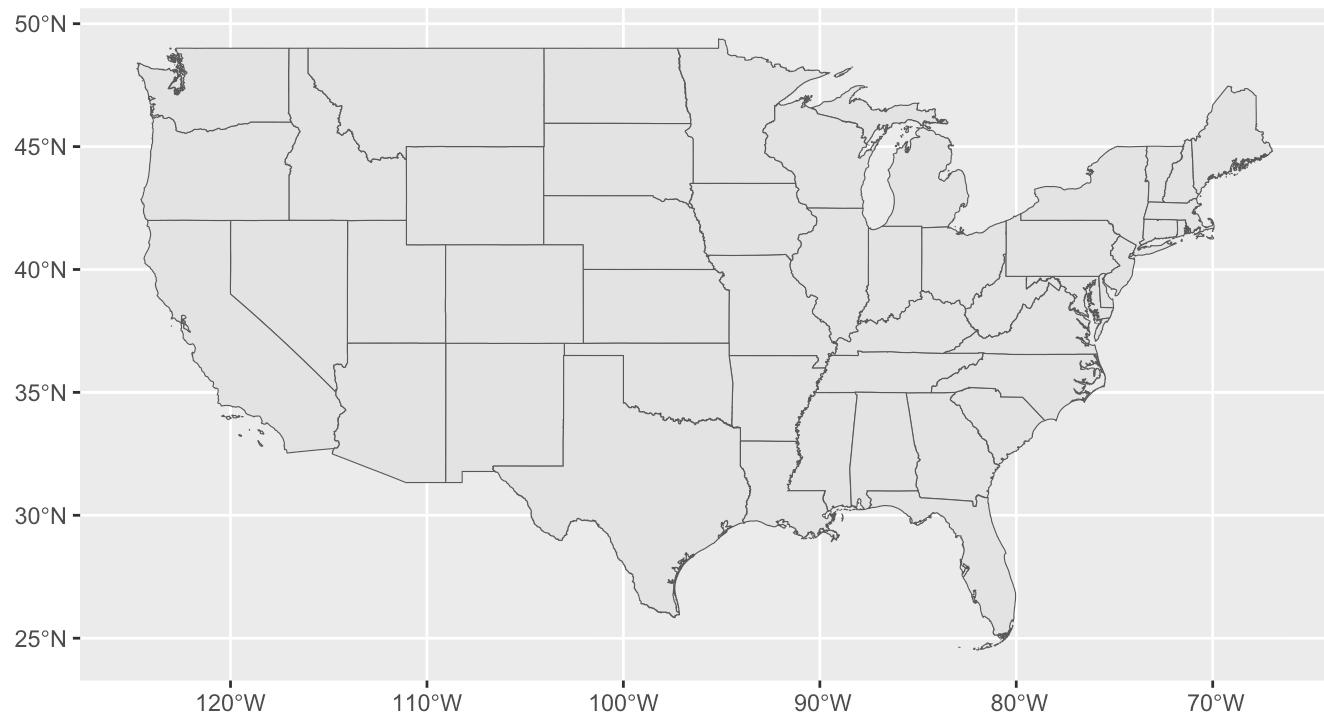
```
us_states <- states(cb = TRUE)
```

```
## Retrieving data for the year 2021
```

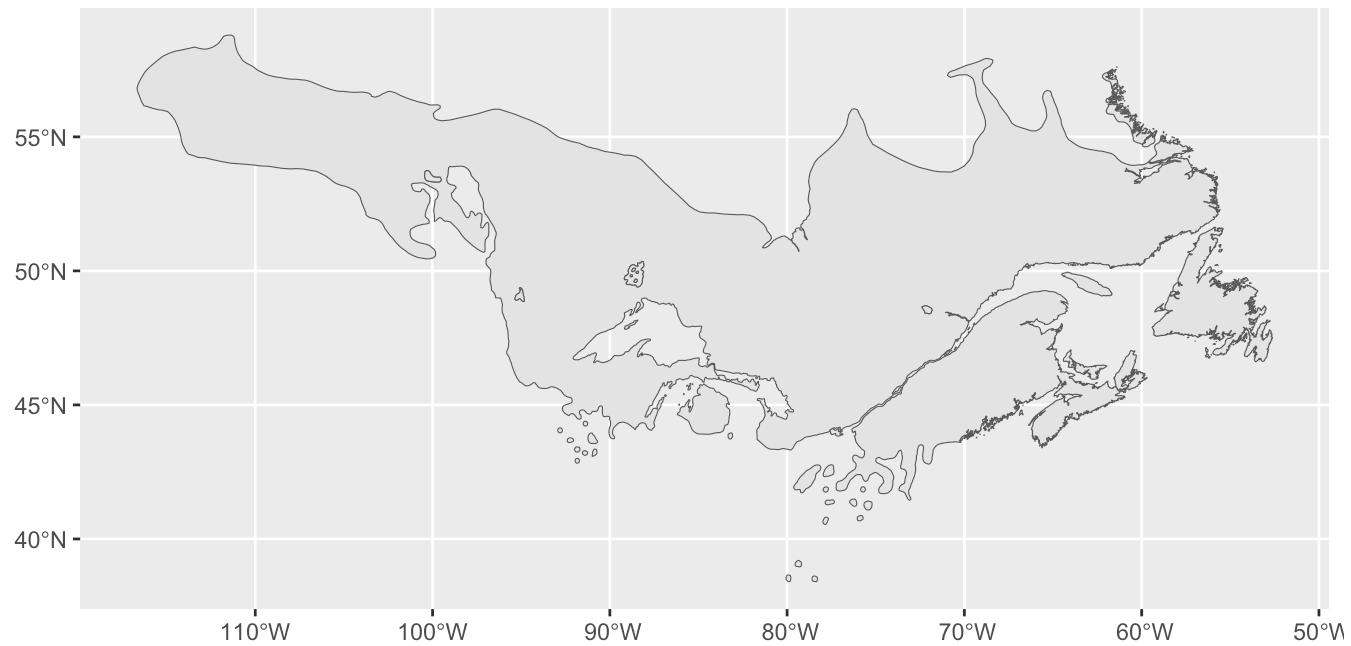
```
continental_states <- us_states %>%
  filter(!NAME %in% c("Alaska", "American Samoa", "Guam", "Commonwealth of the Northern Ma
riana Islands", "Hawaii", "United States Virgin Islands",
  "Puerto Rico"))
```

```
states.map = continental_states %>%
  st_as_sf %>%
  st_transform(st_crs(ABBA.range))
```

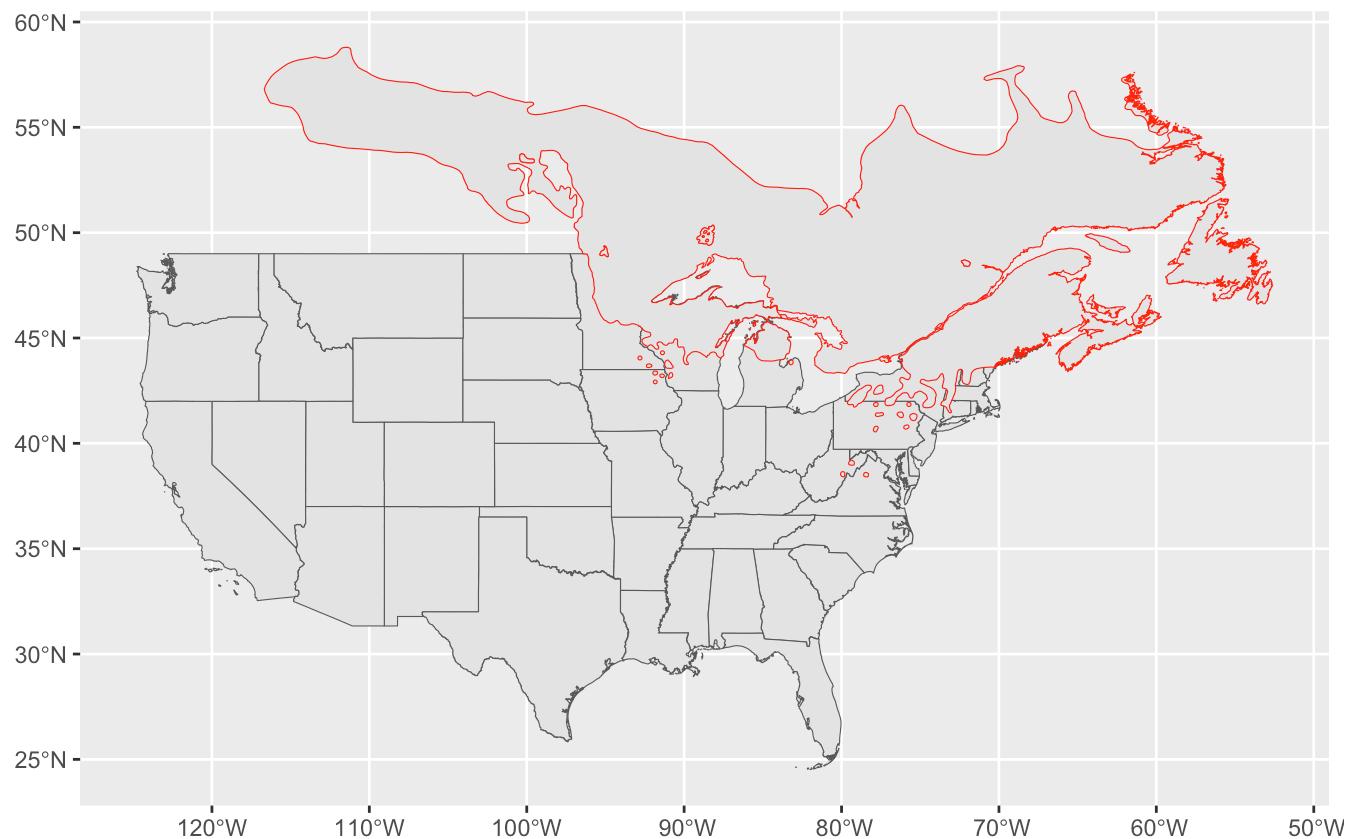
```
ggplot(states.map) +
  geom_sf()
```



```
ggplot(ABBA.range) +  
  geom_sf()
```



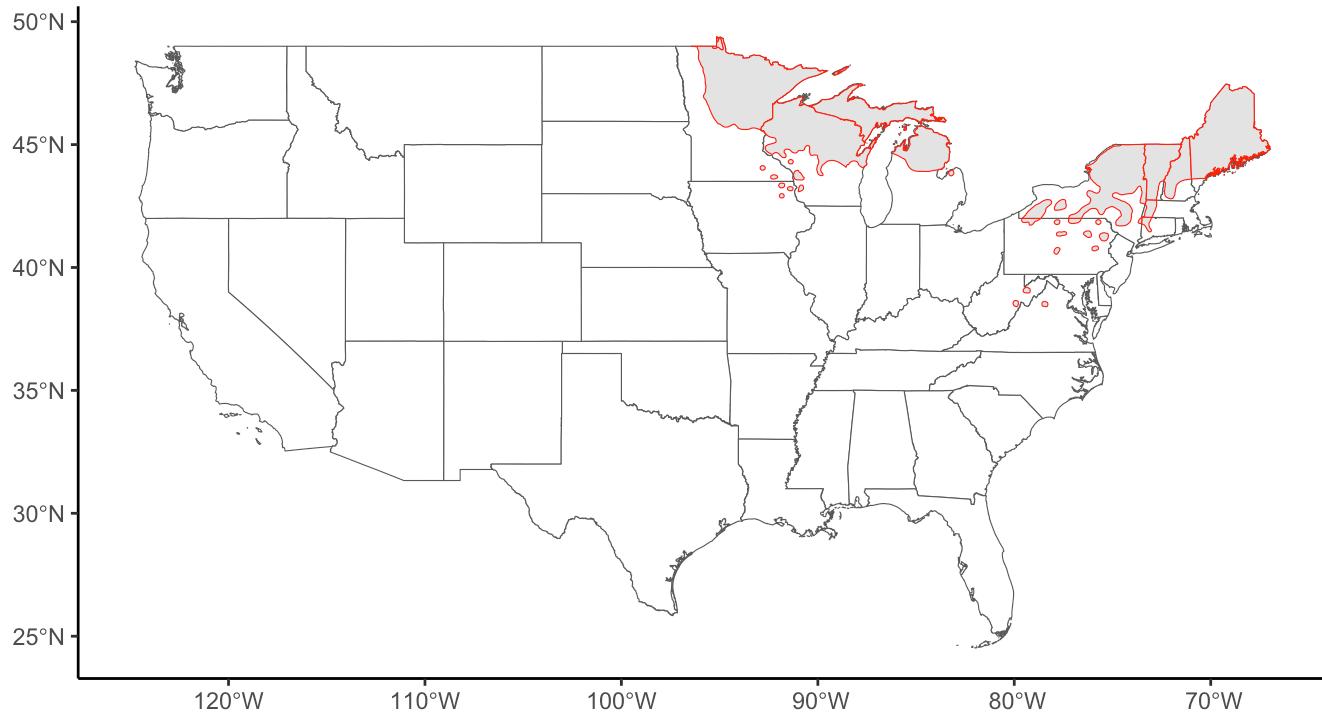
```
ggplot()+
  geom_sf(data = states.map)+
  geom_sf(data = ABBA.range, col = "red")
```



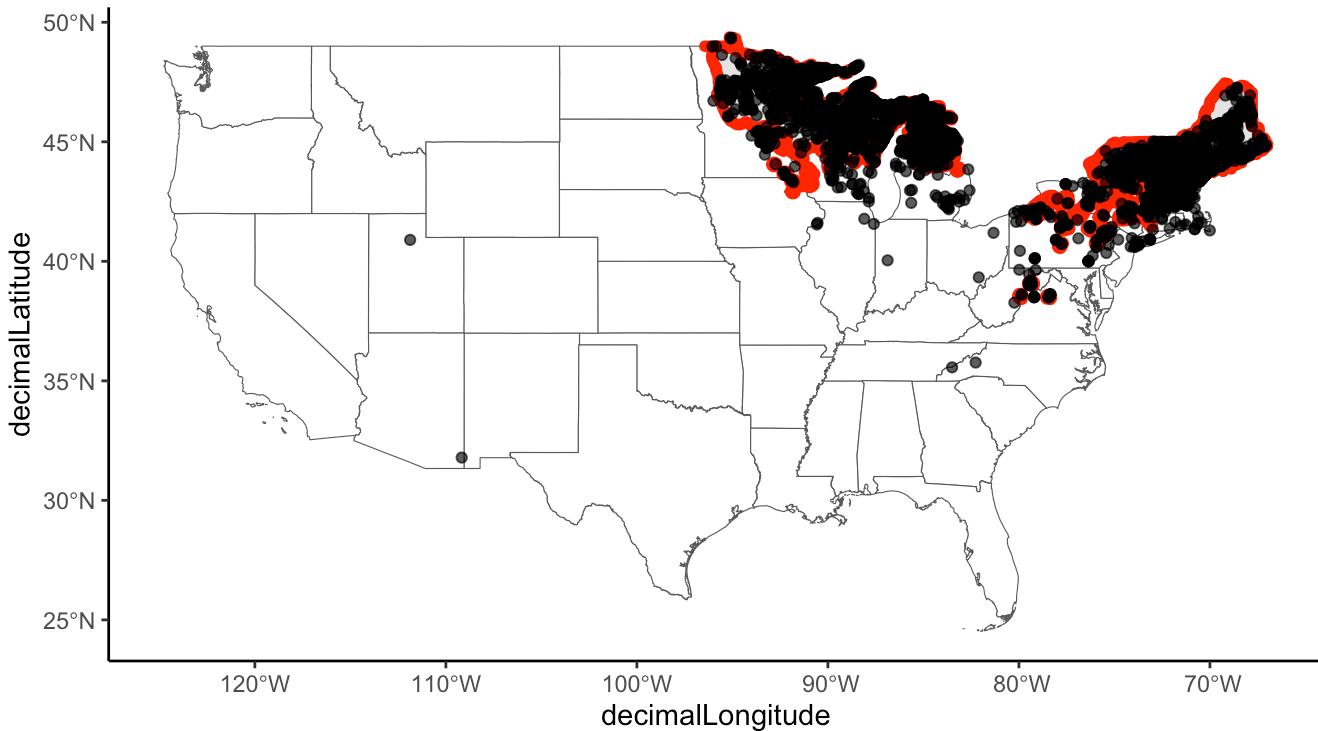
```
ABBA_clipped = st_intersection(ABBA.range, states.map)
```

```
## Warning: attribute variables are assumed to be spatially constant throughout  
## all geometries
```

```
ggplot() +  
  geom_sf(data = states.map, fill = "white") +  
  geom_sf(data = ABBA_clipped, col = "red") +  
  theme_classic()
```



```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = ABBA_clipped, col = "red", linewidth = 2)+
  geom_point(data = ABBA.occ, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
ABBA_clipped$species = "Abies balsamea"
ABBA_flag = cc_iucn(x = ABBA.occ, range = ABBA_clipped, lon = "decimalLongitude", lat =
"decimalLatitude",
                     value = "flagged", buffer = 50000)
```

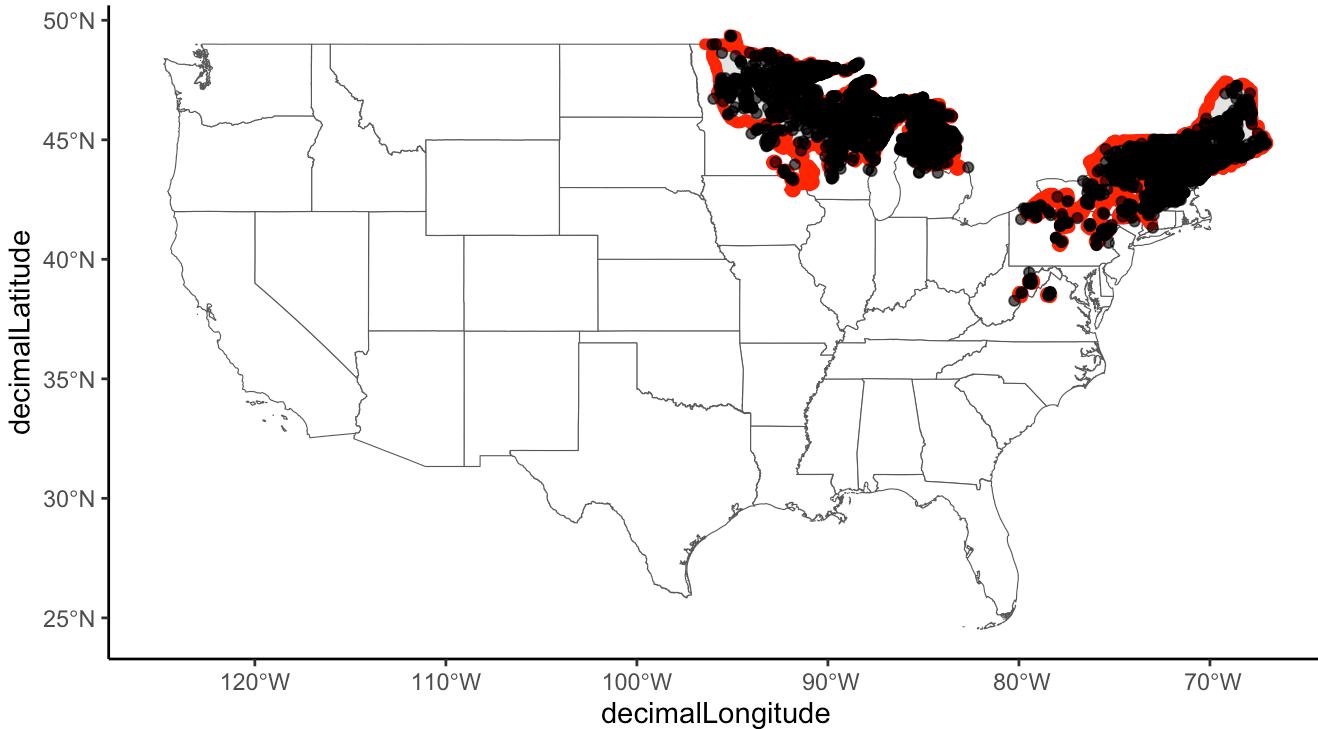
```
## Testing natural ranges
```

```
## Warning in cc_iucn(x = ABBA.occ, range = ABBA_clipped, lon =
## "decimalLongitude", : reprojecting reference to '+proj=longlat +datum=WGS84
## +no_defs'
```

```
## Flagged 148 records.
```

```
ABBA_occ_final = ABBA.occ[ABBA_flag, ]
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = ABBA_clipped, col = "red", linewidth = 2)+
  geom_point(data = ABBA_occ_final, aes(x = decimalLongitude, y = decimalLatitude), colo
r = "black", alpha = 0.7)+
  theme_classic()
```



```
ggsave("../Plots/ABBA.range.pdf", width = 12, height = 8)
```

Repeat basics of steps above for all other species

Subset for *Abies fraseri*

```
ABFR.occ = gbif %>%
  filter(species == "Abies fraseri") %>%
  select(species,decimalLatitude,decimalLongitude)
```

Read in range map

```
ABFR.range = st_read("../USTreeAtlas/shp/abiefras/")
```

```
## Reading layer `abiefras` from data source
##   `/Users/samanthaworthy/Documents/GitHub/USTreeAtlas/shp/abiefras'
##   using driver `ESRI Shapefile'
## Simple feature collection with 8 features and 5 fields
## Geometry type: POLYGON
## Dimension:     XY
## Bounding box:  xmin: -83.82256 ymin: 35.03492 xmax: -81.02652 ymax: 37.00807
## CRS:           NA
```

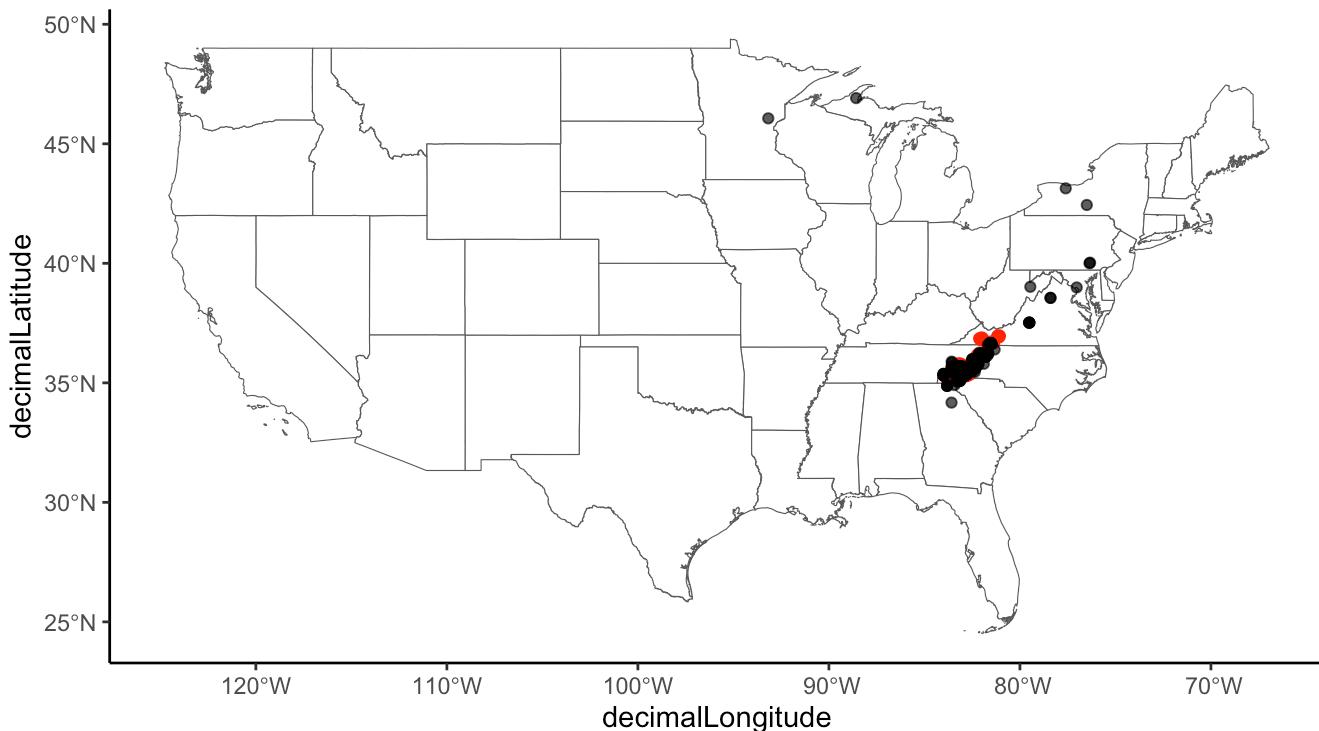
The projection is geographic with latitude and longitude. The datum is NAD27 which is EPSG:4267. The ellipsoid is Clarke 1866, and the transformation parameters

```
st_crs(ABFR.range) <- 4267
```

```
ABFR_clipped = st_intersection(ABFR.range, states.map)
```

```
## Warning: attribute variables are assumed to be spatially constant throughout
## all geometries
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = ABFR_clipped, col = "red", linewidth = 2)+
  geom_point(data = ABFR.occ, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
ABFR_clipped$species = "Abies fraseri"
ABFR_flag = cc_iucn(x = ABFR.occ, range = ABFR_clipped, lon = "decimalLongitude", lat =
"decimalLatitude",
                     value = "flagged", buffer = 50000)
```

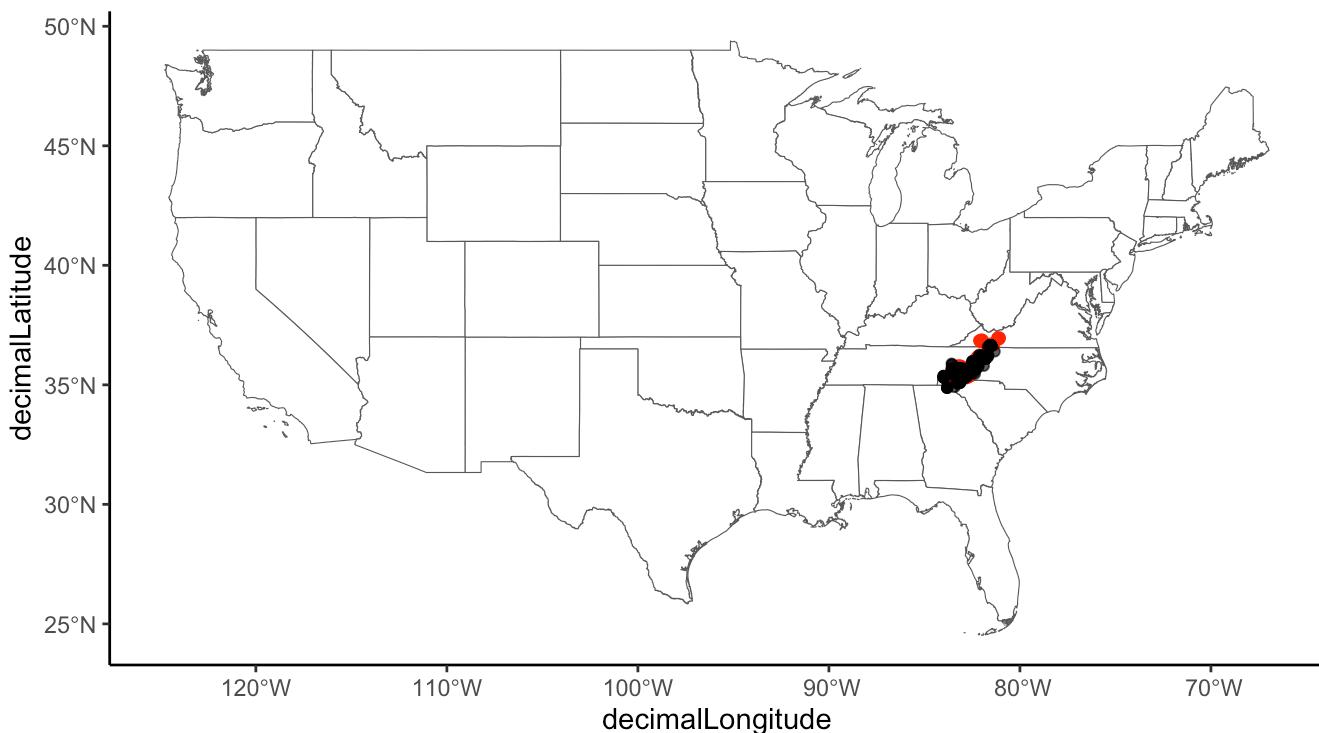
```
## Testing natural ranges
```

```
## Warning in cc_iucn(x = ABFR.occ, range = ABFR_clipped, lon =
## "decimalLongitude", : reprojecting reference to '+proj=longlat +datum=WGS84
## +no_defs'
```

```
## Flagged 15 records.
```

```
ABFR_occ_final = ABFR.occ[ABFR_flag, ]
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = ABFR_clipped, col = "red", linewidth = 2)+
  geom_point(data = ABFR_occ_final, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
ggsave("../Plots/ABFR.range.pdf", width = 12, height = 8)
```

Subset for *Acer barbatum*

```
ACBA3.occ = gbif %>%
  filter(species == "Acer barbatum") %>%
  select(species,decimalLatitude,decimalLongitude)
```

Read in range map

```
ACBA3.range = st_read("../USTreeAtlas/shp/acerbarb/")
```

```
## Reading layer `acerbarb' from data source
##   '/Users/samanthaworthy/Documents/GitHub/USTreeAtlas/shp/acerbarb'
##   using driver `ESRI Shapefile'
## Simple feature collection with 21 features and 5 fields
## Geometry type: POLYGON
## Dimension:     XY
## Bounding box:  xmin: -98.45653 ymin: 28.42883 xmax: -76.26695 ymax: 37.3846
## CRS:           NA
```

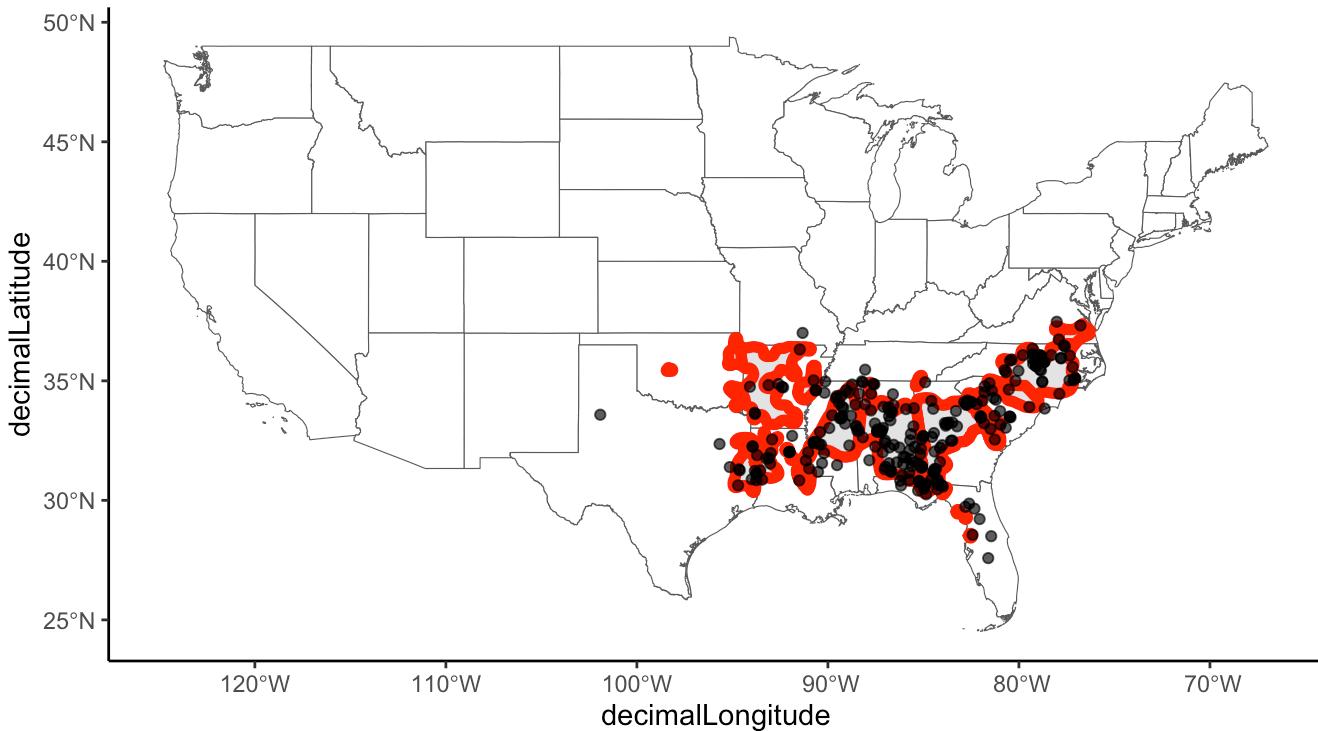
The projection is geographic with latitude and longitude. The datum is NAD27 which is EPSG:4267. The ellipsoid is Clarke 1866, and the transformation parameters

```
st_crs(ACBA3.range) <- 4267
```

```
ACBA3_clipped = st_intersection(ACBA3.range, states.map)
```

```
## Warning: attribute variables are assumed to be spatially constant throughout
## all geometries
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = ACBA3_clipped, col = "red", linewidth = 2)+
  geom_point(data = ACBA3.occ, aes(x = decimalLongitude, y = decimalLatitude), color =
"black", alpha = 0.7)+
  theme_classic()
```



```
ACBA3_clipped$species = "Acer barbatum"
ACBA3_flag = cc_iucn(x = ACBA3.occ, range = ACBA3_clipped, lon = "decimalLongitude", lat = "decimalLatitude",
= "flagged", buffer = 50000)
```

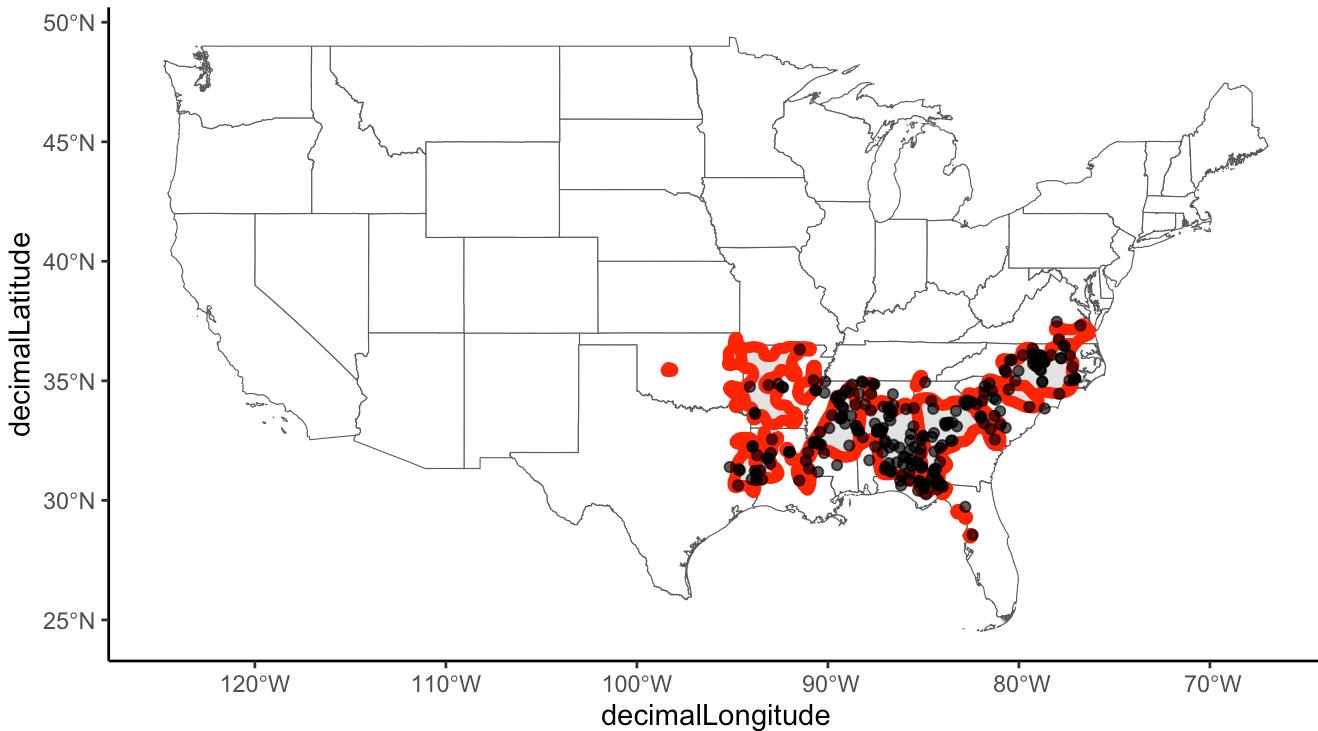
```
## Testing natural ranges
```

```
## Warning in cc_iucn(x = ACBA3.occ, range = ACBA3_clipped, lon =
## "decimalLongitude", : reprojecting reference to '+proj=longlat +datum=WGS84
## +no_defs'
```

```
## Flagged 14 records.
```

```
ACBA3_occ_final = ACBA3.occ[ACBA3_flag, ]
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = ACBA3_clipped, col = "red", linewidth = 2)+
  geom_point(data = ACBA3_occ_final, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
ggsave("../Plots/ACBA3.range.pdf", width = 12, height = 8)
```

Subset for *Acer leucoderme*

```
ACLE.occ = gbif %>%
  filter(species == "Acer leucoderme") %>%
  select(species,decimalLatitude,decimalLongitude)
```

Read in range map

```
ACLE.range = st_read("../USTreeAtlas/shp/acerleuc/")
```

```
## Reading layer `acerleuc' from data source
##   `/Users/samanthaworthy/Documents/GitHub/USTreeAtlas/shp/acerleuc'
##   using driver `ESRI Shapefile'
## Simple feature collection with 21 features and 5 fields
## Geometry type: POLYGON
## Dimension:     XY
## Bounding box:  xmin: -95.10542 ymin: 30.2384 xmax: -78.57996 ymax: 36.43029
## CRS:           NA
```

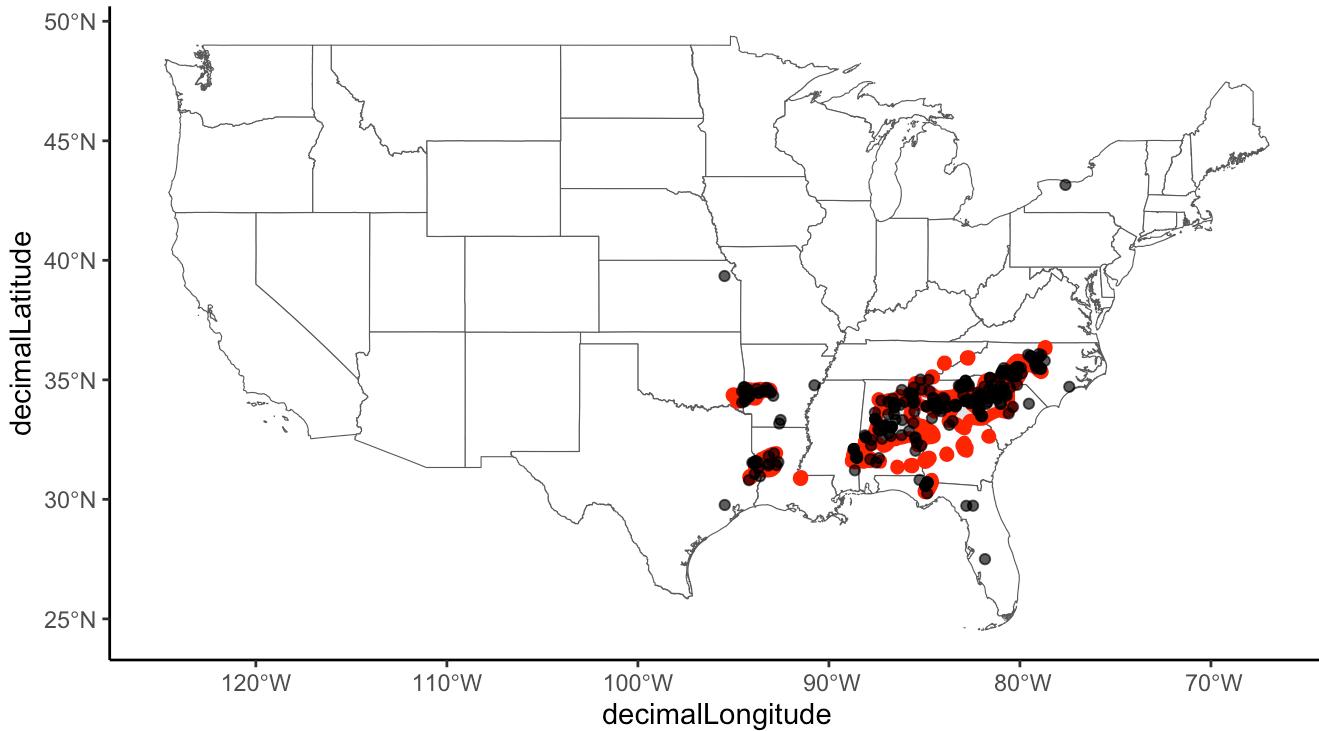
The projection is geographic with latitude and longitude. The datum is NAD27 which is EPSG:4267. The ellipsoid is Clarke 1866, and the transformation parameters

```
st_crs(ACLE.range) <- 4267
```

```
ACLE_clipped = st_intersection(ACLE.range, states.map)
```

```
## Warning: attribute variables are assumed to be spatially constant throughout
## all geometries
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = ACLE_clipped, col = "red", linewidth = 2)+
  geom_point(data = ACLE.occ, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
ACLE_clipped$species = "Acer leucoderme"
ACLE_flag = cc_iucn(x = ACLE.occ, range = ACLE_clipped, lon = "decimalLongitude", lat =
"decimalLatitude",
                     value = "flagged", buffer = 50000)
```

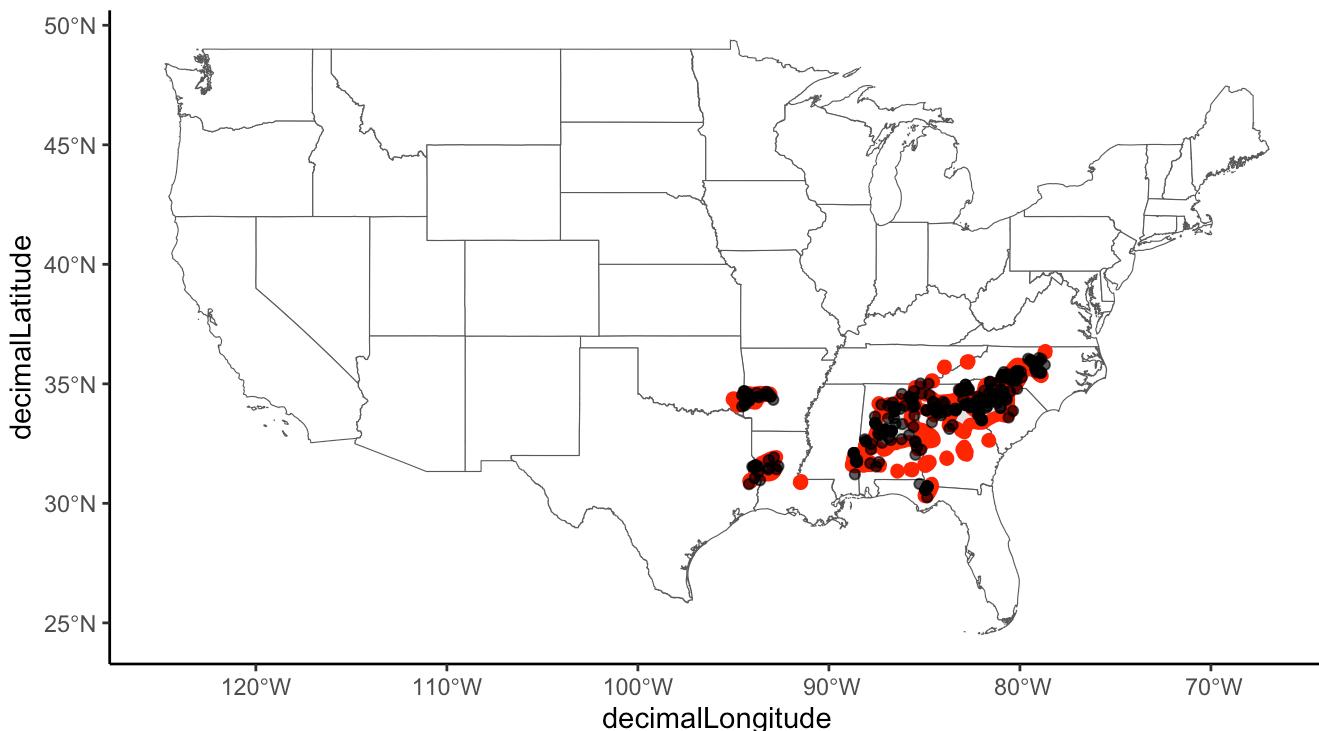
```
## Testing natural ranges
```

```
## Warning in cc_iucn(x = ACLE.occ, range = ACLE_clipped, lon =
## "decimalLongitude", : reprojecting reference to '+proj=longlat +datum=WGS84
## +no_defs'
```

```
## Flagged 11 records.
```

```
ACLE_occ_final = ACLE.occ[ACLE_flag, ]
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = ACLE_clipped, col = "red", linewidth = 2)+
  geom_point(data = ACLE_occ_final, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
ggsave("../Plots/ACLE.range.pdf", width = 12, height = 8)
```

Subset for Acer negundo

```
ACNE3.occ = gbif %>%
  filter(species == "Acer negundo") %>%
  select(species,decimalLatitude,decimalLongitude)
```

Read in range map

```
ACNE3.range = st_read("../USTreeAtlas/shp/acernegu/")
```

```
## Reading layer `acernegu' from data source
##   `/Users/samanthaworthy/Documents/GitHub/USTreeAtlas/shp/acernegu'
##   using driver `ESRI Shapefile'
## Simple feature collection with 114 features and 5 fields
## Geometry type: POLYGON
## Dimension:      XY
## Bounding box:  xmin: -123.3583 ymin: 28.30204 xmax: -67.68153 ymax: 54.28115
## CRS:           NA
```

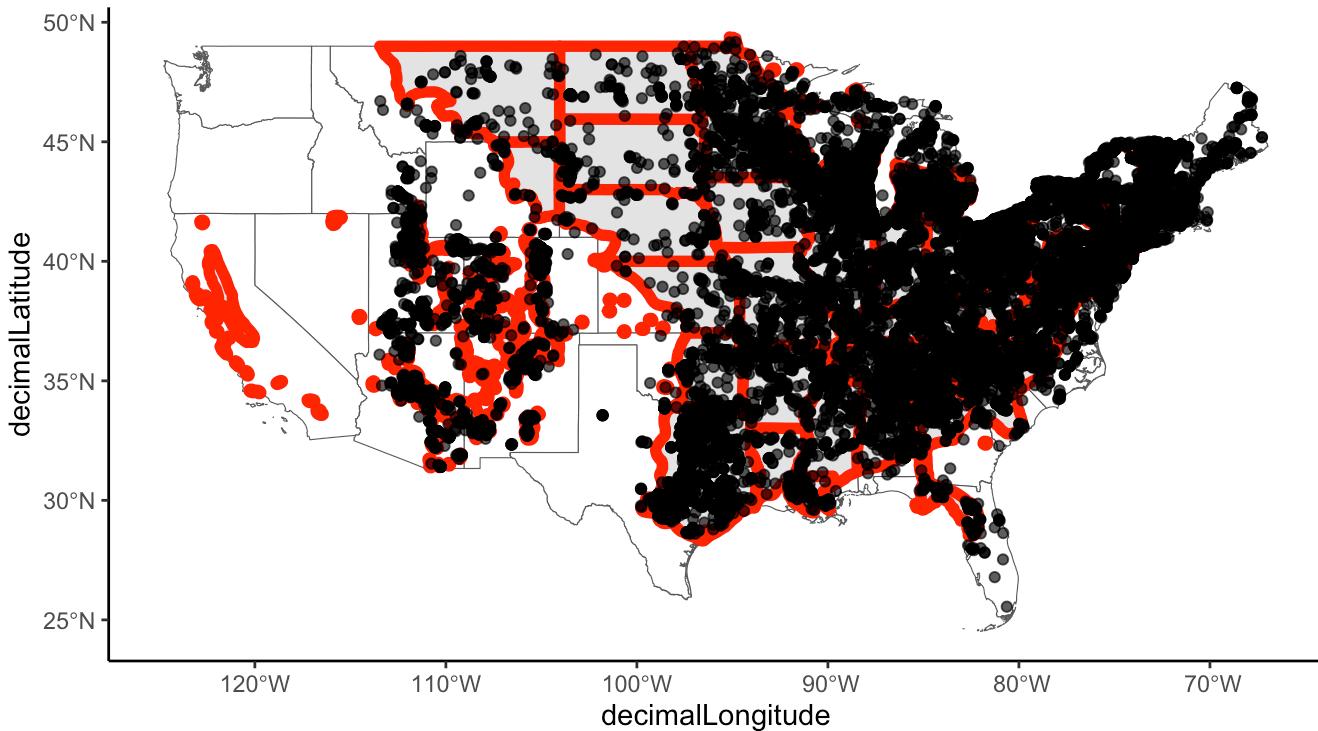
The projection is geographic with latitude and longitude. The datum is NAD27 which is EPSG:4267. The ellipsoid is Clarke 1866, and the transformation parameters

```
st_crs(ACNE3.range) <- 4267
```

```
ACNE3_clipped = st_intersection(ACNE3.range, states.map)
```

```
## Warning: attribute variables are assumed to be spatially constant throughout
## all geometries
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = ACNE3_clipped, col = "red", linewidth = 2)+
  geom_point(data = ACNE3.occ, aes(x = decimalLongitude, y = decimalLatitude), color =
"black", alpha = 0.7)+
  theme_classic()
```



```
ACNE3_clipped$species = "Acer negundo"
ACNE3_flag = cc_iucn(x = ACNE3.occ, range = ACNE3_clipped, lon = "decimalLongitude", lat = "decimalLatitude",
                      value = "flagged", buffer = 50000)
```

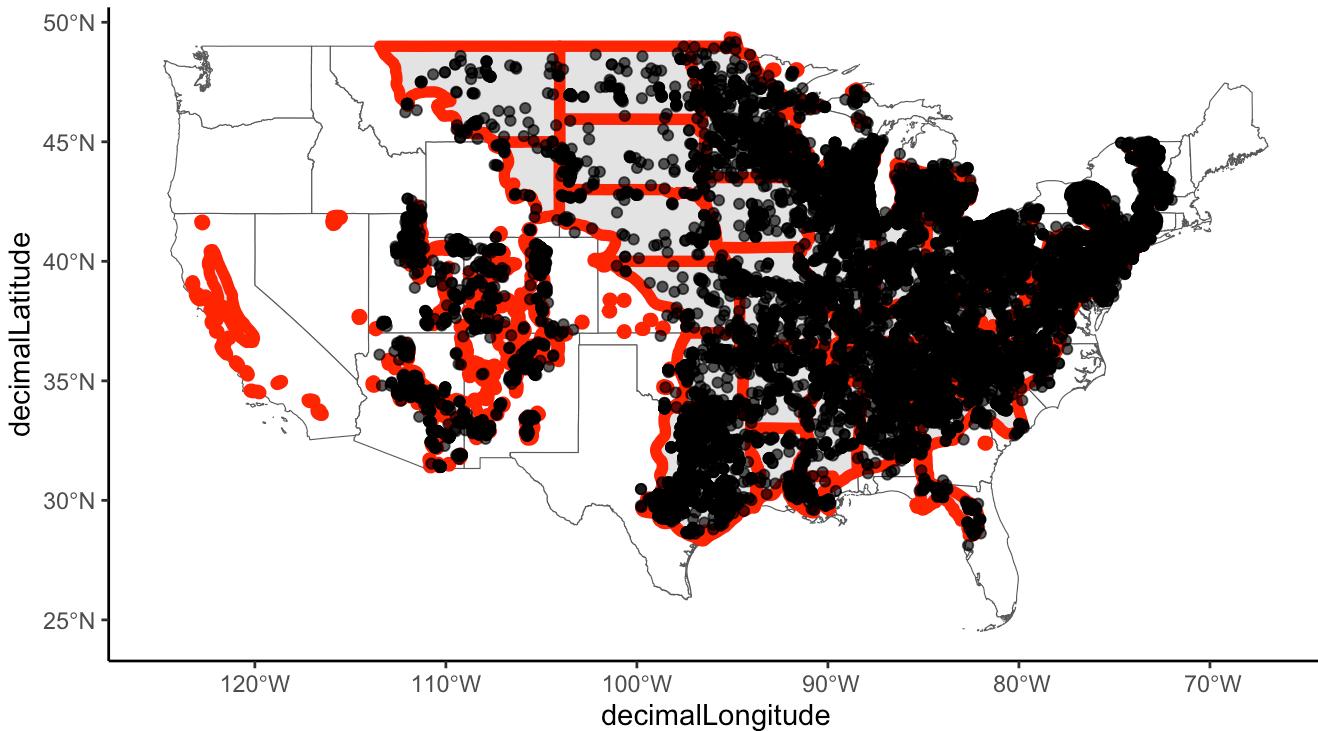
```
## Testing natural ranges
```

```
## Warning in cc_iucn(x = ACNE3.occ, range = ACNE3_clipped, lon =
## "decimalLongitude", : reprojecting reference to '+proj=longlat +datum=WGS84
## +no_defs'
```

```
## Flagged 4422 records.
```

```
ACNE3_occ_final = ACNE3.occ[ACNE3_flag, ]
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = ACNE3_clipped, col = "red", linewidth = 2)+
  geom_point(data = ACNE3_occ_final, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
ggsave("../Plots/ACNE3.range.pdf", width = 12, height = 8)
```

Subset for *Acer nigrum*

```
ACNI5.occ = gbif %>%
  filter(species == "Acer nigrum") %>%
  select(species,decimalLatitude,decimalLongitude)
```

Read in range map

```
ACNI5.range = st_read("../USTreeAtlas/shp/acernigr/")
```

```
## Reading layer `acernigr` from data source
##   `/Users/samanthaworthy/Documents/GitHub/USTreeAtlas/shp/acernigr'
##   using driver `ESRI Shapefile'
## Simple feature collection with 92 features and 5 fields
## Geometry type: POLYGON
## Dimension:     XY
## Bounding box:  xmin: -96.94963 ymin: 35.15816 xmax: -72.13584 ymax: 45.95228
## CRS:           NA
```

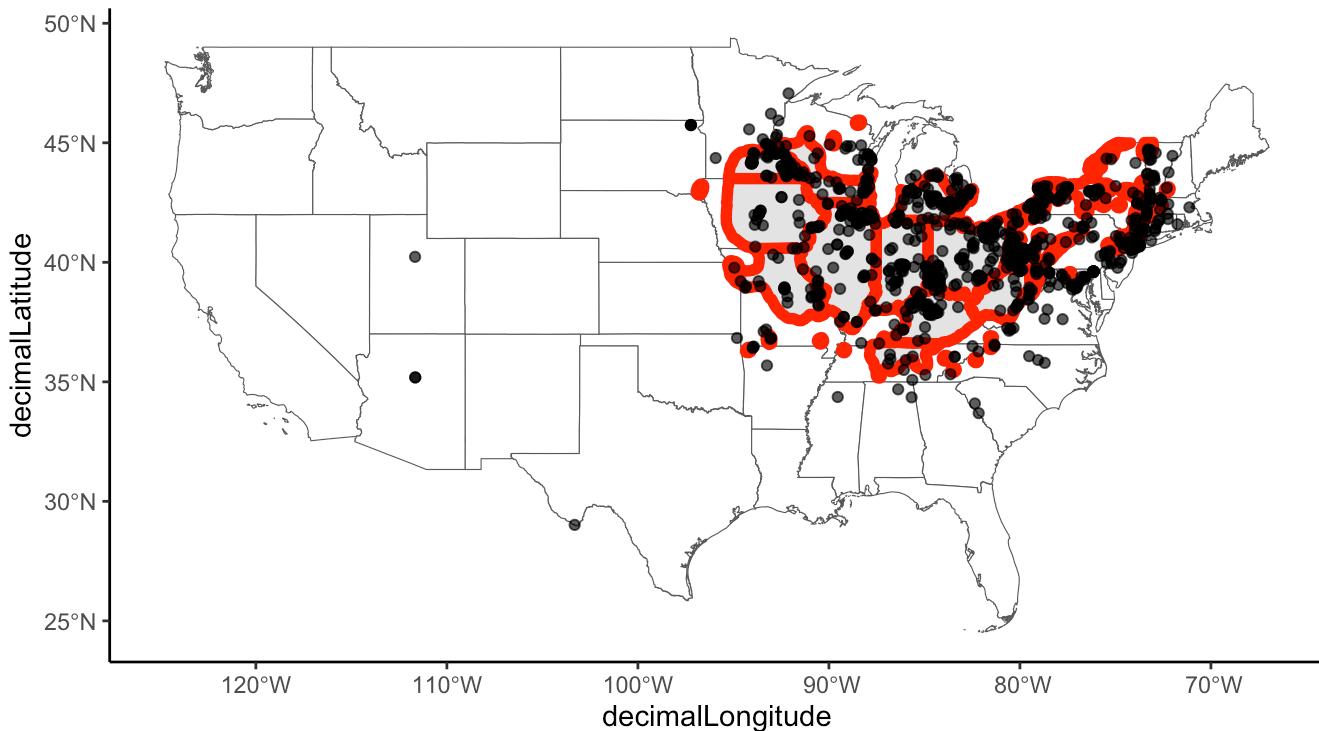
The projection is geographic with latitude and longitude. The datum is NAD27 which is EPSG:4267. The ellipsoid is Clarke 1866, and the transformation parameters

```
st_crs(ACNI5.range) <- 4267
```

```
ACNI5_clipped = st_intersection(ACNI5.range, states.map)
```

```
## Warning: attribute variables are assumed to be spatially constant throughout
## all geometries
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = ACNI5_clipped, col = "red", linewidth = 2)+
  geom_point(data = ACNI5.occ, aes(x = decimalLongitude, y = decimalLatitude), color =
"black", alpha = 0.7)+
  theme_classic()
```



```
ACNI5_clipped$species = "Acer nigrum"
ACNI5_flag = cc_iucn(x = ACNI5.occ, range = ACNI5_clipped, lon = "decimalLongitude", lat =
"decimalLatitude",
                      value = "flagged", buffer = 50000)
```

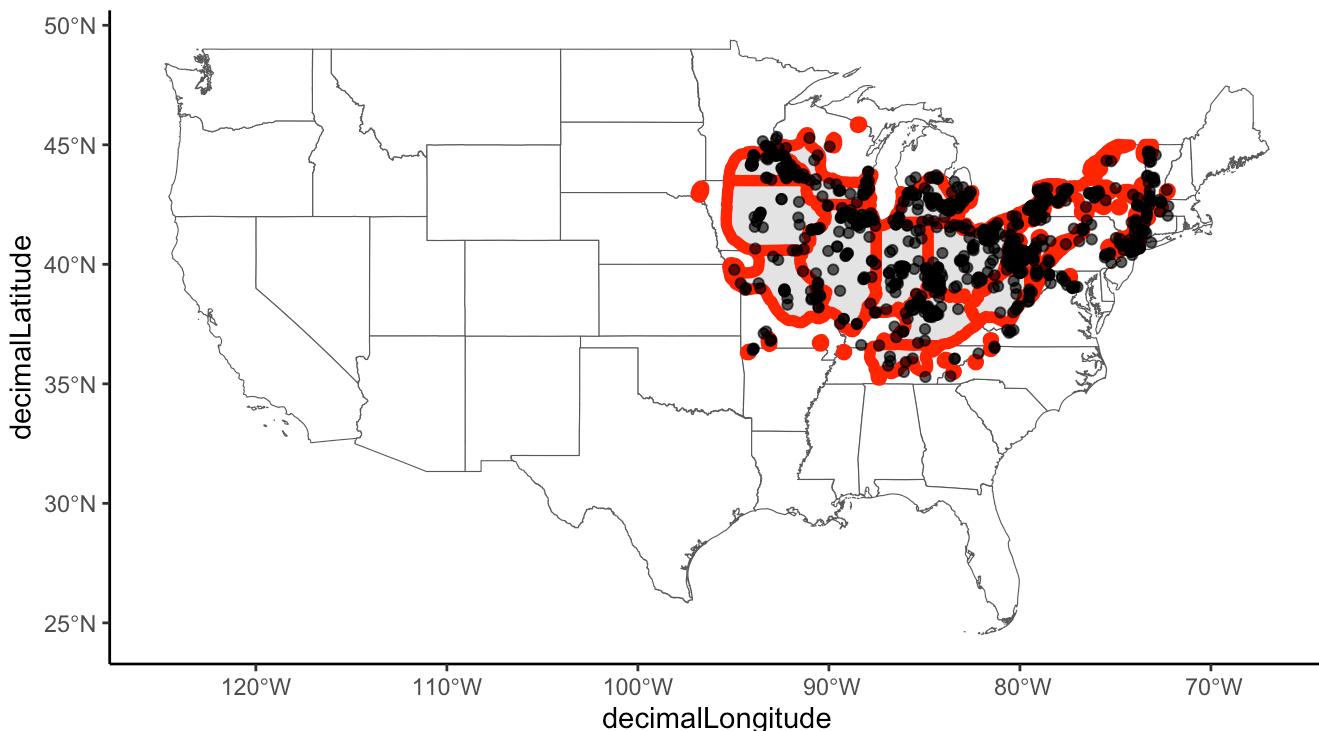
```
## Testing natural ranges
```

```
## Warning in cc_iucn(x = ACNI5.occ, range = ACNI5_clipped, lon =
## "decimalLongitude", : reprojecting reference to '+proj=longlat +datum=WGS84
## +no_defs'
```

```
## Flagged 82 records.
```

```
ACNI5_occ_final = ACNI5.occ[ACNI5_flag, ]
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = ACNI5_clipped, col = "red", linewidth = 2)+
  geom_point(data = ACNI5_occ_final, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
ggsave("../Plots/ACNI5.range.pdf", width = 12, height = 8)
```

Subset for *Acer pensylvanicum*

```
ACPE.occ = gbif %>%
  filter(species == "Acer pensylvanicum") %>%
  select(species,decimalLatitude,decimalLongitude)
```

Read in range map

```
ACPE.range = st_read("../USTreeAtlas/shp/acerpens/")
```

```
## Reading layer `acerpens' from data source  
##   '/Users/samanthaworthy/Documents/GitHub/USTreeAtlas/shp/acerpens'  
##   using driver 'ESRI Shapefile'  
## Simple feature collection with 139 features and 5 fields  
## Geometry type: POLYGON  
## Dimension: XY  
## Bounding box: xmin: -89.90945 ymin: 34.813 xmax: -59.68972 ymax: 49.26055  
## CRS: NA
```

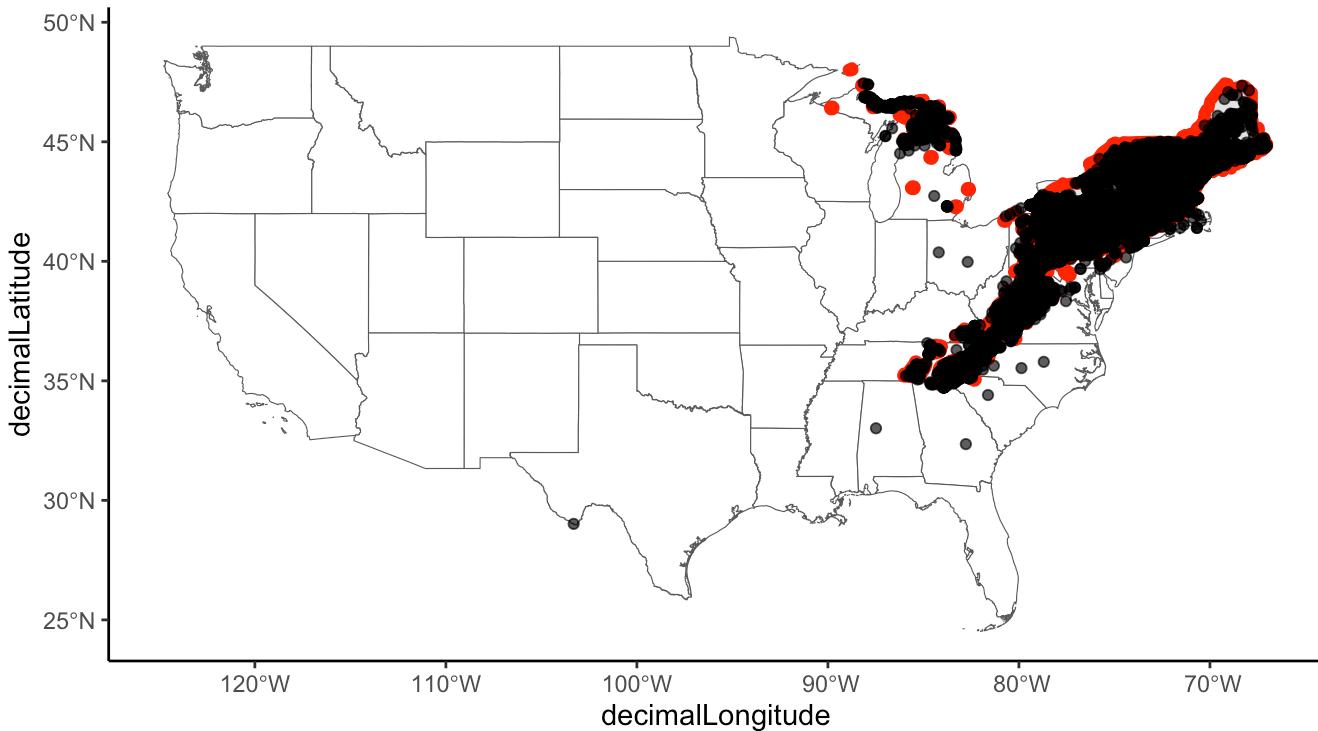
The projection is geographic with latitude and longitude. The datum is NAD27 which is EPSG:4267. The ellipsoid is Clarke 1866, and the transformation parameters

```
st_crs(ACPE.range) <- 4267
```

```
ACPE_clipped = st_intersection(ACPE.range, states.map)
```

```
## Warning: attribute variables are assumed to be spatially constant throughout  
## all geometries
```

```
ggplot() +  
  geom_sf(data = states.map, fill = "white") +  
  geom_sf(data = ACPE_clipped, col = "red", linewidth = 2) +  
  geom_point(data = ACPE.occ, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7) +  
  theme_classic()
```



```
ACPE_clipped$species = "Acer pensylvanicum"
ACPE_flag = cc_iucn(x = ACPE.occ, range = ACPE_clipped, lon = "decimalLongitude", lat =
"decimalLatitude",
value = "flagged", buffer = 50000)
```

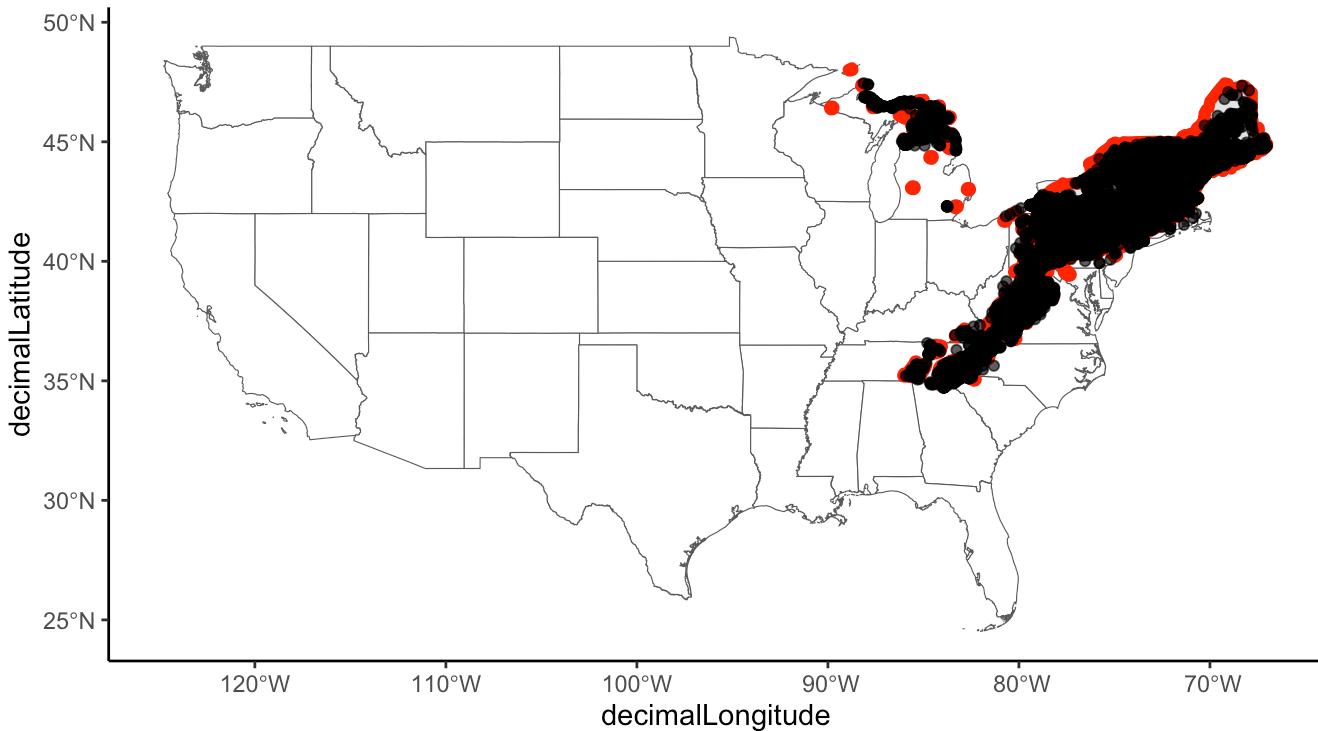
```
## Testing natural ranges
```

```
## Warning in cc_iucn(x = ACPE.occ, range = ACPE_clipped, lon =
## "decimalLongitude", : reprojecting reference to '+proj=longlat +datum=WGS84
## +no_defs'
```

```
## Flagged 113 records.
```

```
ACPE_occ_final = ACPE.occ[ACPE_flag, ]
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = ACPE_clipped, col = "red", linewidth = 2)+
  geom_point(data = ACPE_occ_final, aes(x = decimalLongitude, y = decimalLatitude), colo
r = "black", alpha = 0.7)+
  theme_classic()
```



```
ggsave("../Plots/ACPE.range.pdf", width = 12, height = 8)
```

Subset for Acer rubrum

```
ACRU.occ = gbif %>%
  filter(species == "Acer rubrum") %>%
  select(species,decimalLatitude,decimalLongitude)
```

Read in range map

```
ACRU.range = st_read("../USTreeAtlas/shp/acerrubr/")
```

```
## Reading layer `acerrubr' from data source
##   `/Users/samanthaworthy/Documents/GitHub/USTreeAtlas/shp/acerrubr'
##   using driver `ESRI Shapefile'
## Simple feature collection with 498 features and 5 fields
## Geometry type: POLYGON
## Dimension:     XY
## Bounding box:  xmin: -97.25412 ymin: 25.5467 xmax: -52.61445 ymax: 49.401
## CRS:           NA
```

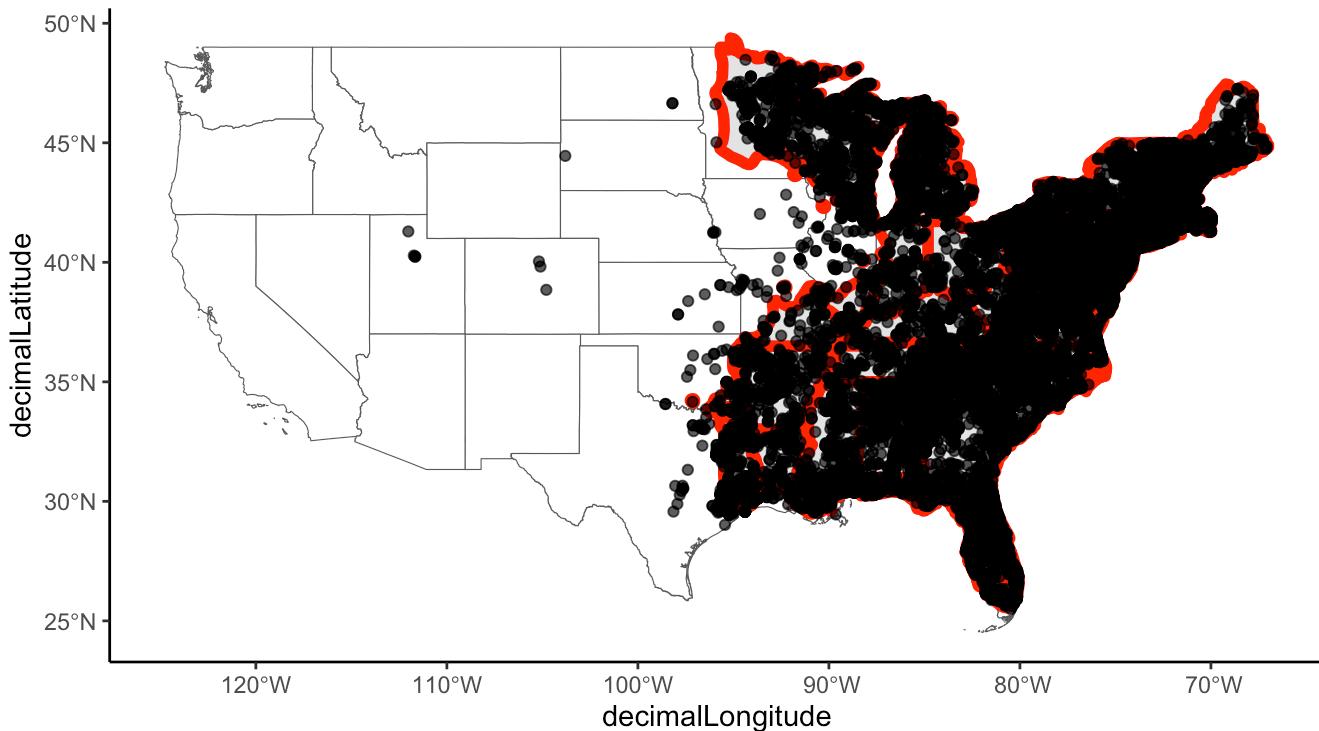
The projection is geographic with latitude and longitude. The datum is NAD27 which is EPSG:4267. The ellipsoid is Clarke 1866, and the transformation parameters

```
st_crs(ACRU.range) <- 4267
```

```
ACRU_clipped = st_intersection(ACRU.range, states.map)
```

```
## Warning: attribute variables are assumed to be spatially constant throughout
## all geometries
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = ACRU_clipped, col = "red", linewidth = 2)+
  geom_point(data = ACRU.occ, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
ACRU_clipped$species = "Acer rubrum"
ACRU_flag = cc_iucn(x = ACRU.occ, range = ACRU_clipped, lon = "decimalLongitude", lat =
"decimalLatitude",
                     value = "flagged", buffer = 50000)
```

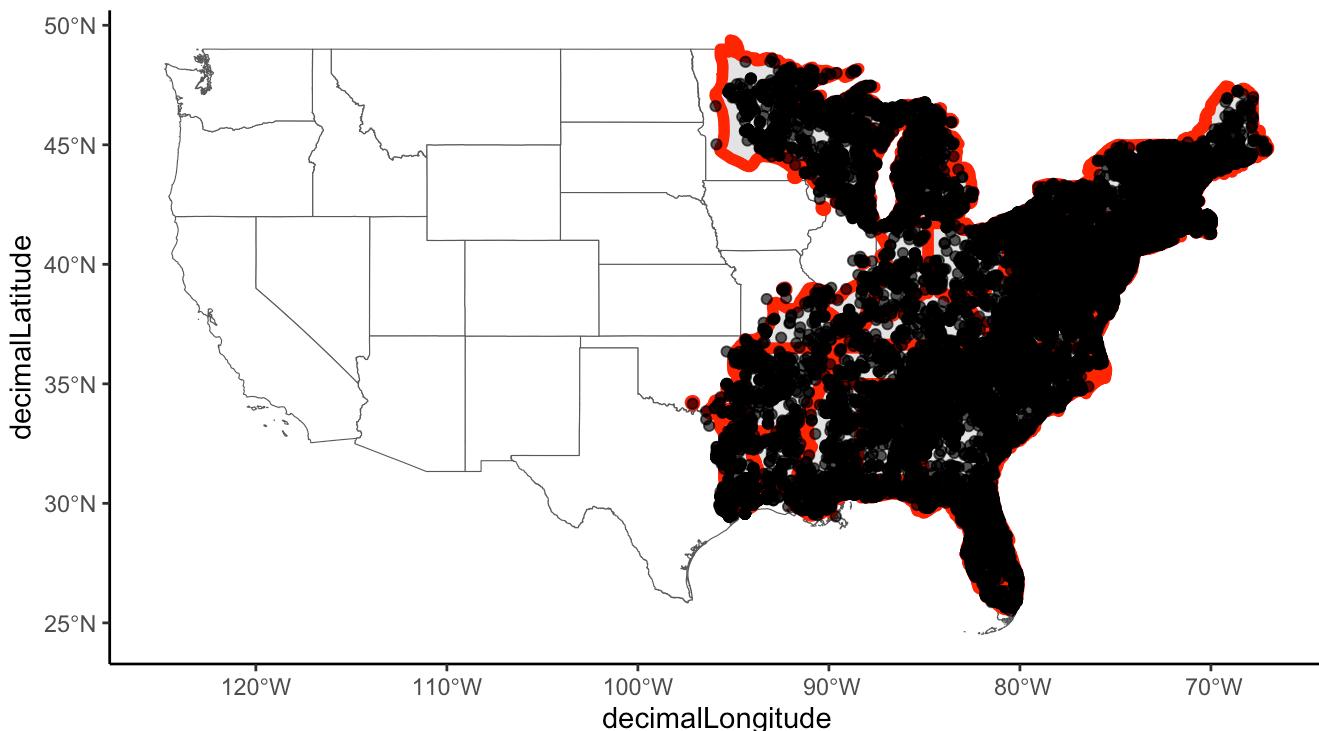
```
## Testing natural ranges
```

```
## Warning in cc_iucn(x = ACRU.occ, range = ACRU_clipped, lon =
## "decimalLongitude", : reprojecting reference to '+proj=longlat +datum=WGS84
## +no_defs'
```

```
## Flagged 135 records.
```

```
ACRU_occ_final = ACRU.occ[ACRU_flag, ]
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = ACRU_clipped, col = "red", linewidth = 2)+
  geom_point(data = ACRU_occ_final, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
ggsave("../Plots/ACRU.range.pdf", width = 12, height = 8)
```

Subset for *Acer saccharinum*

```
ACSA2.occ = gbif %>%
  filter(species == "Acer saccharinum") %>%
  select(species,decimalLatitude,decimalLongitude)
```

Read in range map

```
ACSA2.range = st_read("../USTreeAtlas/shp/acersacc/")
```

```
## Reading layer `acersacc' from data source
##   `/Users/samanthaworthy/Documents/GitHub/USTreeAtlas/shp/acersacc'
##   using driver `ESRI Shapefile'
## Simple feature collection with 38 features and 5 fields
## Geometry type: POLYGON
## Dimension:      XY
## Bounding box:  xmin: -98.05198 ymin: 29.9023 xmax: -66.47555 ymax: 48.20345
## CRS:           NA
```

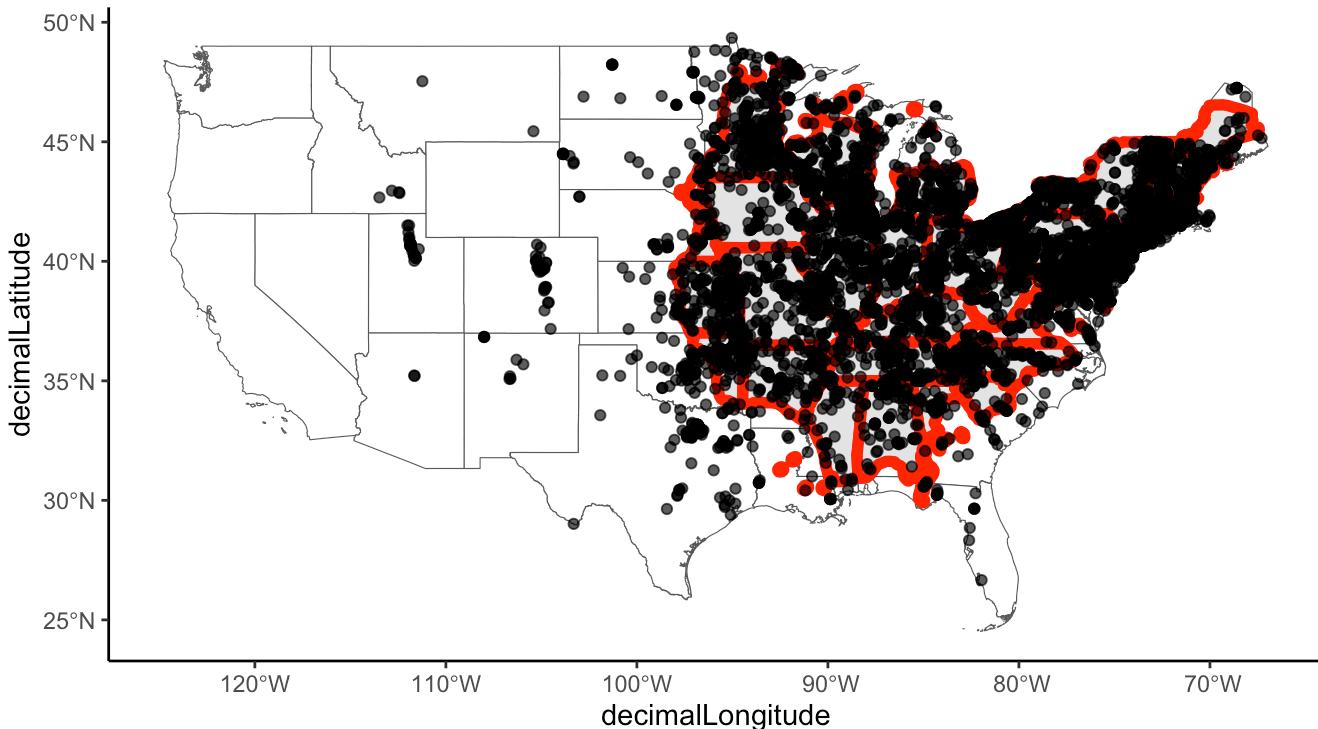
The projection is geographic with latitude and longitude. The datum is NAD27 which is EPSG:4267. The ellipsoid is Clarke 1866, and the transformation parameters

```
st_crs(ACSA2.range) <- 4267
```

```
ACSA2_clipped = st_intersection(ACSA2.range, states.map)
```

```
## Warning: attribute variables are assumed to be spatially constant throughout
## all geometries
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = ACSA2_clipped, col = "red", linewidth = 2)+
  geom_point(data = ACSA2.occ, aes(x = decimalLongitude, y = decimalLatitude), color =
"black", alpha = 0.7)+
  theme_classic()
```



```
ACSA2_clipped$species = "Acer saccharinum"
ACSA2_flag = cc_iucn(x = ACSA2.occ, range = ACSA2_clipped, lon = "decimalLongitude", lat = "decimalLatitude",
= value = "flagged", buffer = 50000)
```

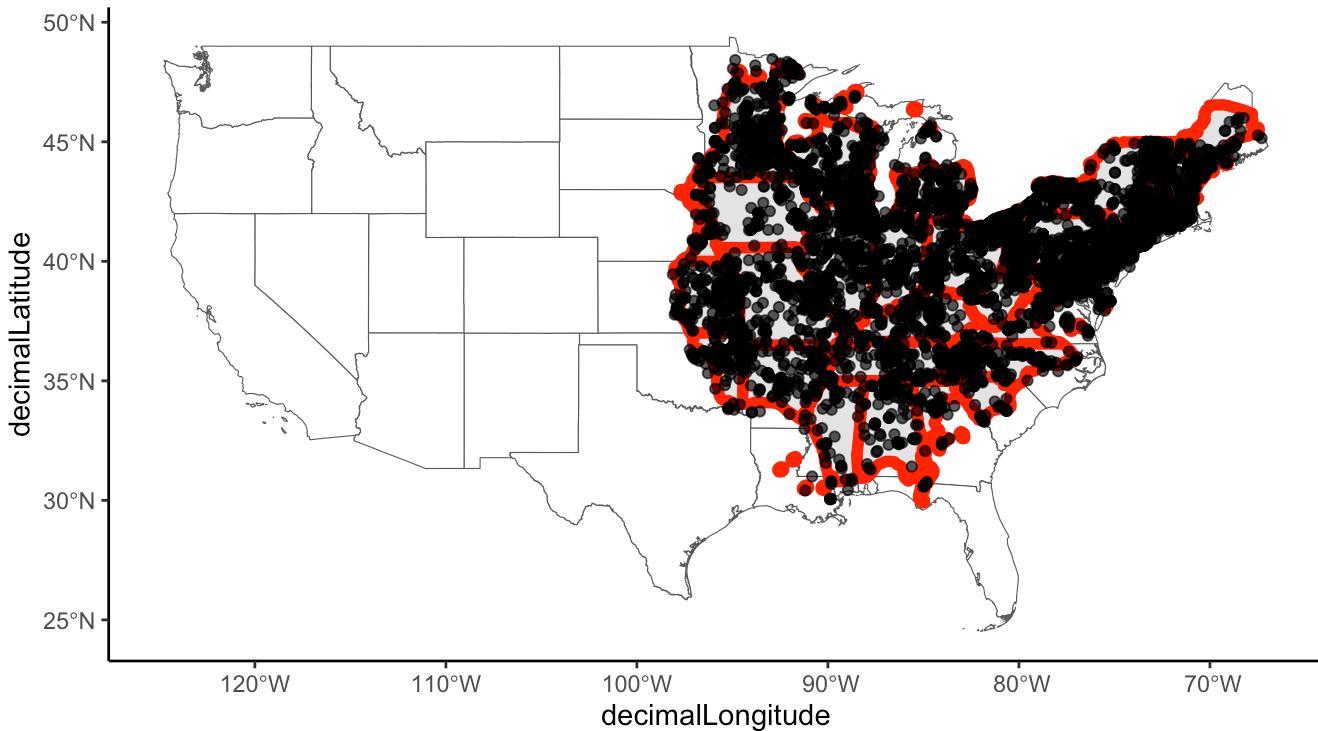
```
## Testing natural ranges
```

```
## Warning in cc_iucn(x = ACSA2.occ, range = ACSA2_clipped, lon =
## "decimalLongitude", : reprojecting reference to '+proj=longlat +datum=WGS84
## +no_defs'
```

```
## Flagged 452 records.
```

```
ACSA2_occ_final = ACSA2.occ[ACSA2_flag, ]
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = ACSA2_clipped, col = "red", linewidth = 2)+
  geom_point(data = ACSA2_occ_final, aes(x = decimalLongitude, y = decimalLatitude), col = "black", alpha = 0.7)+
  theme_classic()
```



```
ggsave("../Plots/ACSA2.range.pdf", width = 12, height = 8)
```

Subset for *Acer saccharum*

```
ACSA3.occ = gbif %>%
  filter(species == "Acer saccharum") %>%
  select(species,decimalLatitude,decimalLongitude)
```

Read in range map

```
ACSA3.range = st_read("../USTreeAtlas/shp/acersacr/")
```

```
## Reading layer `acersacr` from data source
##   `/Users/samanthaworthy/Documents/GitHub/USTreeAtlas/shp/acersacr'
##   using driver `ESRI Shapefile'
## Simple feature collection with 441 features and 5 fields
## Geometry type: POLYGON
## Dimension:     XY
## Bounding box:  xmin: -97.7326 ymin: 33.45683 xmax: -59.68972 ymax: 49.4221
## CRS:           NA
```

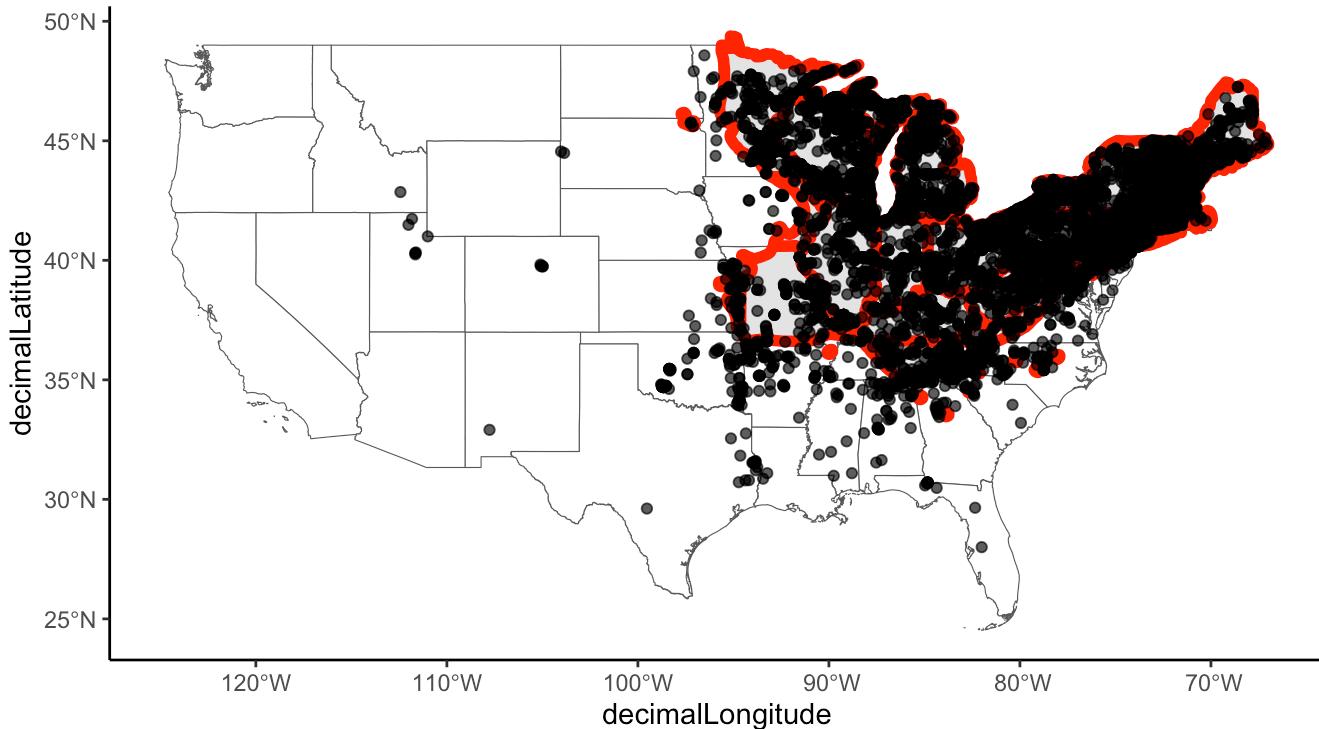
The projection is geographic with latitude and longitude. The datum is NAD27 which is EPSG:4267. The ellipsoid is Clarke 1866, and the transformation parameters

```
st_crs(ACSA3.range) <- 4267
```

```
ACSA3_clipped = st_intersection(ACSA3.range, states.map)
```

```
## Warning: attribute variables are assumed to be spatially constant throughout
## all geometries
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = ACSA3_clipped, col = "red", linewidth = 2)+
  geom_point(data = ACSA3.occ, aes(x = decimalLongitude, y = decimalLatitude), color =
"black", alpha = 0.7)+
  theme_classic()
```



```
ACSA3_clipped$species = "Acer saccharum"
ACSA3_flag = cc_iucn(x = ACSA3.occ, range = ACSA3_clipped, lon = "decimalLongitude", lat =
"decimalLatitude",
                      value = "flagged", buffer = 50000)
```

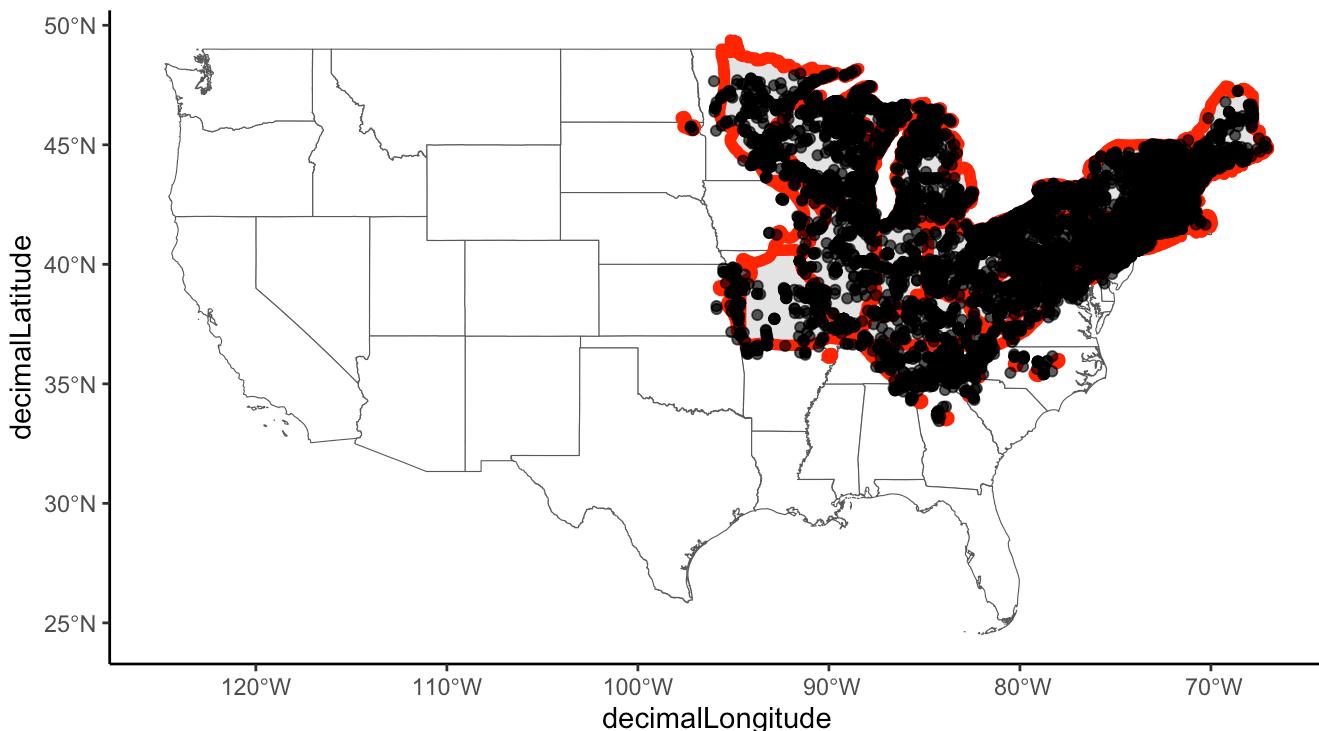
```
## Testing natural ranges
```

```
## Warning in cc_iucn(x = ACSA3.occ, range = ACSA3_clipped, lon =
## "decimalLongitude", : reprojecting reference to '+proj=longlat +datum=WGS84
## +no_defs'
```

```
## Flagged 375 records.
```

```
ACSA3_occ_final = ACSA3.occ[ACSA3_flag, ]
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = ACSA3_clipped, col = "red", linewidth = 2)+
  geom_point(data = ACSA3_occ_final, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
ggsave("../Plots/ACSA3.range.pdf", width = 12, height = 8)
```

Subset for *Acer spicatum*

```
ACSP2.occ = gbif %>%
  filter(species == "Acer spicatum") %>%
  select(species,decimalLatitude,decimalLongitude)
```

Read in range map

```
ACSP2.range = st_read("../USTreeAtlas/shp/acerspic/")
```

```
## Reading layer `acerspic' from data source
##   `/Users/samanthaworthy/Documents/GitHub/USTreeAtlas/shp/acerspic'
##   using driver `ESRI Shapefile'
## Simple feature collection with 264 features and 5 fields
## Geometry type: POLYGON
## Dimension:      XY
## Bounding box:  xmin: -104.7974 ymin: 34.86549 xmax: -52.61445 ymax: 54.83275
## CRS:           NA
```

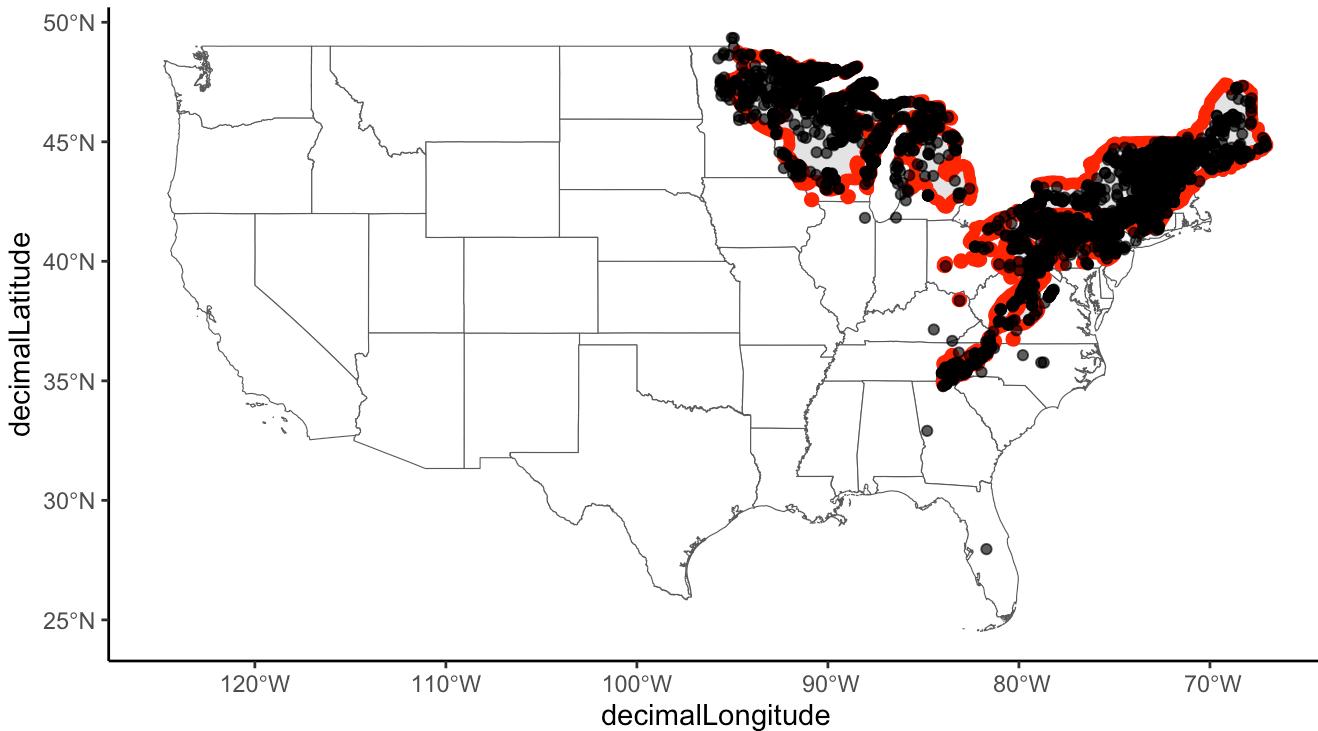
The projection is geographic with latitude and longitude. The datum is NAD27 which is EPSG:4267. The ellipsoid is Clarke 1866, and the transformation parameters

```
st_crs(ACSP2.range) <- 4267
```

```
ACSP2_clipped = st_intersection(ACSP2.range, states.map)
```

```
## Warning: attribute variables are assumed to be spatially constant throughout
## all geometries
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = ACSP2_clipped, col = "red", linewidth = 2)+
  geom_point(data = ACSP2.occ, aes(x = decimalLongitude, y = decimalLatitude), color =
"black", alpha = 0.7)+
  theme_classic()
```



```
ACSP2_clipped$species = "Acer spicatum"
ACSP2_flag = cc_iucn(x = ACSP2.occ, range = ACSP2_clipped, lon = "decimalLongitude", lat = "decimalLatitude",
= "flagged", buffer = 50000)
```

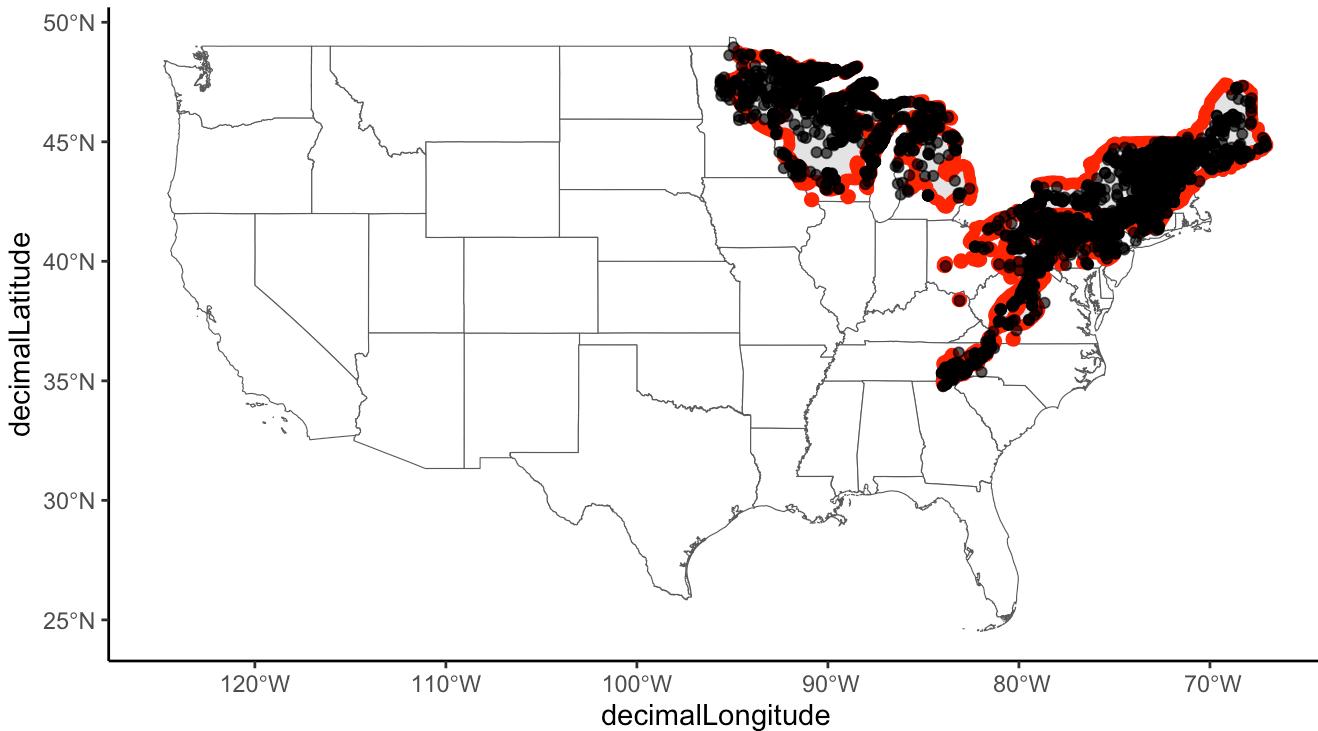
```
## Testing natural ranges
```

```
## Warning in cc_iucn(x = ACSP2.occ, range = ACSP2_clipped, lon =
## "decimalLongitude", : reprojecting reference to '+proj=longlat +datum=WGS84
## +no_defs'
```

```
## Flagged 61 records.
```

```
ACSP2_occ_final = ACSP2.occ[ACSP2_flag, ]
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = ACSP2_clipped, col = "red", linewidth = 2)+
  geom_point(data = ACSP2_occ_final, aes(x = decimalLongitude, y = decimalLatitude), col = "black", alpha = 0.7)+
  theme_classic()
```



```
ggsave("../Plots/ACSP2.range.pdf", width = 12, height = 8)
```

Subset for *Aesculus flava*. Little range map not available.

```
AEFL.occ = gbif %>%
  filter(species == "Aesculus flava") %>%
  select(species,decimalLatitude,decimalLongitude)
```

Get range map from BIEN

```
(AEFL.range.sf <- BIEN_ranges_load_species('Aesculus flava'))
```

```
## Simple feature collection with 1 feature and 2 fields
## Geometry type: MULTIPOLYGON
## Dimension: XY
## Bounding box: xmin: -93.90865 ymin: 31.19165 xmax: -69.90763 ymax: 45.48371
## Geodetic CRS: WGS 84
##           species      gid      geometry
## 1 Aesculus_flava 2133 MULTIPOLYGON (((-93.90865 3...
```

The projection is geographic with latitude and longitude. The datum is NAD27 which is EPSG:4267. The BIEN ranges are WG84.

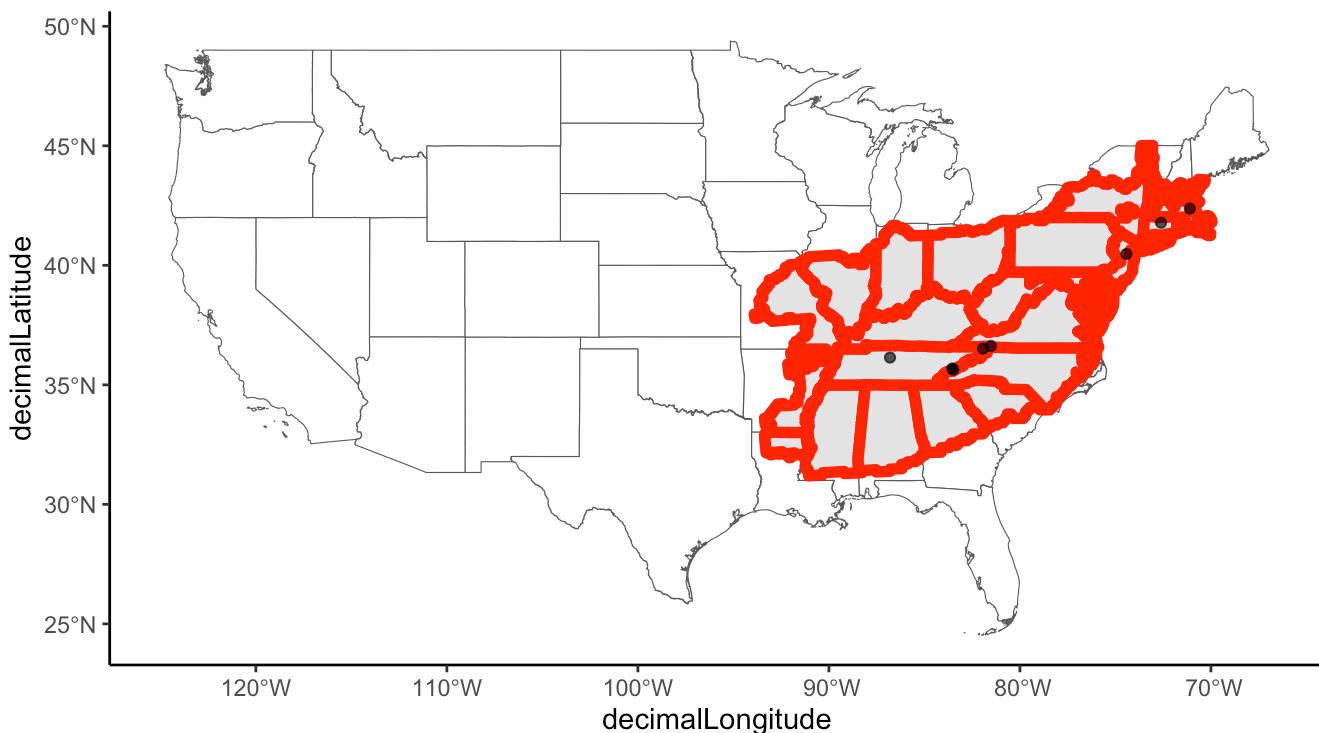
```
AEFL.range.2 = AEFL.range.sf %>%
  st_transform(st_crs(states.map))
```

```
AEFL.range.3 = terra::vect(AEFL.range.2)
states.map.2 = terra::vect(states.map)
```

```
AEFL.range.4 = terra::intersect(AEFL.range.3, states.map.2)
```

```
AEFL.range.5 = st_as_sf(AEFL.range.4)
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(dat = AEFL.range.5, col = "red", linewidth = 2)+
  geom_point(data = AEFL.occ, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
ggsave("../Plots/AEFL.range.pdf", width = 12, height = 8)
```

Subset for *Aesculus glabra*

```
AEGL.occ = gbif %>%
  filter(species == "Aesculus glabra") %>%
  select(species,decimalLatitude,decimalLongitude)
```

Read in range map

```
AEGL.range = st_read("../USTreeAtlas/shp/aescglab/")
```

```
## Reading layer `aescglab' from data source
##   `/Users/samanthaworthy/Documents/GitHub/USTreeAtlas/shp/aescglab'
##   using driver `ESRI Shapefile'
## Simple feature collection with 17 features and 5 fields
## Geometry type: POLYGON
## Dimension:     XY
## Bounding box:  xmin: -99.97602 ymin: 29.33802 xmax: -79.56816 ymax: 42.69205
## CRS:           NA
```

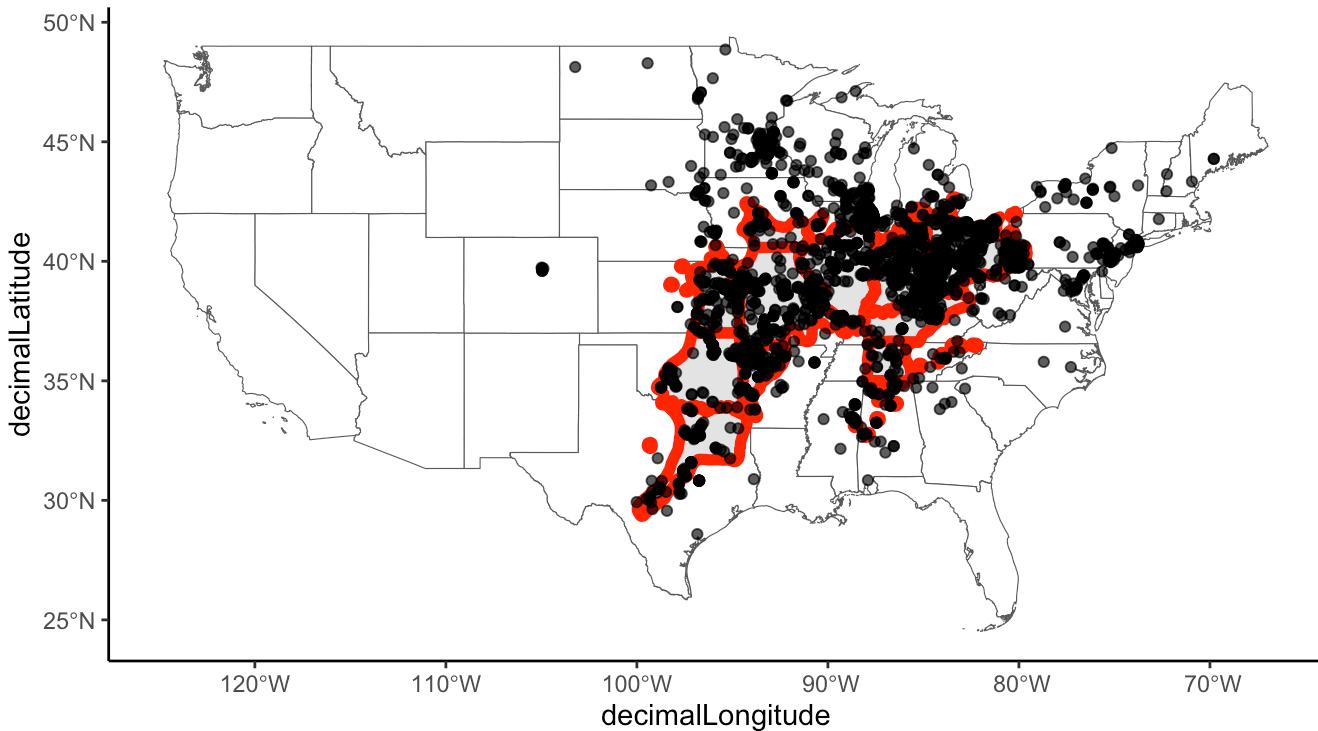
The projection is geographic with latitude and longitude. The datum is NAD27 which is EPSG:4267. The ellipsoid is Clarke 1866, and the transformation parameters

```
st_crs(AEGL.range) <- 4267
```

```
AEGL_clipped = st_intersection(AEGL.range, states.map)
```

```
## Warning: attribute variables are assumed to be spatially constant throughout
## all geometries
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = AEGL_clipped, col = "red", linewidth = 2)+
  geom_point(data = AEGL.occ, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
AEGL_clipped$species = "Aesculus glabra"
AEGL_flag = cc_iucn(x = AEGL.occ, range = AEGL_clipped, lon = "decimalLongitude", lat =
"decimalLatitude",
value = "flagged", buffer = 50000)
```

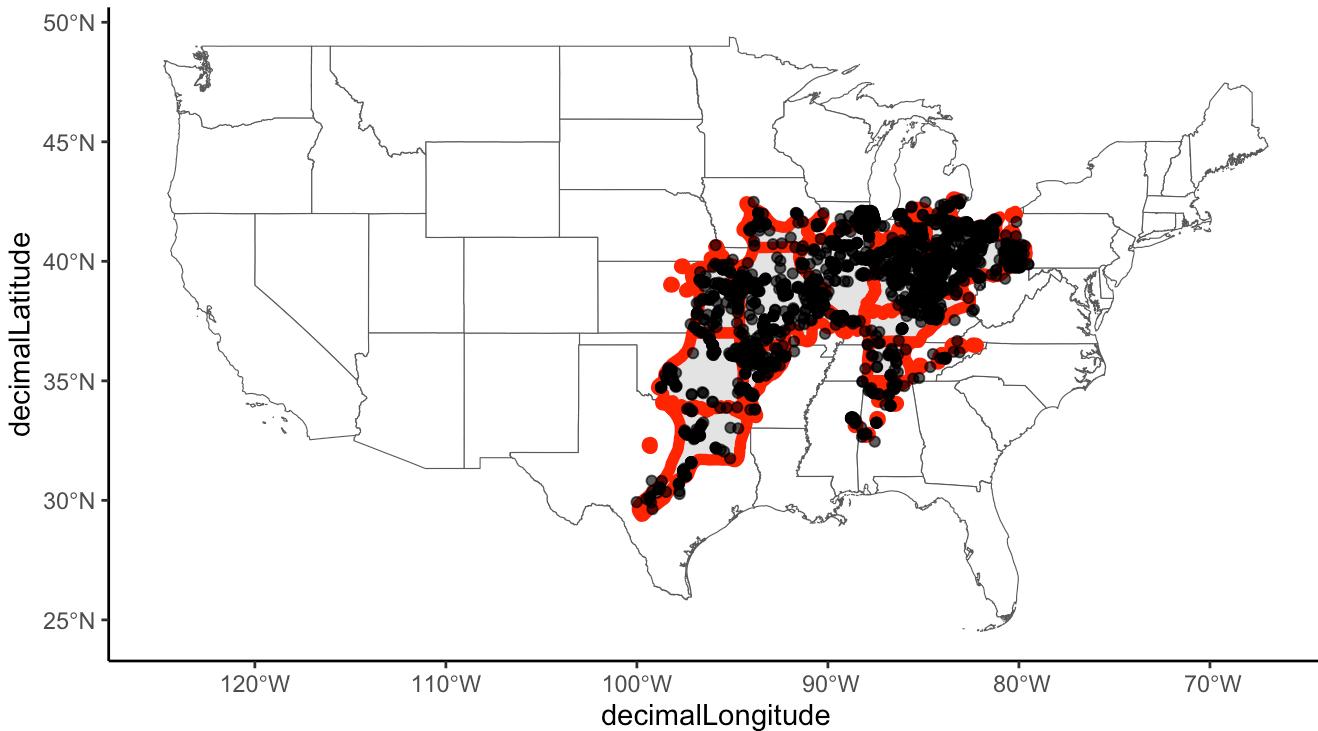
```
## Testing natural ranges
```

```
## Warning in cc_iucn(x = AEGL.occ, range = AEGL_clipped, lon =
## "decimalLongitude", : reprojecting reference to '+proj=longlat +datum=WGS84
## +no_defs'
```

```
## Flagged 667 records.
```

```
AEGL_occ_final = AEGL.occ[AEGL_flag, ]
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = AEGL_clipped, col = "red", linewidth = 2)+
  geom_point(data = AEGL_occ_final, aes(x = decimalLongitude, y = decimalLatitude), colo
r = "black", alpha = 0.7)+
  theme_classic()
```



```
ggsave("../Plots/AEGL.range.pdf", width = 12, height = 8)
```

Subset for Ailanthus altissima. Little range map not available.

```
AIAL.occ = gbif %>%
  filter(species == "Ailanthus altissima") %>%
  select(species,decimalLatitude,decimalLongitude)
```

Get range map from BIEN

```
(AIAL.range.sf <- BIEN_ranges_load_species('Ailanthus altissima'))
```

```
## Simple feature collection with 1 feature and 2 fields
## Geometry type: MULTIPOLYGON
## Dimension: XY
## Bounding box: xmin: -133.106 ymin: -50.14707 xmax: -62.02493 ymax: 55.9796
## Geodetic CRS: WGS 84
##           species      gid      geometry
## 1 Ailanthus_altissima 2732 MULTIPOLYGON (((-69.98753 -...
```

The projection is geographic with latitude and longitude. The datum is NAD27 which is EPSG:4267. The BIEN ranges are WG84.

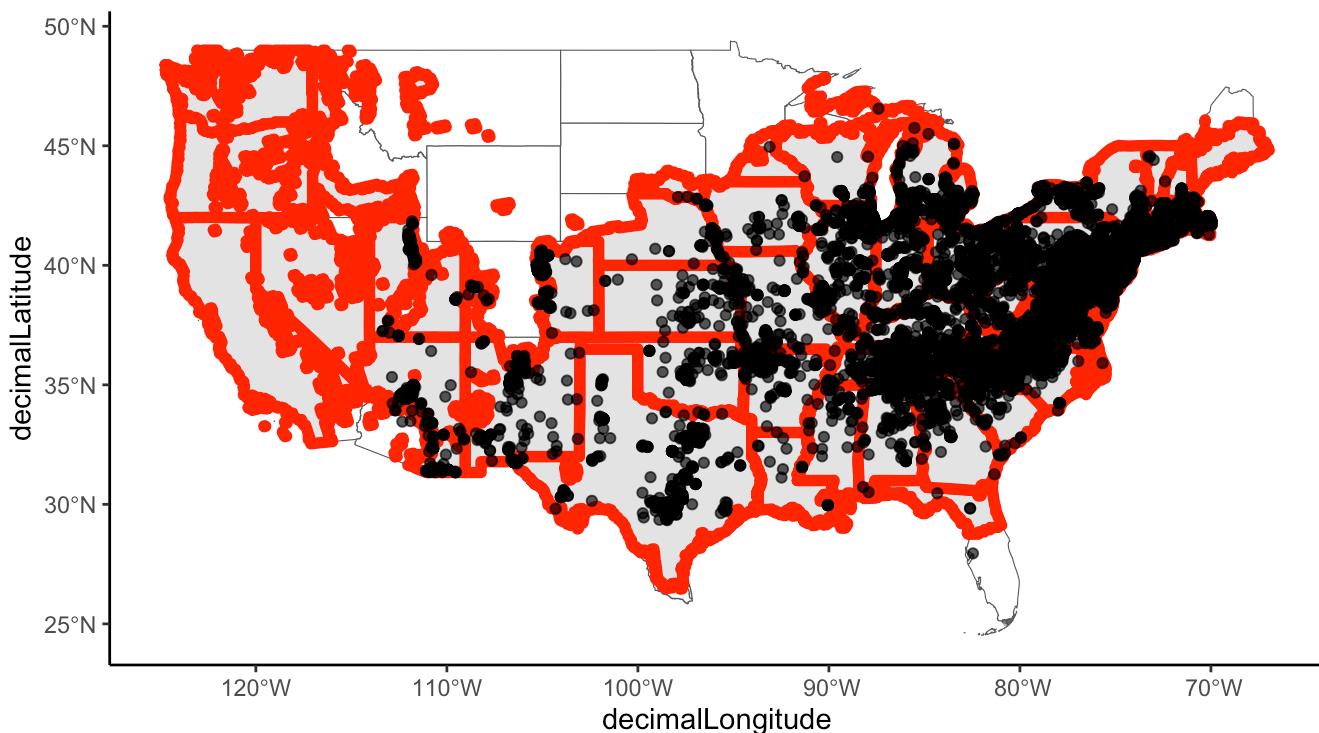
```
AIAL.range.2 = AIAL.range.sf %>%
  st_transform(st_crs(states.map))
```

```
AIAL.range.3 = terra::vect(AIAL.range.2)
states.map.2 = terra::vect(states.map)
```

```
AIAL.range.4 = terra::intersect(AIAL.range.3, states.map.2)
```

```
AIAL.range.5 = st_as_sf(AIAL.range.4)
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(dat = AIAL.range.5, col = "red", linewidth = 2)+
  geom_point(data = AIAL.occ, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
AIAL.range.5$species = "Ailanthus altissima"
AIAL_flag = cc_iucn(x = AIAL.occ, range = AIAL.range.5, lon = "decimalLongitude", lat =
  "decimalLatitude",
  value = "flagged", buffer = 50000)
```

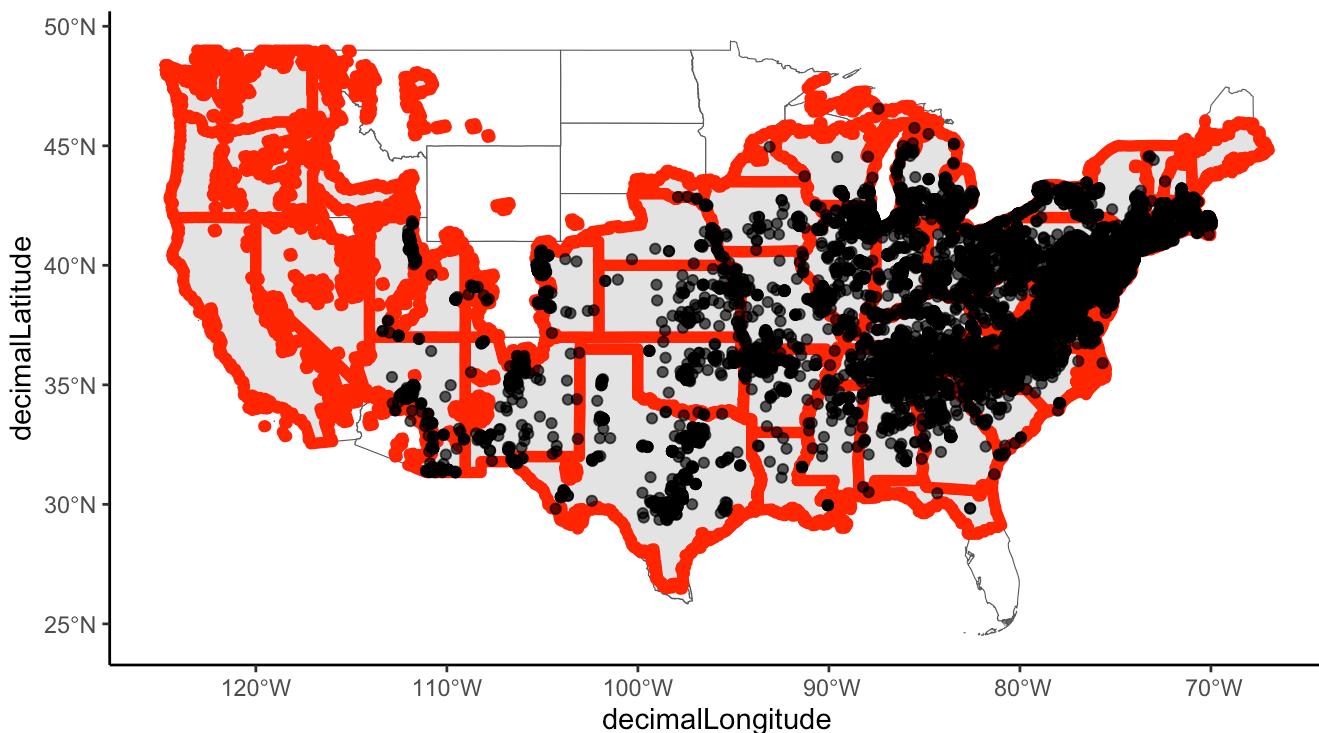
```
## Testing natural ranges
```

```
## Warning in cc_iucn(x = AIAL.occ, range = AIAL.range.5, lon =
## "decimalLongitude", : reprojecting reference to '+proj=longlat +datum=WGS84
## +no_defs'
```

```
## Flagged 2 records.
```

```
AIAL.occ_final = AIAL.occ[AIAL_flag, ]
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(dat = AIAL.range.5, col = "red", linewidth = 2)+
  geom_point(data = AIAL.occ_final, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
ggsave("../Plots/AIAL.range.pdf", width = 12, height = 8)
```

Subset for *Annona glabra*. Little range map not available.

```
ANGL4.occ = gbif %>%
  filter(species == "Annona glabra") %>%
  select(species,decimalLatitude,decimalLongitude)
```

Get range map from BIEN

```
(ANGL4.range.sf <- BIEN_ranges_load_species('Annona glabra'))
```

```
## Simple feature collection with 1 feature and 2 fields
## Geometry type: MULTIPOLYGON
## Dimension: XY
## Bounding box: xmin: -112.3496 ymin: -39.02829 xmax: -29.33156 ymax: 37.96143
## Geodetic CRS: WGS 84
##           species      gid      geometry
## 1 Annona_glabra 4698 MULTIPOLYGON (((-29.45189 -...
```

The projection is geographic with latitude and longitude. The datum is NAD27 which is EPSG:4267. The BIEN ranges are WG84.

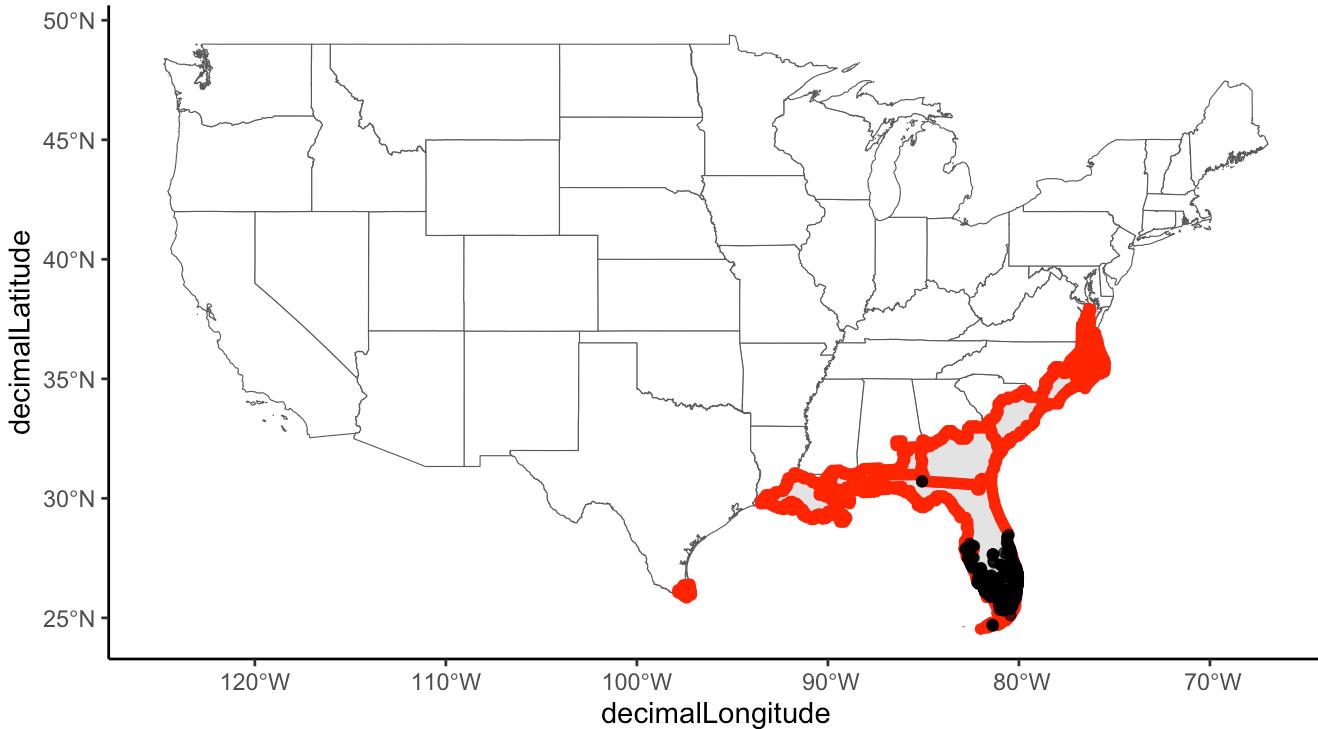
```
ANGL4.range.2 = ANGL4.range.sf %>%
  st_transform(st_crs(states.map))
```

```
ANGL4.range.3 = terra::vect(ANGL4.range.2)
states.map.2 = terra::vect(states.map)
```

```
ANGL4.range.4 = terra::intersect(ANGL4.range.3, states.map.2)
```

```
ANGL4.range.5 = st_as_sf(ANGL4.range.4)
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(dat = ANGL4.range.5, col = "red", linewidth = 2)+
  geom_point(data = ANGL4.occ, aes(x = decimalLongitude, y = decimalLatitude), color =
"black", alpha = 0.7)+
  theme_classic()
```



```
ggsave("../Plots/ANGL4.range.pdf", width = 12, height = 8)
```

Subset for *Asimina triloba*

```
ASTR.occ = gbif %>%
  filter(species == "Asimina triloba") %>%
  select(species,decimalLatitude,decimalLongitude)
```

Read in range map

```
ASTR.range = st_read("../USTreeAtlas/shp/asimtril/")
```

```
## Reading layer `asimtril' from data source
##   `/Users/samanthaworthy/Documents/GitHub/USTreeAtlas/shp/asimtril'
##   using driver `ESRI Shapefile'
## Simple feature collection with 44 features and 5 fields
## Geometry type: POLYGON
## Dimension:     XY
## Bounding box:  xmin: -97.22963 ymin: 29.65825 xmax: -74.09969 ymax: 43.43197
## CRS:           NA
```

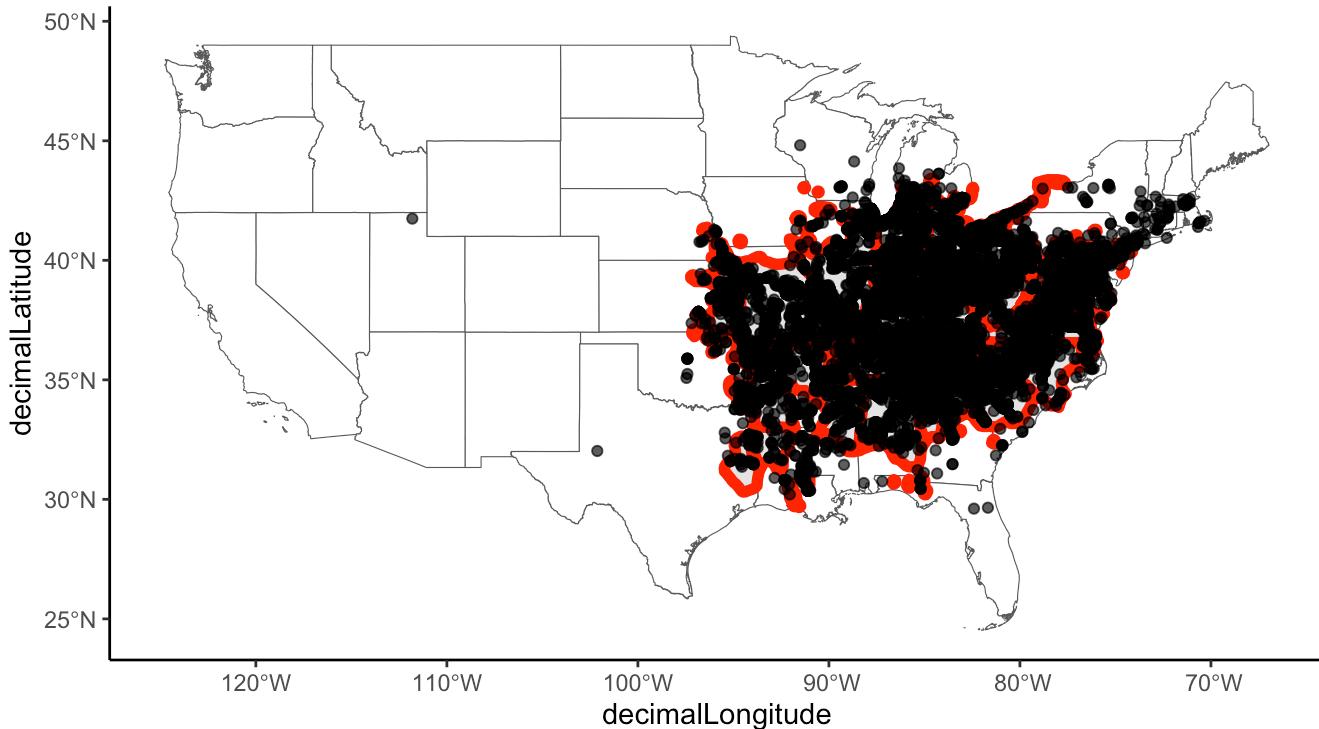
The projection is geographic with latitude and longitude. The datum is NAD27 which is EPSG:4267. The ellipsoid is Clarke 1866, and the transformation parameters

```
st_crs(STR.range) <- 4267
```

```
ASTR_clipped = st_intersection(STR.range, states.map)
```

```
## Warning: attribute variables are assumed to be spatially constant throughout
## all geometries
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = ASTR_clipped, col = "red", linewidth = 2)+
  geom_point(data = ASTR.occ, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
ASTR_clipped$species = "Asimina triloba"
ASTR_flag = cc_iucn(x = ASTR.occ, range = ASTR_clipped, lon = "decimalLongitude", lat =
"decimalLatitude",
                     value = "flagged", buffer = 50000)
```

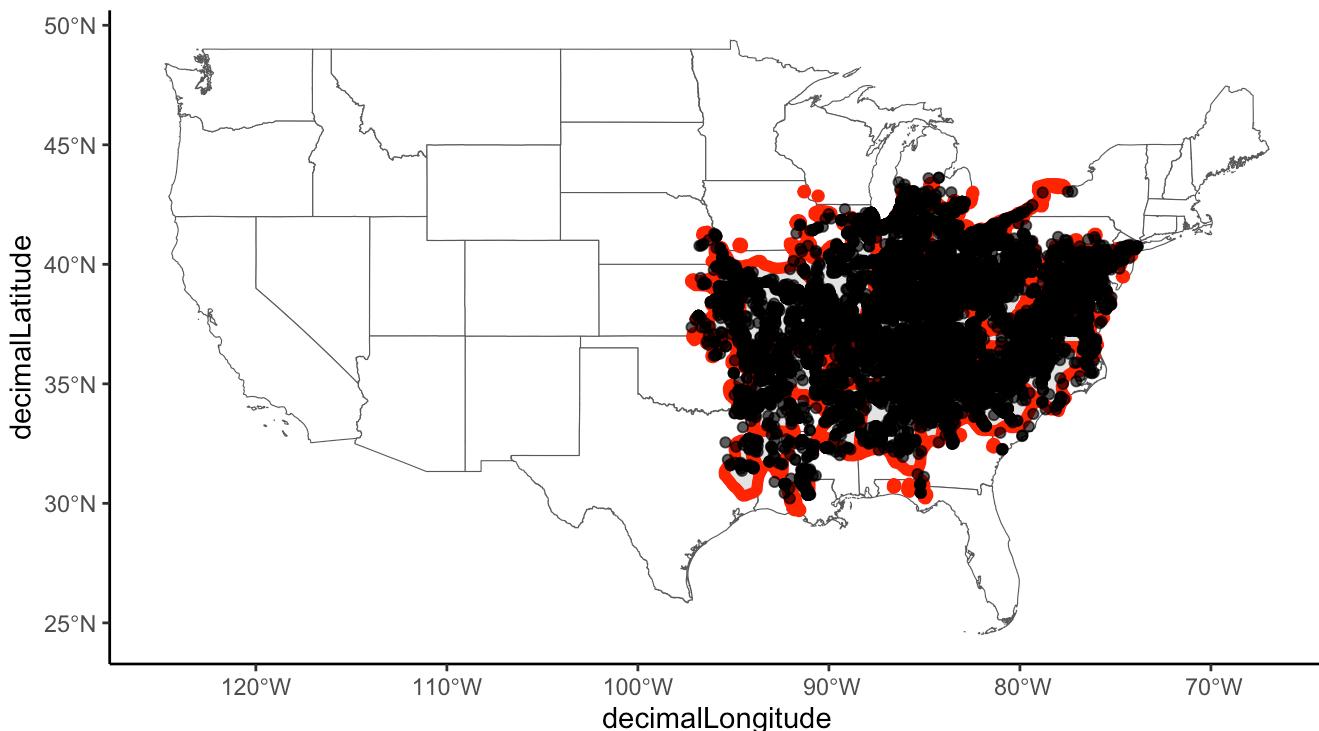
```
## Testing natural ranges
```

```
## Warning in cc_iucn(x = ASTR.occ, range = ASTR_clipped, lon =
## "decimalLongitude", : reprojecting reference to '+proj=longlat +datum=WGS84
## +no_defs'
```

```
## Flagged 142 records.
```

```
ASTR_occ_final = ASTR.occ[ASTR_flag, ]
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = ASTR_clipped, col = "red", linewidth = 2)+
  geom_point(data = ASTR_occ_final, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
ggsave("../Plots/ASTR.range.pdf", width = 12, height = 8)
```

Subset for *Betula alleghaniensis*

```
BEAL2.occ = gbif %>%
  filter(species == "Betula alleghaniensis") %>%
  select(species,decimalLatitude,decimalLongitude)
```

Read in range map

```
BEAL2.range = st_read("../USTreeAtlas/shp/betualle/")
```

```
## Reading layer `betualle' from data source
##   '/Users/samanthaworthy/Documents/GitHub/USTreeAtlas/shp/betualle'
##   using driver 'ESRI Shapefile'
## Simple feature collection with 91 features and 5 fields
## Geometry type: POLYGON
## Dimension:      XY
## Bounding box:  xmin: -96.07653 ymin: 34.77789 xmax: -52.61445 ymax: 49.95027
## CRS:           NA
```

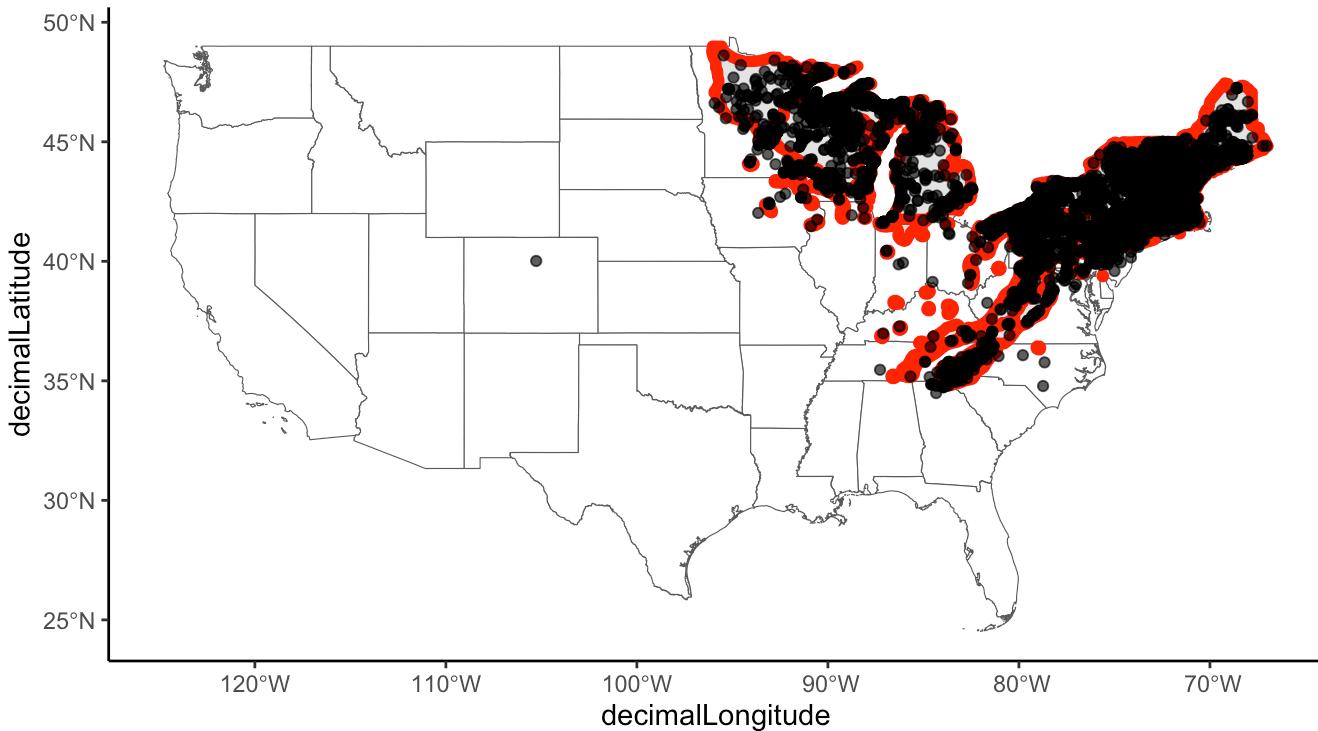
The projection is geographic with latitude and longitude. The datum is NAD27 which is EPSG:4267. The ellipsoid is Clarke 1866, and the transformation parameters

```
st_crs(BEAL2.range) <- 4267
```

```
BEAL2_clipped = st_intersection(BEAL2.range, states.map)
```

```
## Warning: attribute variables are assumed to be spatially constant throughout
## all geometries
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = BEAL2_clipped, col = "red", linewidth = 2)+
  geom_point(data = BEAL2.occ, aes(x = decimalLongitude, y = decimalLatitude), color =
"black", alpha = 0.7)+
  theme_classic()
```



```
BEAL2_clipped$species = "Betula alleghaniensis"
BEAL2_flag = cc_iucn(x = BEAL2.occ, range = BEAL2_clipped, lon = "decimalLongitude", lat = "decimalLatitude",
                      value = "flagged", buffer = 50000)
```

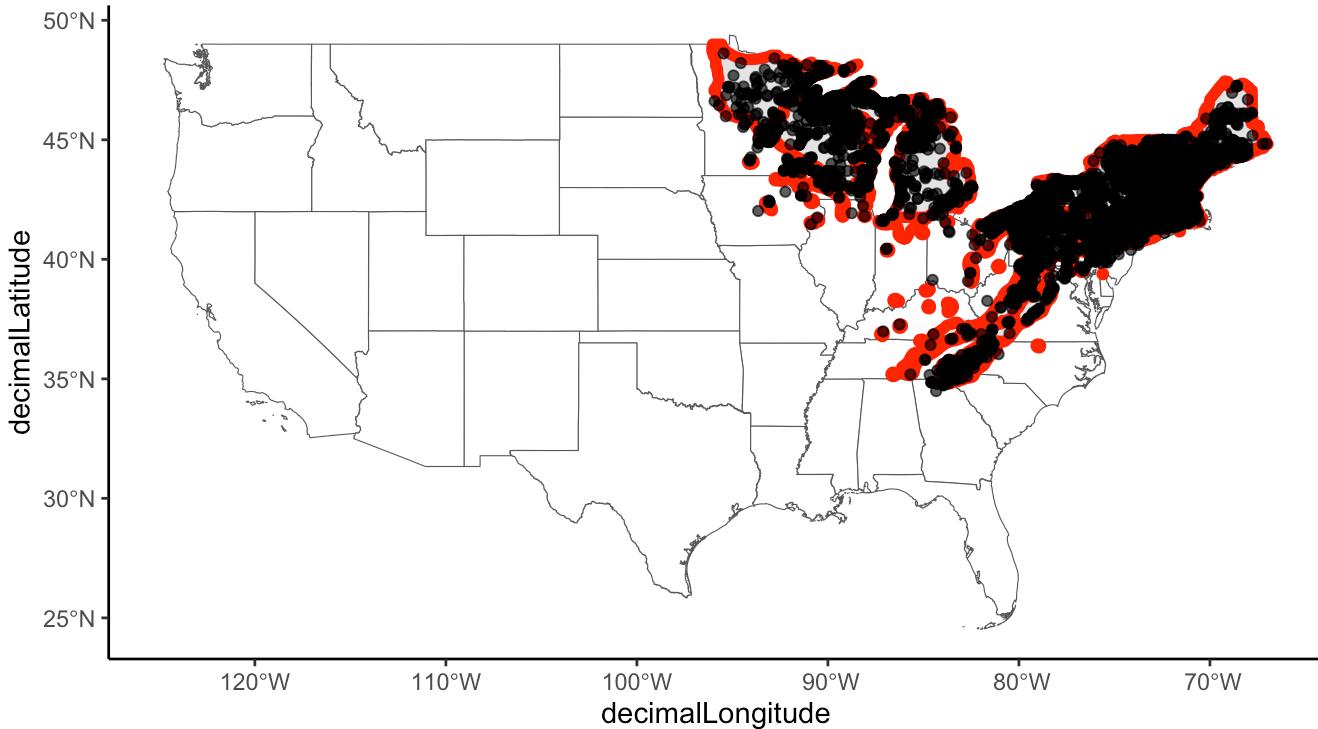
```
## Testing natural ranges
```

```
## Warning in cc_iucn(x = BEAL2.occ, range = BEAL2_clipped, lon =
## "decimalLongitude", : reprojecting reference to '+proj=longlat +datum=WGS84
## +no_defs'
```

```
## Flagged 16 records.
```

```
BEAL2_occ_final = BEAL2.occ[BEAL2_flag, ]
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = BEAL2_clipped, col = "red", linewidth = 2)+
  geom_point(data = BEAL2_occ_final, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
ggsave("../Plots/BEAL2.range.pdf", width = 12, height = 8)
```

Subset for *Betula lenta*

```
BELE.occ = gbif %>%
  filter(species == "Betula lenta") %>%
  select(species,decimalLatitude,decimalLongitude)
```

Read in range map

```
BELE.range = st_read("../USTreeAtlas/shp/betulent/")
```

```
## Reading layer `betulent' from data source
##   `/Users/samanthaworthy/Documents/GitHub/USTreeAtlas/shp/betulent'
##   using driver `ESRI Shapefile'
## Simple feature collection with 20 features and 5 fields
## Geometry type: POLYGON
## Dimension:     XY
## Bounding box:  xmin: -87.99353 ymin: 33.1902 xmax: -68.21455 ymax: 48.70293
## CRS:           NA
```

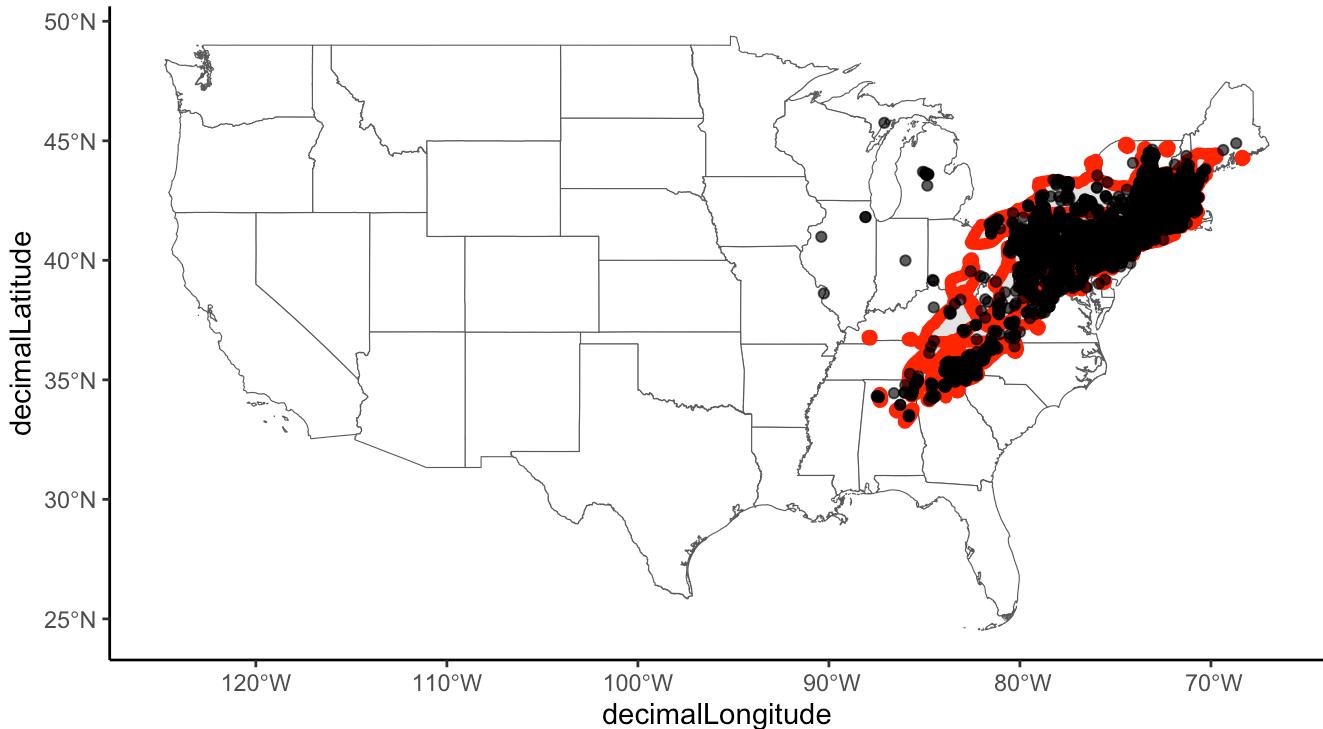
The projection is geographic with latitude and longitude. The datum is NAD27 which is EPSG:4267. The ellipsoid is Clarke 1866, and the transformation parameters

```
st_crs(BELE.range) <- 4267
```

```
BELE_clipped = st_intersection(BELE.range, states.map)
```

```
## Warning: attribute variables are assumed to be spatially constant throughout
## all geometries
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = BELE_clipped, col = "red", linewidth = 2)+
  geom_point(data = BELE.occ, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
BELE_clipped$species = "Betula lenta"
BELE_flag = cc_iucn(x = BELE.occ, range = BELE_clipped, lon = "decimalLongitude", lat =
"decimalLatitude",
                     value = "flagged", buffer = 50000)
```

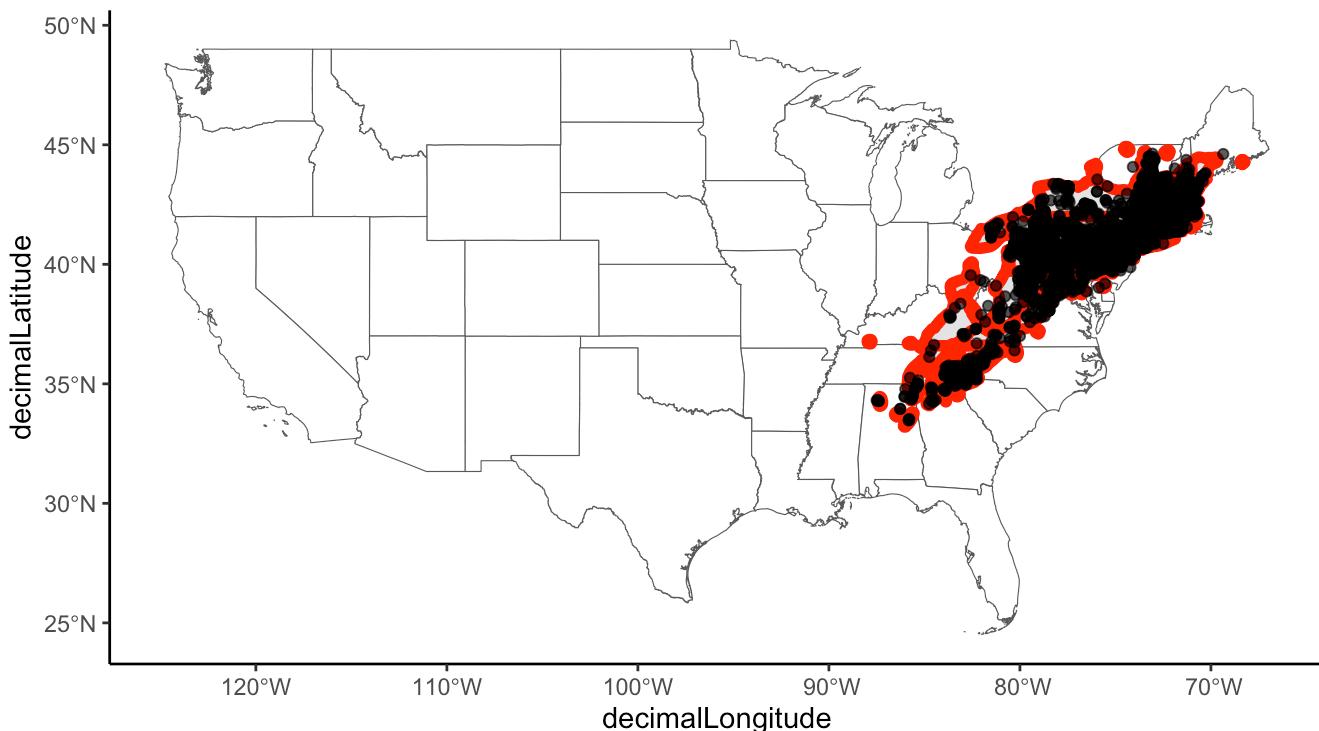
```
## Testing natural ranges
```

```
## Warning in cc_iucn(x = BELE.occ, range = BELE_clipped, lon =
## "decimalLongitude", : reprojecting reference to '+proj=longlat +datum=WGS84
## +no_defs'
```

```
## Flagged 19 records.
```

```
BELE_occ_final = BELE.occ[BELE_flag, ]
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = BELE_clipped, col = "red", linewidth = 2)+
  geom_point(data = BELE_occ_final, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
ggsave("../Plots/BELE.range.pdf", width = 12, height = 8)
```

Subset for *Betula nigra*

```
BENI.occ = gbif %>%
  filter(species == "Betula nigra") %>%
  select(species,decimalLatitude,decimalLongitude)
```

Read in range map

```
BENI.range = st_read("../USTreeAtlas/shp/betunigr/")
```

```
## Reading layer `betunigr' from data source
##   `/Users/samanthaworthy/Documents/GitHub/USTreeAtlas/shp/betunigr'
##   using driver `ESRI Shapefile'
## Simple feature collection with 48 features and 5 fields
## Geometry type: POLYGON
## Dimension:      XY
## Bounding box:  xmin: -96.42217 ymin: 29.56167 xmax: -70.57861 ymax: 45.09521
## CRS:           NA
```

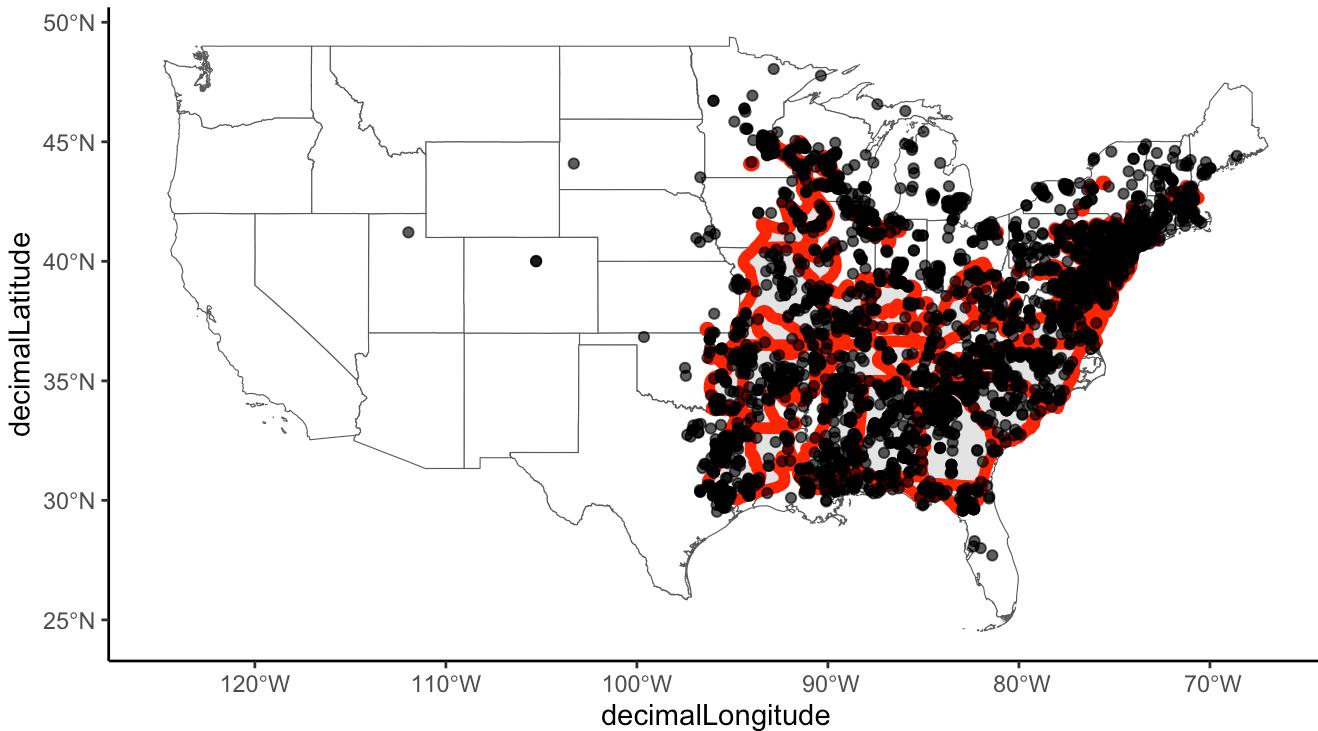
The projection is geographic with latitude and longitude. The datum is NAD27 which is EPSG:4267. The ellipsoid is Clarke 1866, and the transformation parameters

```
st_crs(BENI.range) <- 4267
```

```
BENI_clipped = st_intersection(BENI.range, states.map)
```

```
## Warning: attribute variables are assumed to be spatially constant throughout
## all geometries
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = BENI_clipped, col = "red", linewidth = 2)+
  geom_point(data = BENI.occ, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
BENI_clipped$species = "Betula nigra"
BENI_flag = cc_iucn(x = BENI.occ, range = BENI_clipped, lon = "decimalLongitude", lat =
"decimalLatitude",
value = "flagged", buffer = 50000)
```

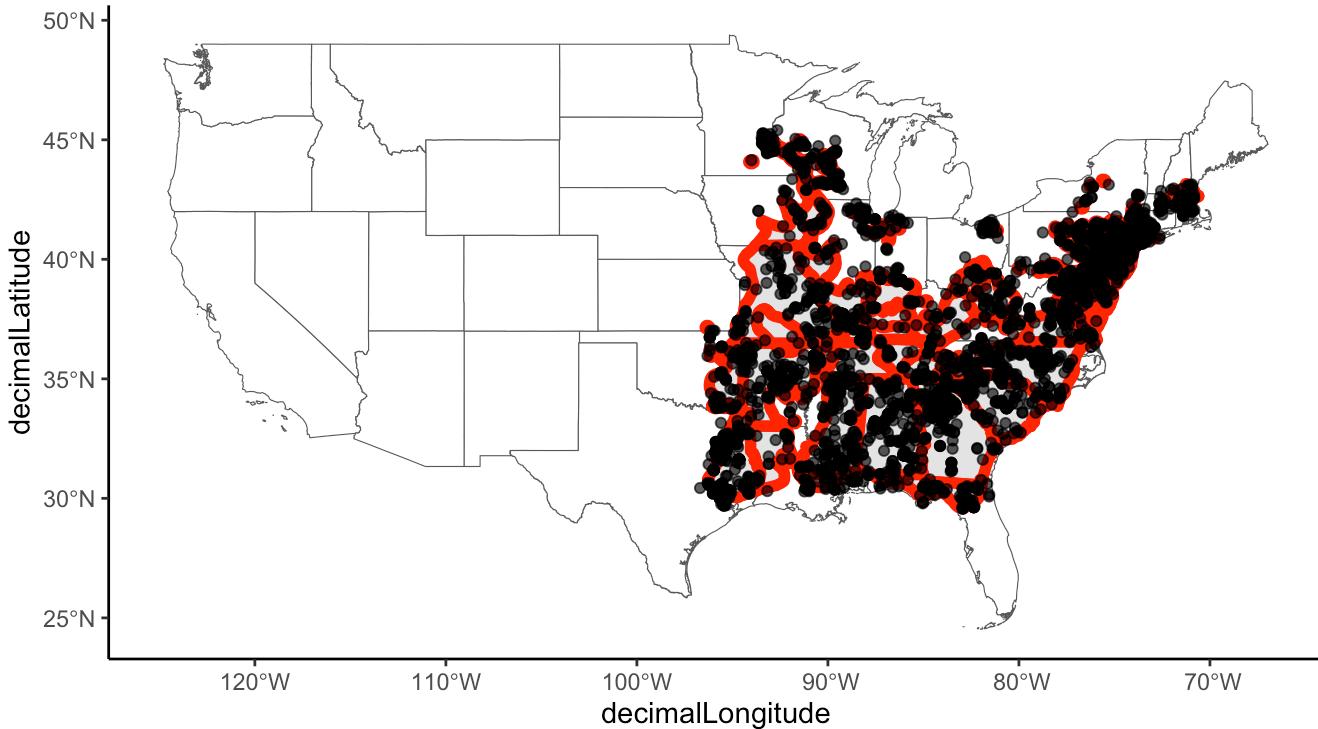
```
## Testing natural ranges
```

```
## Warning in cc_iucn(x = BENI.occ, range = BENI_clipped, lon =
## "decimalLongitude", : reprojecting reference to '+proj=longlat +datum=WGS84
## +no_defs'
```

```
## Flagged 410 records.
```

```
BENI_occ_final = BENI.occ[BENI_flag, ]
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = BENI_clipped, col = "red", linewidth = 2)+
  geom_point(data = BENI_occ_final, aes(x = decimalLongitude, y = decimalLatitude), colo
r = "black", alpha = 0.7)+
  theme_classic()
```



```
ggsave("../Plots/BENI.range.pdf", width = 12, height = 8)
```

Subset for *Betula papyrifera*

```
BEPA.occ = gbif %>%
  filter(species == "Betula papyrifera") %>%
  select(species,decimalLatitude,decimalLongitude)
```

Read in range map

```
BEPA.range = st_read("../USTreeAtlas/shp/betupapy/")
```

```
## Reading layer `betupapy' from data source
##   `/Users/samanthaworthy/Documents/GitHub/USTreeAtlas/shp/betupapy'
##   using driver `ESRI Shapefile'
## Simple feature collection with 482 features and 5 fields
## Geometry type: POLYGON
## Dimension:     XY
## Bounding box:  xmin: -164.7386 ymin: 35.027 xmax: -52.61445 ymax: 68.50498
## CRS:           NA
```

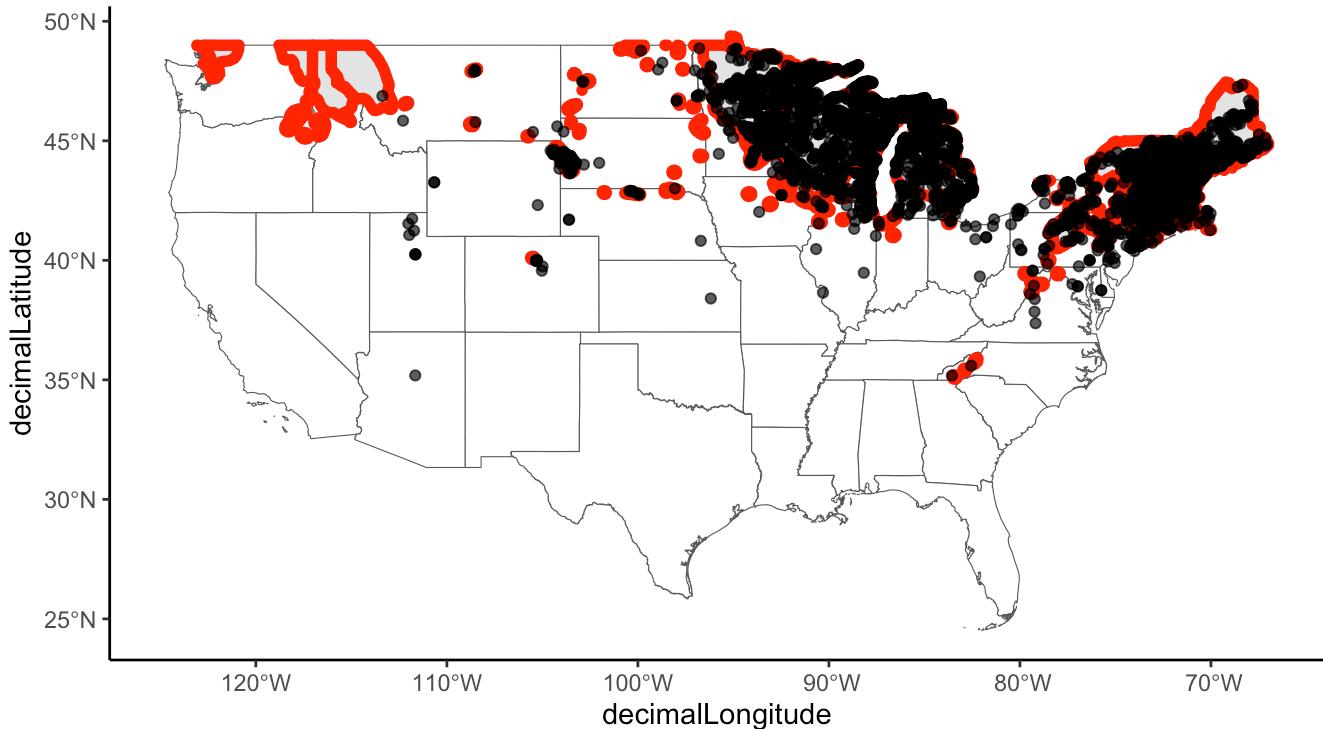
The projection is geographic with latitude and longitude. The datum is NAD27 which is EPSG:4267. The ellipsoid is Clarke 1866, and the transformation parameters

```
st_crs(BEPA.range) <- 4267
```

```
BEPA_clipped = st_intersection(BEPA.range, states.map)
```

```
## Warning: attribute variables are assumed to be spatially constant throughout
## all geometries
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = BEPA_clipped, col = "red", linewidth = 2)+
  geom_point(data = BEPA.occ, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
BEPA_clipped$species = "Betula papyrifera"
BEPA_flag = cc_iucn(x = BEPA.occ, range = BEPA_clipped, lon = "decimalLongitude", lat =
"decimalLatitude",
                     value = "flagged", buffer = 50000)
```

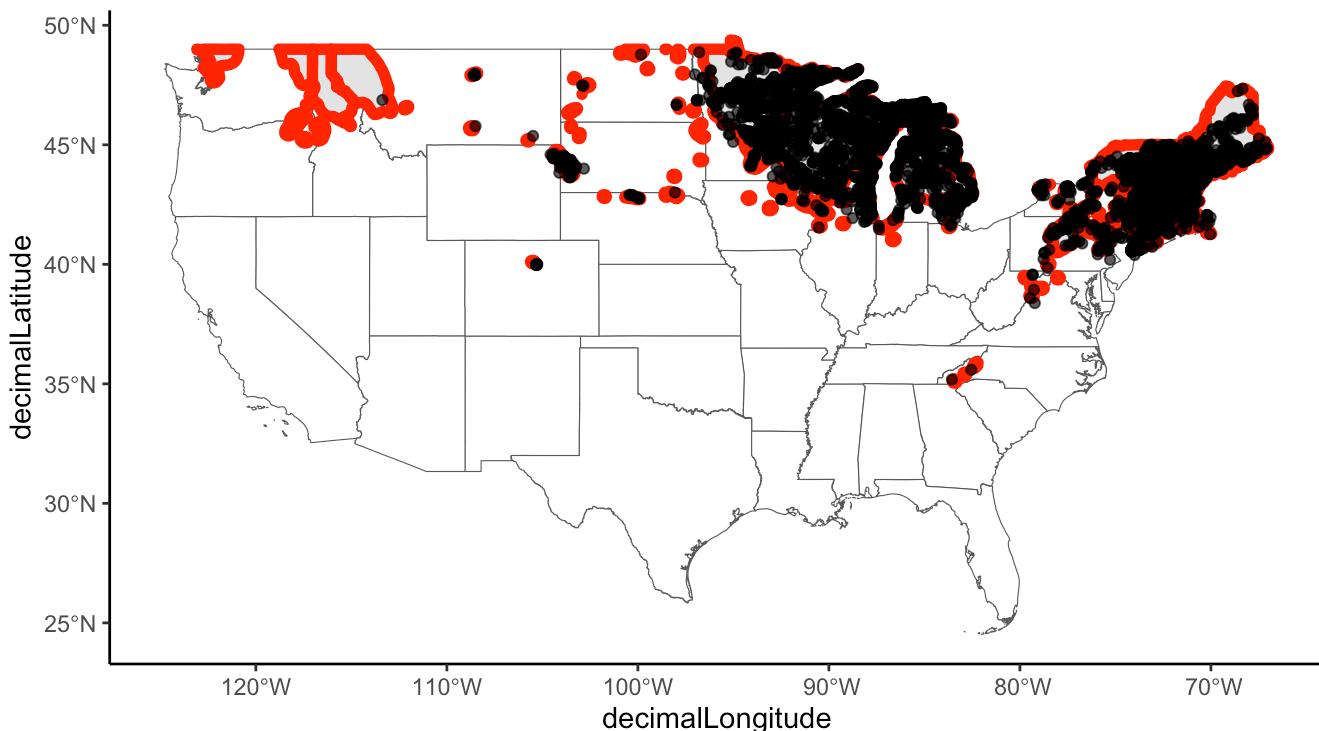
```
## Testing natural ranges
```

```
## Warning in cc_iucn(x = BEPA.occ, range = BEPA_clipped, lon =
## "decimalLongitude", : reprojecting reference to '+proj=longlat +datum=WGS84
## +no_defs'
```

```
## Flagged 92 records.
```

```
BEPA_occ_final = BEPA.occ[BEPA_flag, ]
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = BEPA_clipped, col = "red", linewidth = 2)+
  geom_point(data = BEPA_occ_final, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
ggsave("../Plots/BEPA.range.pdf", width = 12, height = 8)
```

Subset for *Betula populifolia*

```
BEP0.occ = gbif %>%
  filter(species == "Betula populifolia") %>%
  select(species,decimalLatitude,decimalLongitude)
```

Read in range map

```
BEP0.range = st_read("../USTreeAtlas/shp/betupopu/")
```

```
## Reading layer `betupopu' from data source
##   `/Users/samanthaworthy/Documents/GitHub/USTreeAtlas/shp/betupopu'
##   using driver `ESRI Shapefile'
## Simple feature collection with 145 features and 5 fields
## Geometry type: POLYGON
## Dimension:      XY
## Bounding box:  xmin: -87.36114 ymin: 35.00822 xmax: -59.68972 ymax: 47.98228
## CRS:           NA
```

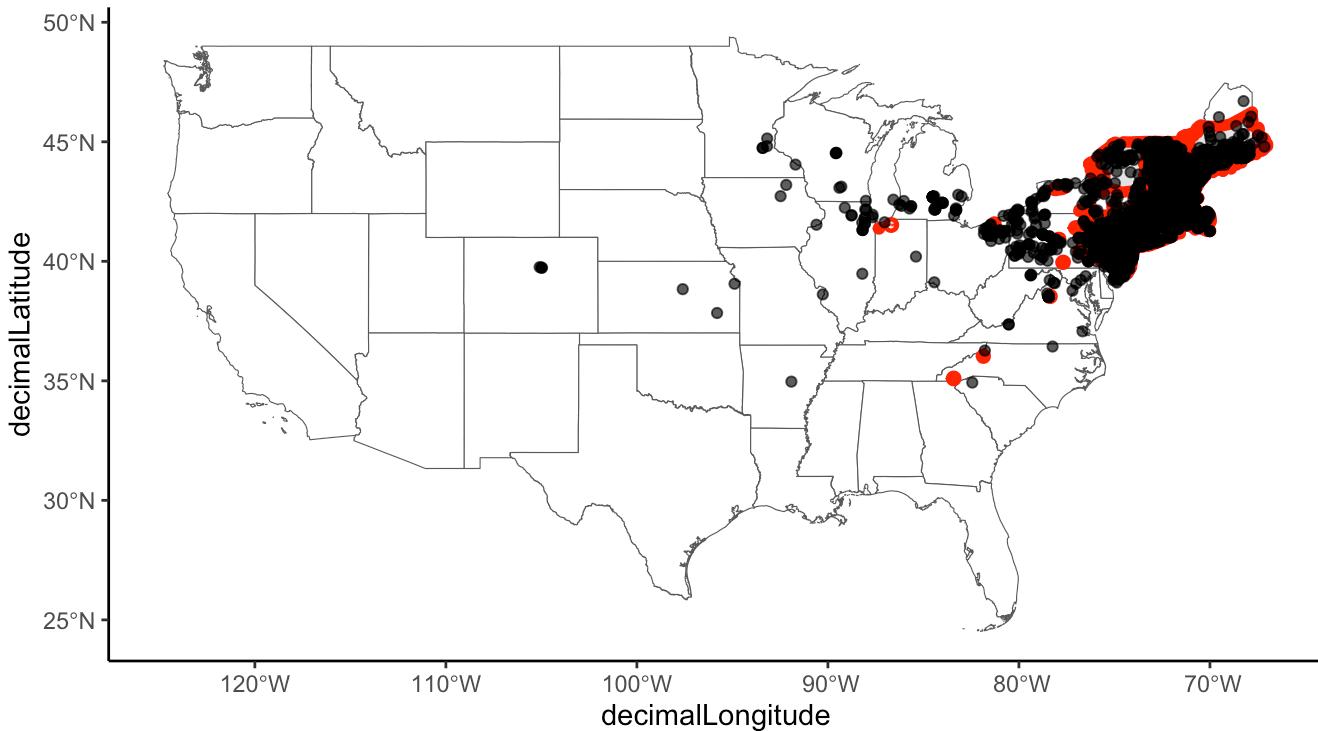
The projection is geographic with latitude and longitude. The datum is NAD27 which is EPSG:4267. The ellipsoid is Clarke 1866, and the transformation parameters

```
st_crs(BEP0.range) <- 4267
```

```
BEP0_clipped = st_intersection(BEP0.range, states.map)
```

```
## Warning: attribute variables are assumed to be spatially constant throughout
## all geometries
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = BEP0_clipped, col = "red", linewidth = 2)+
  geom_point(data = BEP0.occ, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
BEP0_clipped$species = "Betula populifolia"
BEP0_flag = cc_iucn(x = BEP0.occ, range = BEP0_clipped, lon = "decimalLongitude", lat =
"decimalLatitude",
                     value = "flagged", buffer = 50000)
```

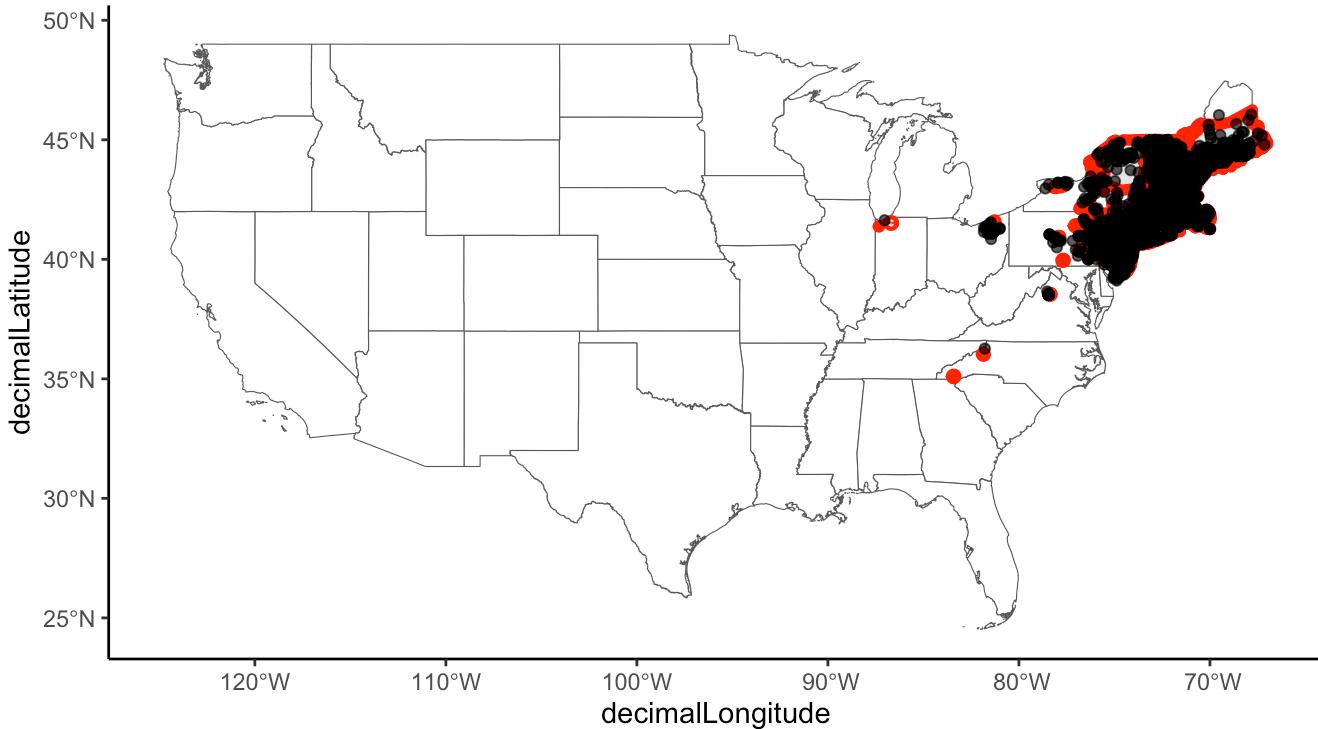
```
## Testing natural ranges
```

```
## Warning in cc_iucn(x = BEP0.occ, range = BEP0_clipped, lon =
## "decimalLongitude", : reprojecting reference to '+proj=longlat +datum=WGS84
## +no_defs'
```

```
## Flagged 178 records.
```

```
BEP0_occ_final = BEP0.occ[BEP0_flag, ]
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = BEP0_clipped, col = "red", linewidth = 2)+
  geom_point(data = BEP0_occ_final, aes(x = decimalLongitude, y = decimalLatitude), colo
r = "black", alpha = 0.7)+
  theme_classic()
```



```
ggsave("../Plots/BEP0.range.pdf", width = 12, height = 8)
```

Subset for *Carpinus caroliniana*

```
CACA18.occ = gbif %>%
  filter(species == "Carpinus caroliniana") %>%
  select(species,decimalLatitude,decimalLongitude)
```

Read in range map

```
CACA18.range = st_read("../USTreeAtlas/shp/carpcaro/")
```

```
## Reading layer `carpcaro' from data source
##   `/Users/samanthaworthy/Documents/GitHub/USTreeAtlas/shp/carpcaro'
##   using driver `ESRI Shapefile'
## Simple feature collection with 74 features and 5 fields
## Geometry type: POLYGON
## Dimension:     XY
## Bounding box:  xmin: -108.0685 ymin: 13.74625 xmax: -68.47728 ymax: 47.47089
## CRS:           NA
```

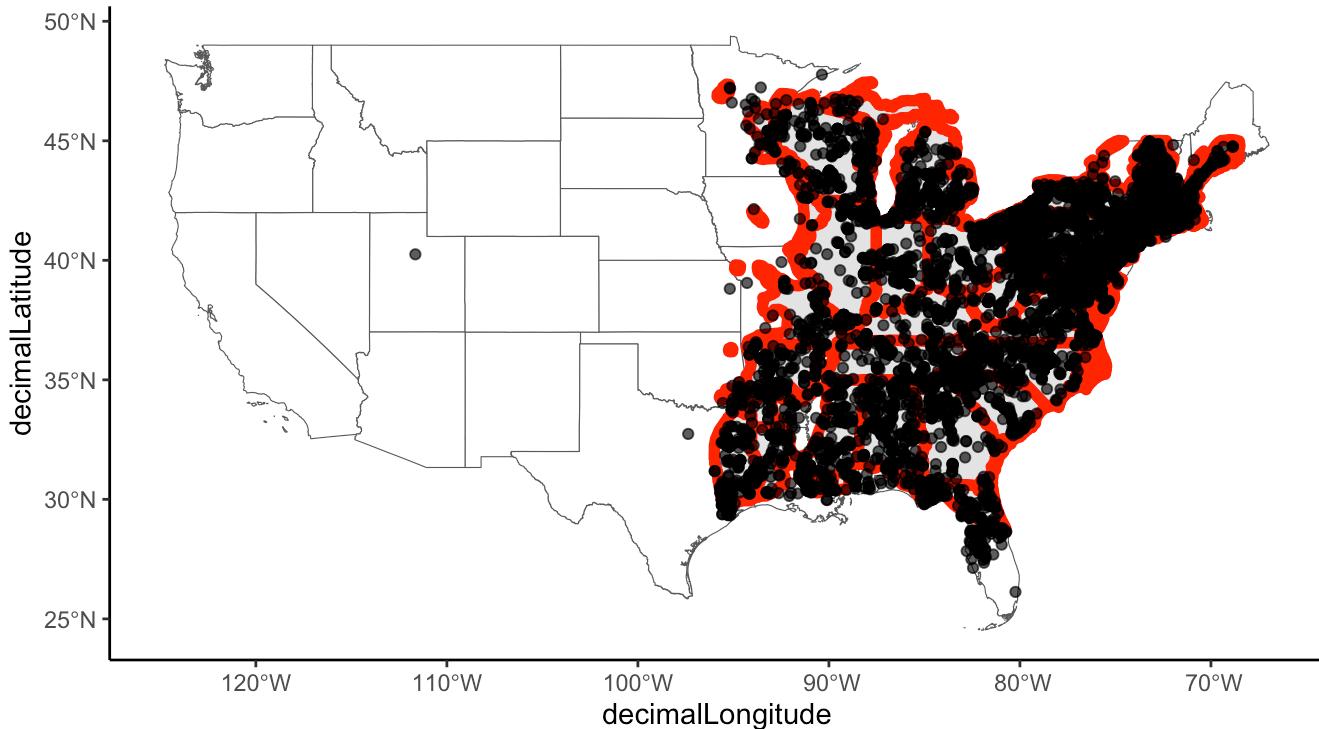
The projection is geographic with latitude and longitude. The datum is NAD27 which is EPSG:4267. The ellipsoid is Clarke 1866, and the transformation parameters

```
st_crs(CACA18.range) <- 4267
```

```
CACA18_clipped = st_intersection(CACA18.range, states.map)
```

```
## Warning: attribute variables are assumed to be spatially constant throughout
## all geometries
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = CACA18_clipped, col = "red", linewidth = 2)+
  geom_point(data = CACA18.occ, aes(x = decimalLongitude, y = decimalLatitude), color =
"black", alpha = 0.7)+
  theme_classic()
```



```
CACA18_clipped$species = "Carpinus caroliniana"
CACA18_flag = cc_iucn(x = CACA18.occ, range = CACA18_clipped, lon = "decimalLongitude",
lat = "decimalLatitude",
value = "flagged", buffer = 50000)
```

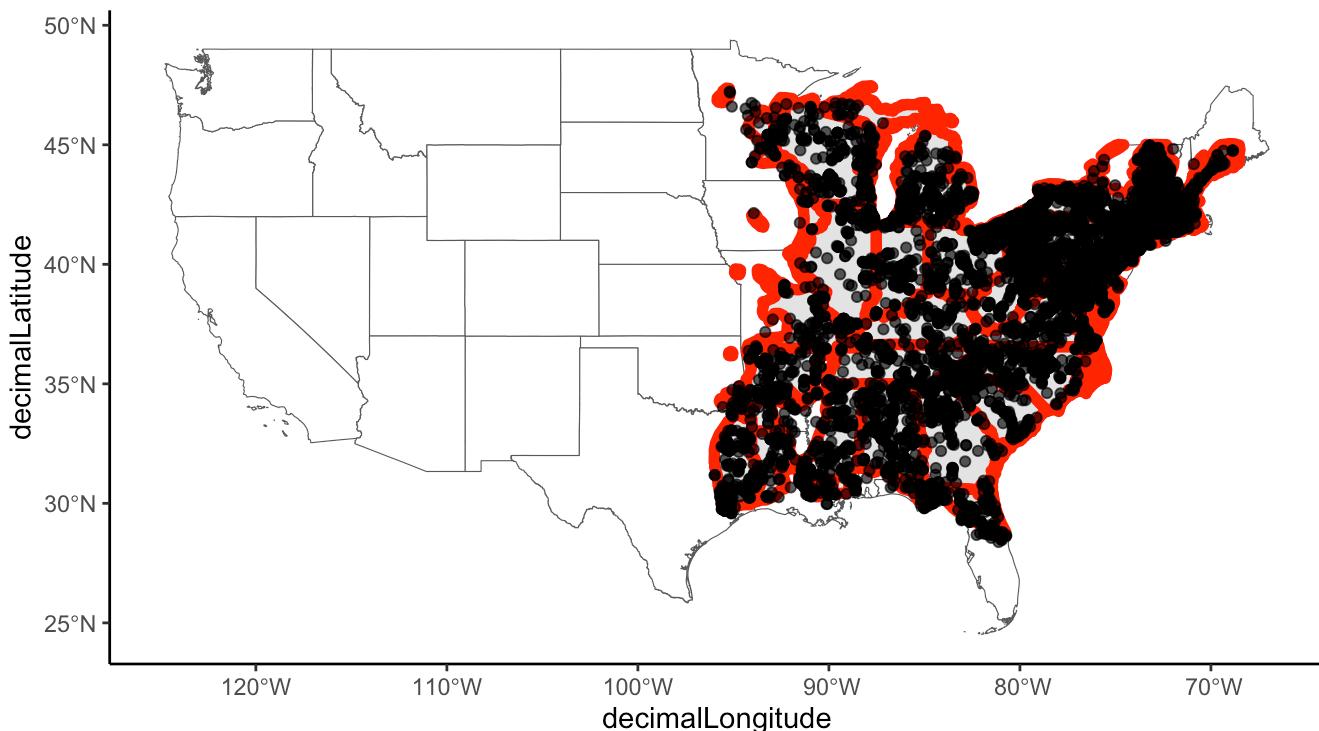
```
## Testing natural ranges
```

```
## Warning in cc_iucn(x = CACA18.occ, range = CACA18_clipped, lon =
## "decimalLongitude", : reprojecting reference to '+proj=longlat +datum=WGS84
## +no_defs'
```

```
## Flagged 71 records.
```

```
CACA18_occ_final = CACA18.occ[CACA18_flag, ]
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = CACA18_clipped, col = "red", linewidth = 2)+
  geom_point(data = CACA18_occ_final, aes(x = decimalLongitude, y = decimalLatitude), co
lor = "black", alpha = 0.7)+
  theme_classic()
```



```
ggsave("../Plots/CACA18.range.pdf", width = 12, height = 8)
```

Subset for *Carya alba*. Little range map unavailable.

```
CAAL27.occ = gbif %>%
  filter(species == "Carya alba") %>%
  select(species,decimalLatitude,decimalLongitude)
```

Get range map from BIEN

```
(CAAL27.range.sf <- BIEN_ranges_load_species('Carya alba'))
```

```
## Simple feature collection with 1 feature and 2 fields
## Geometry type: MULTIPOLYGON
## Dimension: XY
## Bounding box: xmin: -100.7872 ymin: 24.96015 xmax: -69.82852 ymax: 45.10361
## Geodetic CRS: WGS 84
##   species      gid      geometry
## 1 Carya_alba 16705 MULTIPOLYGON (((-100.3058 2...
```

The projection is geographic with latitude and longitude. The datum is NAD27 which is EPSG:4267. The BIEN ranges are WG84.

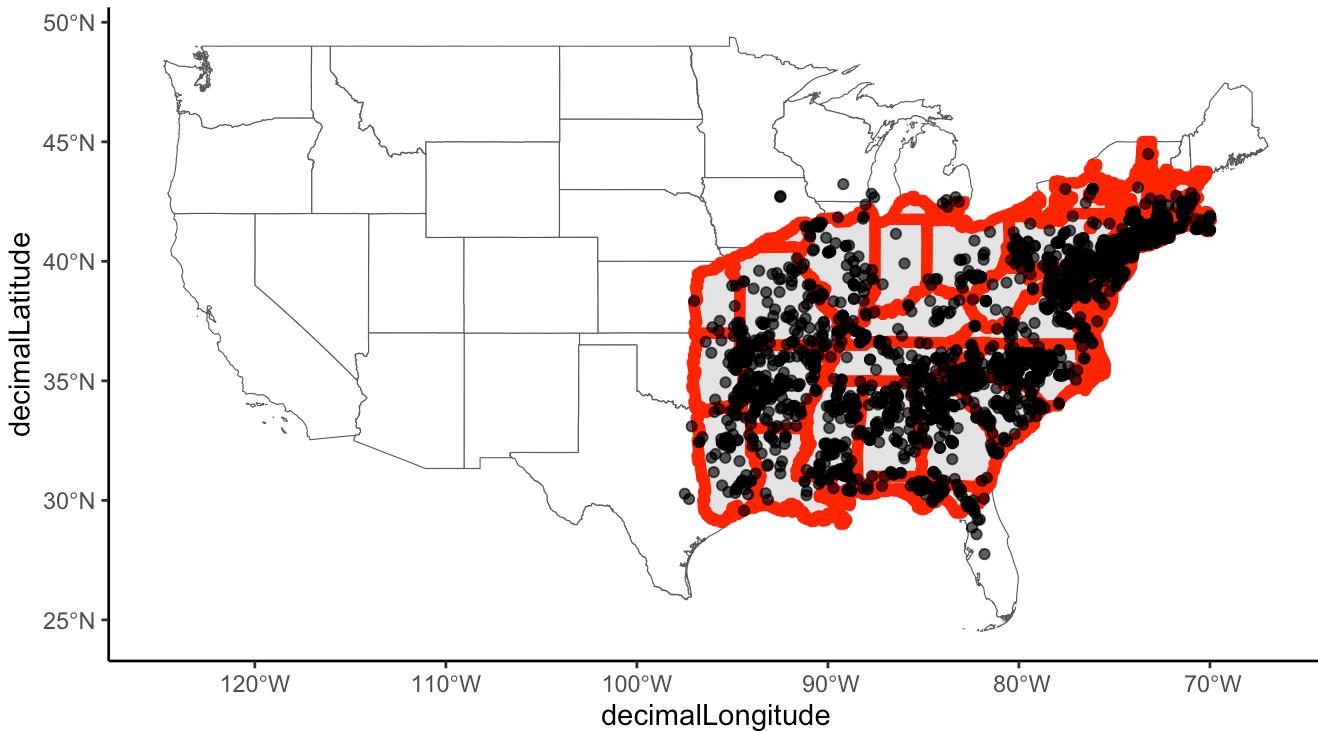
```
CAAL27.range.2 = CAAL27.range.sf %>%
  st_transform(st_crs(states.map))
```

```
CAAL27.range.3 = terra::vect(CAAL27.range.2)
states.map.2 = terra::vect(states.map)
```

```
CAAL27.range.4 = terra::intersect(CAAL27.range.3, states.map.2)
```

```
CAAL27.range.5 = st_as_sf(CAAL27.range.4)
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(dat = CAAL27.range.5, col = "red", linewidth = 2)+
  geom_point(data = CAAL27.occ, aes(x = decimalLongitude, y = decimalLatitude), color =
"black", alpha = 0.7)+
  theme_classic()
```



```
CAAL27.range.5$species = "Carya alba"
CAAL27_flag = cc_iucn(x = CAAL27.occ, range = CAAL27.range.5, lon = "decimalLongitude",
lat = "decimalLatitude",
value = "flagged", buffer = 50000)
```

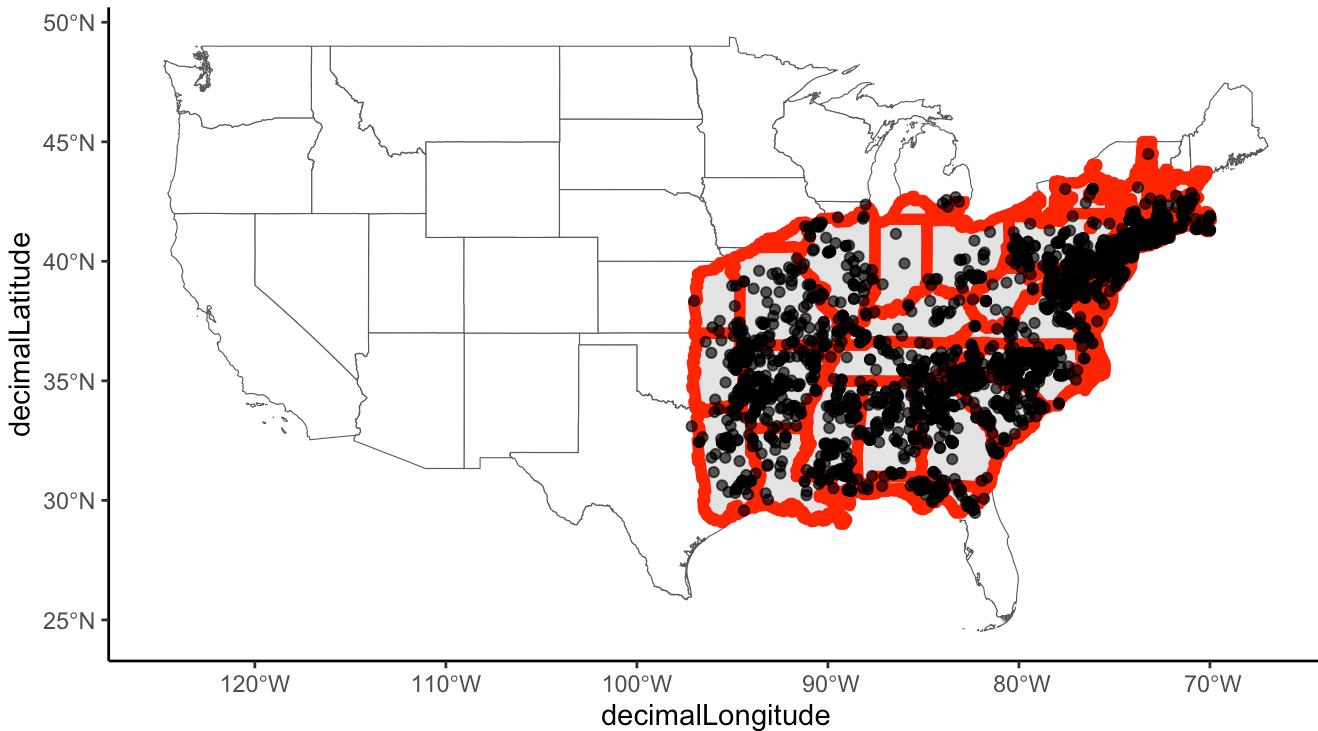
```
## Testing natural ranges
```

```
## Warning in cc_iucn(x = CAAL27.occ, range = CAAL27.range.5, lon =
## "decimalLongitude", : reprojecting reference to '+proj=longlat +datum=WGS84
## +no_defs'
```

```
## Flagged 12 records.
```

```
CAAL27_occ_final = CAAL27.occ[CAAL27_flag, ]
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = CAAL27.range.5, col = "red", linewidth = 2)+
  geom_point(data = CAAL27_occ_final, aes(x = decimalLongitude, y = decimalLatitude), co
lor = "black", alpha = 0.7)+
  theme_classic()
```



```
ggsave("../Plots/CAAL27.range.pdf", width = 12, height = 8)
```

Subset for *Carya aquatica*

```
CAAQ2.occ = gbif %>%
  filter(species == "Carya aquatica") %>%
  select(species,decimalLatitude,decimalLongitude)
```

Read in range map

```
CAAQ2.range = st_read("../USTreeAtlas/shp/caryaqua/")
```

```
## Reading layer `caryaqua` from data source
##   `/Users/samanthaworthy/Documents/GitHub/USTreeAtlas/shp/caryaqua'
##   using driver `ESRI Shapefile'
## Simple feature collection with 46 features and 5 fields
## Geometry type: POLYGON
## Dimension:     XY
## Bounding box:  xmin: -97.70158 ymin: 26.41639 xmax: -75.71973 ymax: 37.88053
## CRS:           NA
```

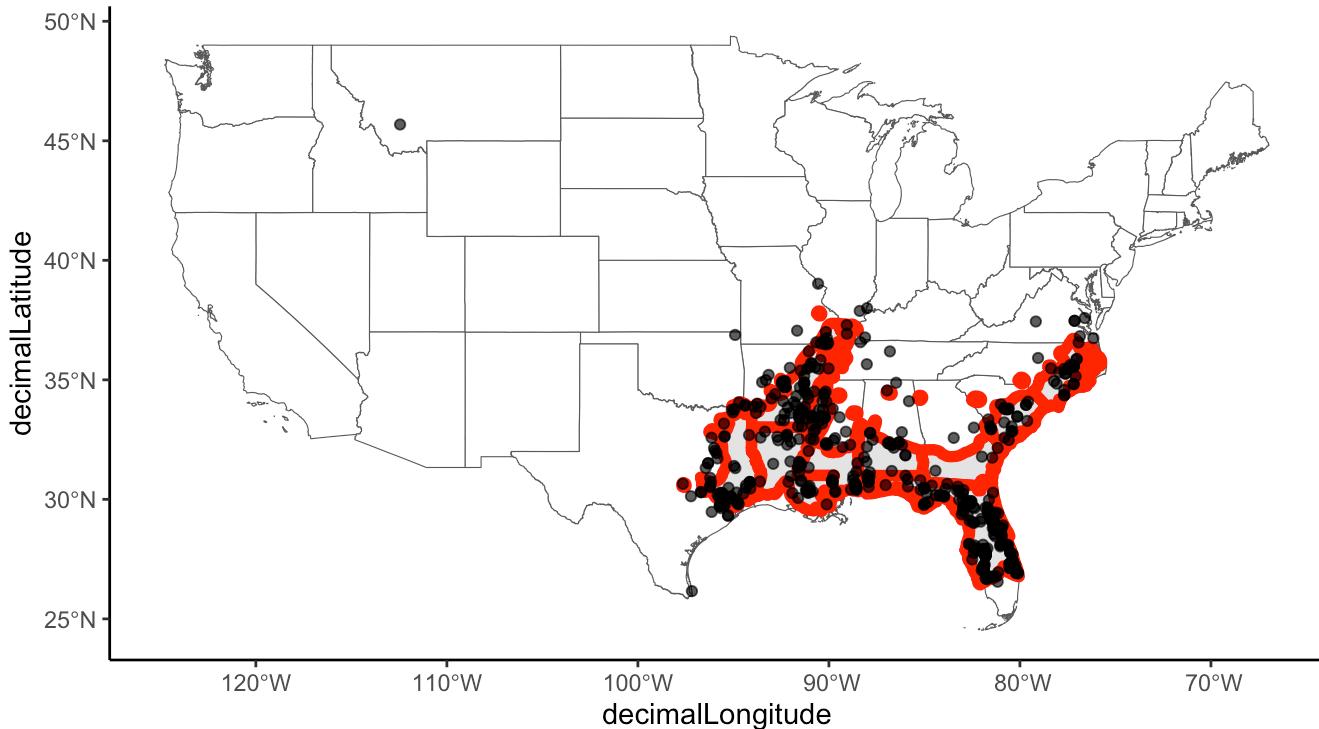
The projection is geographic with latitude and longitude. The datum is NAD27 which is EPSG:4267. The ellipsoid is Clarke 1866, and the transformation parameters

```
st_crs(CAAQ2.range) <- 4267
```

```
CAAQ2_clipped = st_intersection(CAAQ2.range, states.map)
```

```
## Warning: attribute variables are assumed to be spatially constant throughout
## all geometries
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = CAAQ2_clipped, col = "red", linewidth = 2)+
  geom_point(data = CAAQ2.occ, aes(x = decimalLongitude, y = decimalLatitude), color =
"black", alpha = 0.7)+
  theme_classic()
```



```
CAAQ2_clipped$species = "Carya aquatica"
CAAQ2_flag = cc_iucn(x = CAAQ2.occ, range = CAAQ2_clipped, lon = "decimalLongitude", lat =
"decimalLatitude",
                      value = "flagged", buffer = 50000)
```

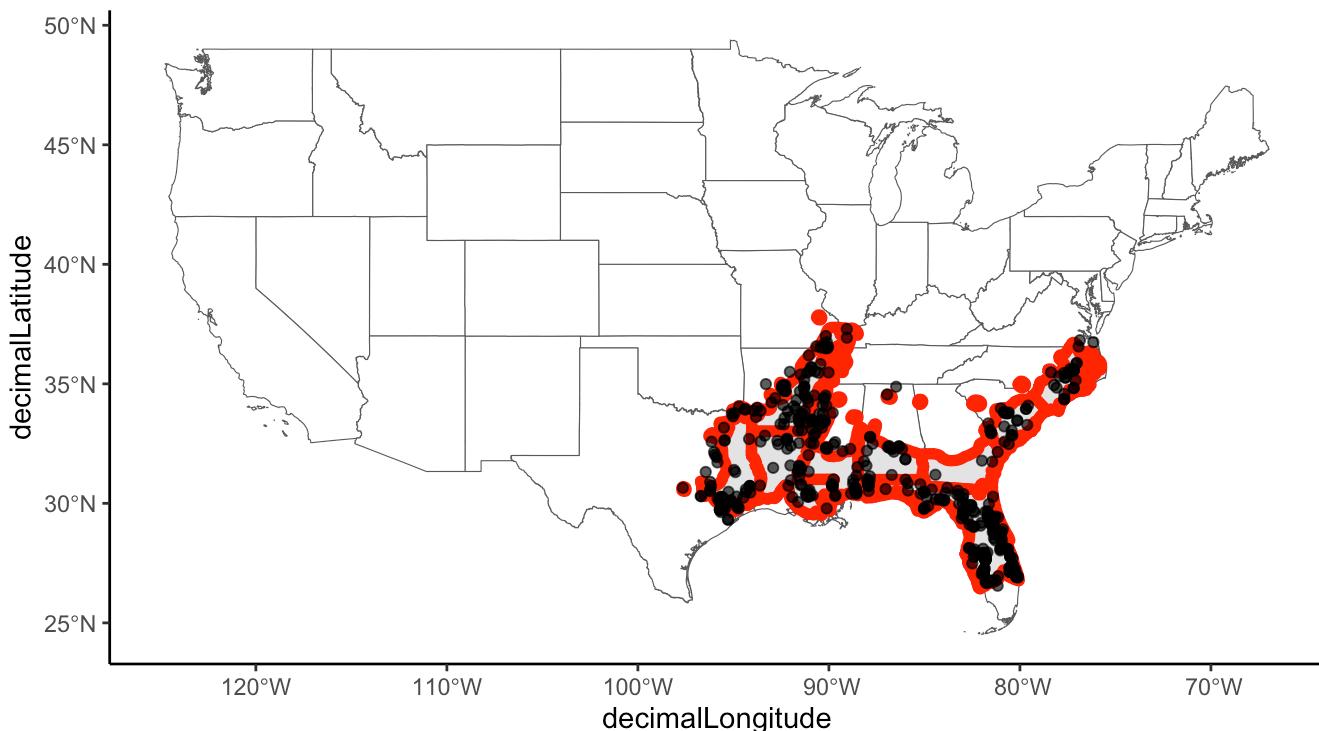
```
## Testing natural ranges
```

```
## Warning in cc_iucn(x = CAAQ2.occ, range = CAAQ2_clipped, lon =
## "decimalLongitude", : reprojecting reference to '+proj=longlat +datum=WGS84
## +no_defs'
```

```
## Flagged 28 records.
```

```
CAAQ2_occ_final = CAAQ2.occ[CAAQ2_flag, ]
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = CAAQ2_clipped, col = "red", linewidth = 2)+
  geom_point(data = CAAQ2_occ_final, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
ggsave("../Plots/CAAQ2.range.pdf", width = 12, height = 8)
```

Subset for *Carya cordiformis*

```
CAC015.occ = gbif %>%
  filter(species == "Carya cordiformis") %>%
  select(species,decimalLatitude,decimalLongitude)
```

Read in range map

```
CAC015.range = st_read("../USTreeAtlas/shp/carycord/")
```

```
## Reading layer `carycord' from data source
##   `/Users/samanthaworthy/Documents/GitHub/USTreeAtlas/shp/carycord'
##   using driver `ESRI Shapefile'
## Simple feature collection with 62 features and 5 fields
## Geometry type: POLYGON
## Dimension:      XY
## Bounding box:  xmin: -98.77852 ymin: 29.61891 xmax: -70.9063 ymax: 47.43512
## CRS:            NA
```

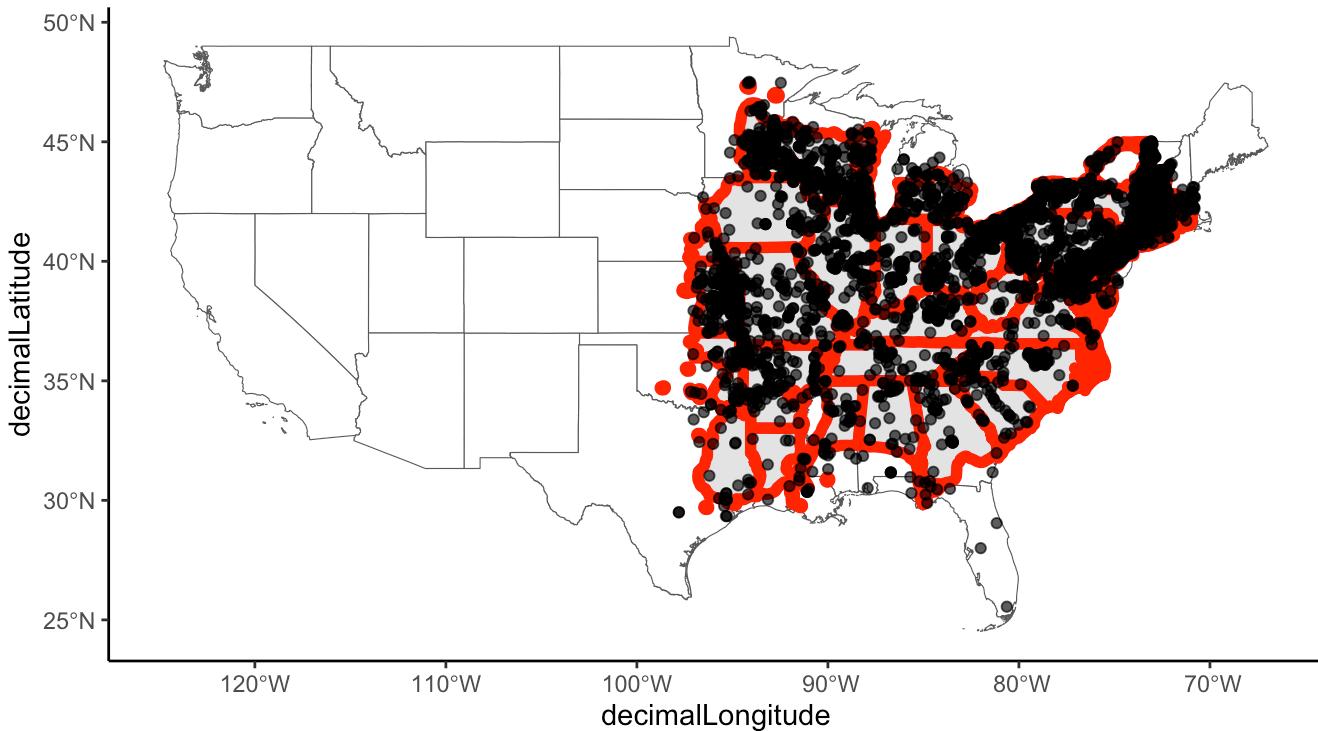
The projection is geographic with latitude and longitude. The datum is NAD27 which is EPSG:4267. The ellipsoid is Clarke 1866, and the transformation parameters

```
st_crs(CAC015.range) <- 4267
```

```
CAC015_clipped = st_intersection(CAC015.range, states.map)
```

```
## Warning: attribute variables are assumed to be spatially constant throughout
## all geometries
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = CAC015_clipped, col = "red", linewidth = 2)+
  geom_point(data = CAC015.occ, aes(x = decimalLongitude, y = decimalLatitude), color =
"black", alpha = 0.7)+
  theme_classic()
```



```
CAC015_clipped$species = "Carya cordiformis"
CAC015_flag = cc_iucn(x = CAC015.occ, range = CAC015_clipped, lon = "decimalLongitude",
lat = "decimalLatitude",
value = "flagged", buffer = 50000)
```

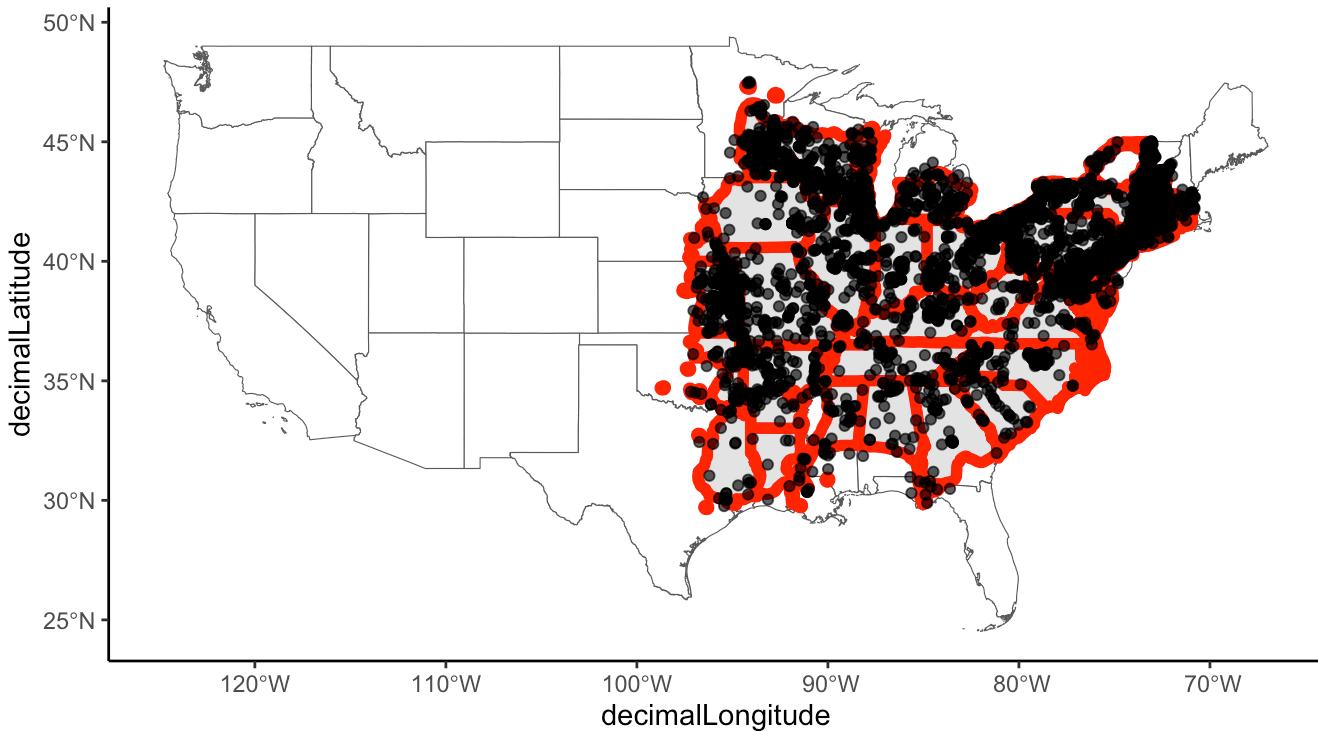
```
## Testing natural ranges
```

```
## Warning in cc_iucn(x = CAC015.occ, range = CAC015_clipped, lon =
## "decimalLongitude", : reprojecting reference to '+proj=longlat +datum=WGS84
## +no_defs'
```

```
## Flagged 25 records.
```

```
CAC015_occ_final = CAC015.occ[CAC015_flag, ]
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = CAC015_clipped, col = "red", linewidth = 2)+
  geom_point(data = CAC015_occ_final, aes(x = decimalLongitude, y = decimalLatitude), co
lor = "black", alpha = 0.7)+
  theme_classic()
```



```
ggsave("../Plots/CAC015.range.pdf", width = 12, height = 8)
```

Subset for *Carya glabra*

```
CAGL8.occ = gbif %>%
  filter(species == "Carya glabra") %>%
  select(species,decimalLatitude,decimalLongitude)
```

Read in range map

```
CAGL8.range = st_read("../USTreeAtlas/shp/caryglab/")
```

```
## Reading layer `caryglab` from data source
##   `/Users/samanthaworthy/Documents/GitHub/USTreeAtlas/shp/caryglab'
##   using driver `ESRI Shapefile'
## Simple feature collection with 88 features and 5 fields
## Geometry type: POLYGON
## Dimension:     XY
## Bounding box:  xmin: -95.0925 ymin: 26.5667 xmax: -69.92722 ymax: 44.09084
## CRS:           NA
```

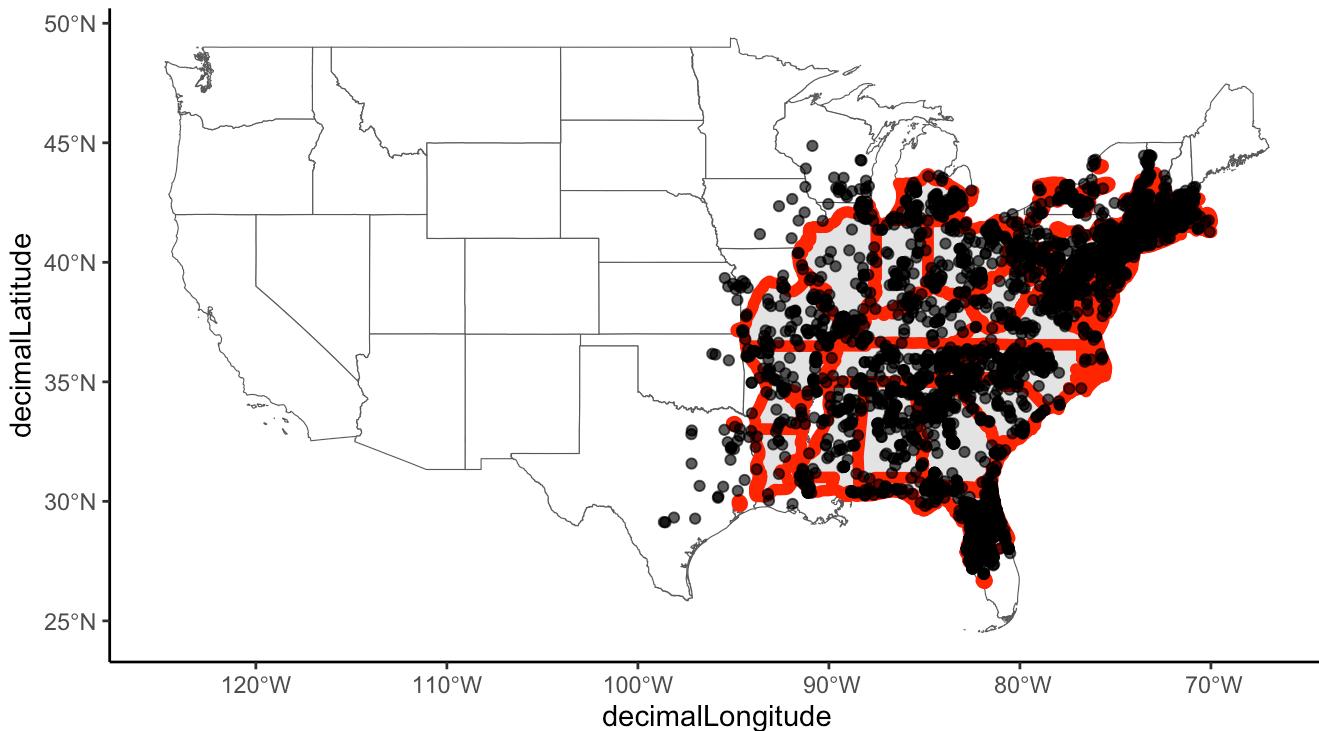
The projection is geographic with latitude and longitude. The datum is NAD27 which is EPSG:4267. The ellipsoid is Clarke 1866, and the transformation parameters

```
st_crs(CAGL8.range) <- 4267
```

```
CAGL8_clipped = st_intersection(CAGL8.range, states.map)
```

```
## Warning: attribute variables are assumed to be spatially constant throughout
## all geometries
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = CAGL8_clipped, col = "red", linewidth = 2)+
  geom_point(data = CAGL8.occ, aes(x = decimalLongitude, y = decimalLatitude), color =
"black", alpha = 0.7)+
  theme_classic()
```



```
CAGL8_clipped$species = "Carya glabra"
CAGL8_flag = cc_iucn(x = CAGL8.occ, range = CAGL8_clipped, lon = "decimalLongitude", lat =
= "decimalLatitude",
                      value = "flagged", buffer = 50000)
```

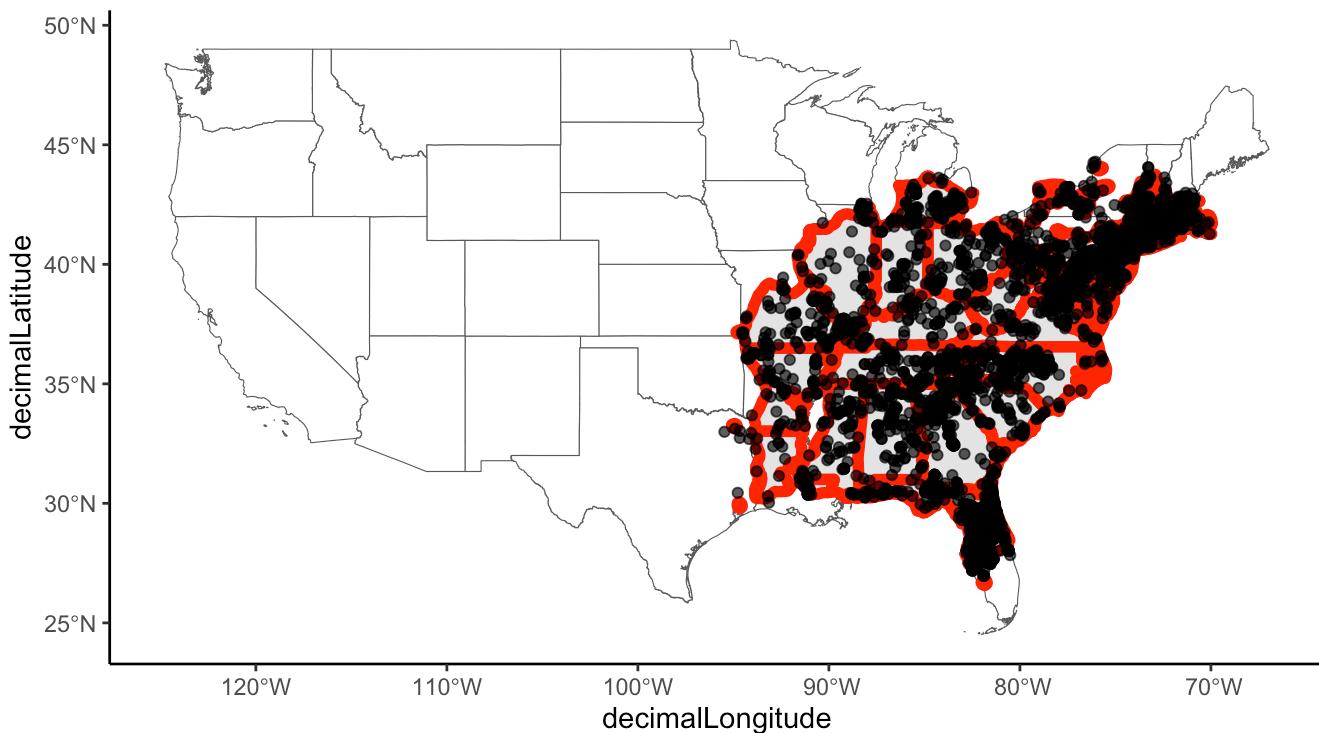
```
## Testing natural ranges
```

```
## Warning in cc_iucn(x = CAGL8.occ, range = CAGL8_clipped, lon =
## "decimalLongitude", : reprojecting reference to '+proj=longlat +datum=WGS84
## +no_defs'
```

```
## Flagged 82 records.
```

```
CAGL8_occ_final = CAGL8.occ[CAGL8_flag, ]
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = CAGL8_clipped, col = "red", linewidth = 2)+
  geom_point(data = CAGL8_occ_final, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
ggsave("../Plots/CAGL8.range.pdf", width = 12, height = 8)
```

Subset for *Carya illinoiensis*

```
CAIL2.occ = gbif %>%
  filter(species == "Carya illinoiensis") %>%
  select(species,decimalLatitude,decimalLongitude)
```

Read in range map

```
CAIL2.range = st_read("../USTreeAtlas/shp/caryilli/")
```

```
## Reading layer `caryilli' from data source
##   `/Users/samanthaworthy/Documents/GitHub/USTreeAtlas/shp/caryilli'
##   using driver `ESRI Shapefile'
## Simple feature collection with 22 features and 5 fields
## Geometry type: POLYGON
## Dimension:      XY
## Bounding box:  xmin: -104.0874 ymin: 25.38815 xmax: -84.48216 ymax: 42.30187
## CRS:           NA
```

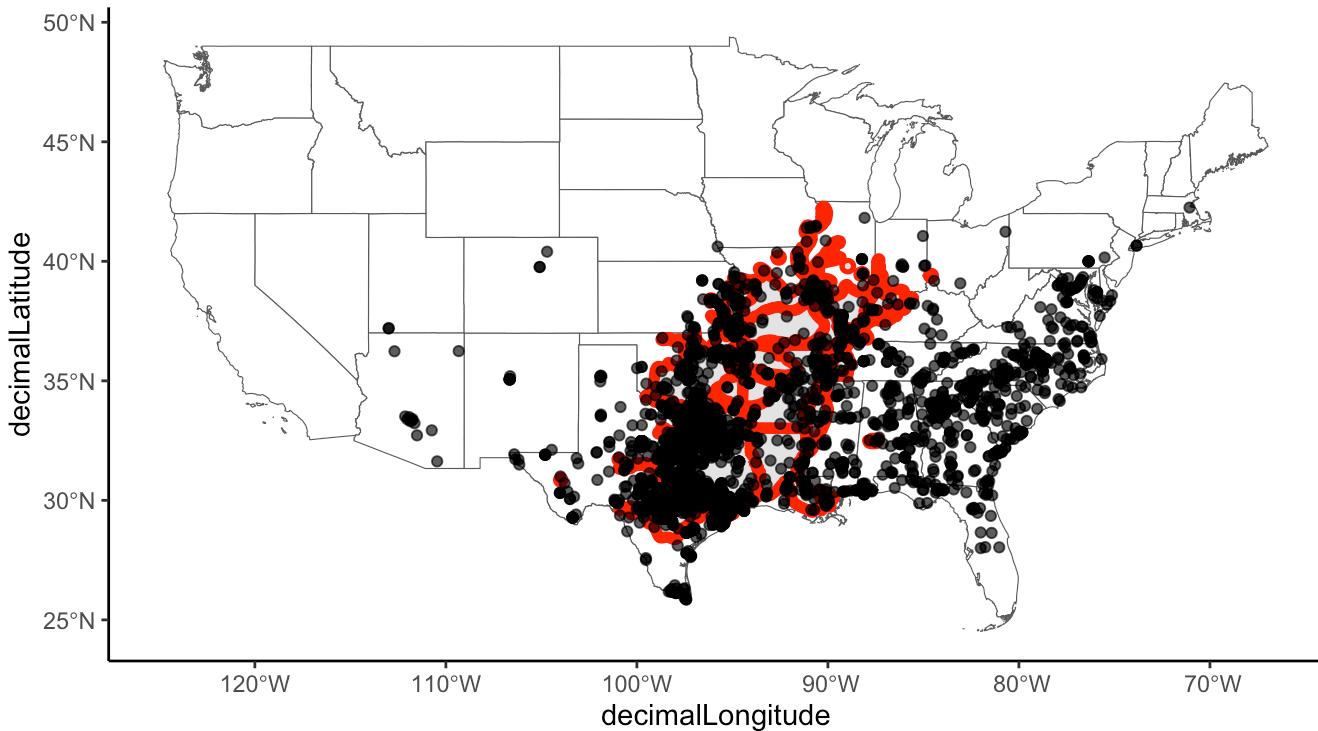
The projection is geographic with latitude and longitude. The datum is NAD27 which is EPSG:4267. The ellipsoid is Clarke 1866, and the transformation parameters

```
st_crs(CAIL2.range) <- 4267
```

```
CAIL2_clipped = st_intersection(CAIL2.range, states.map)
```

```
## Warning: attribute variables are assumed to be spatially constant throughout
## all geometries
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = CAIL2_clipped, col = "red", linewidth = 2)+
  geom_point(data = CAIL2.occ, aes(x = decimalLongitude, y = decimalLatitude), color =
"black", alpha = 0.7)+
  theme_classic()
```



```
CAIL2_clipped$species = "Carya illinoiensis"
CAIL2_flag = cc_iucn(x = CAIL2.occ, range = CAIL2_clipped, lon = "decimalLongitude", lat = "decimalLatitude",
                      value = "flagged", buffer = 50000)
```

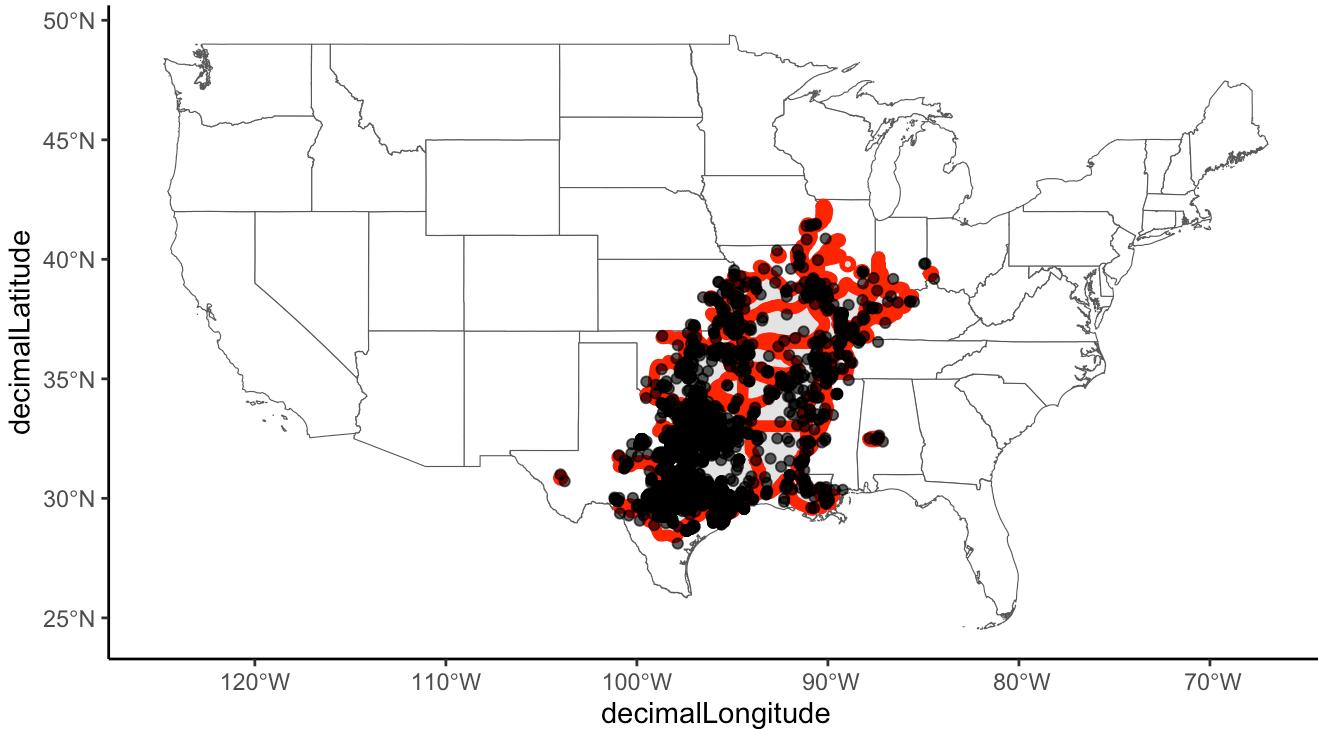
```
## Testing natural ranges
```

```
## Warning in cc_iucn(x = CAIL2.occ, range = CAIL2_clipped, lon =
## "decimalLongitude", : reprojecting reference to '+proj=longlat +datum=WGS84
## +no_defs'
```

```
## Flagged 899 records.
```

```
CAIL2_occ_final = CAIL2.occ[CAIL2_flag, ]
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = CAIL2_clipped, col = "red", linewidth = 2)+
  geom_point(data = CAIL2_occ_final, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
ggsave("../Plots/CAIL2.range.pdf", width = 12, height = 8)
```

Subset for *Carya ovata*

```
CAOV2.occ = gbif %>%
  filter(species == "Carya ovata") %>%
  select(species,decimalLatitude,decimalLongitude)
```

Read in range map

```
CAOV2.range = st_read("../USTreeAtlas/shp/caryovat/")
```

```
## Reading layer `caryovat' from data source
##   `/Users/samanthaworthy/Documents/GitHub/USTreeAtlas/shp/caryovat'
##   using driver `ESRI Shapefile'
## Simple feature collection with 49 features and 5 fields
## Geometry type: POLYGON
## Dimension:     XY
## Bounding box:  xmin: -101.1183 ymin: 19.93666 xmax: -69.77362 ymax: 46.39629
## CRS:           NA
```

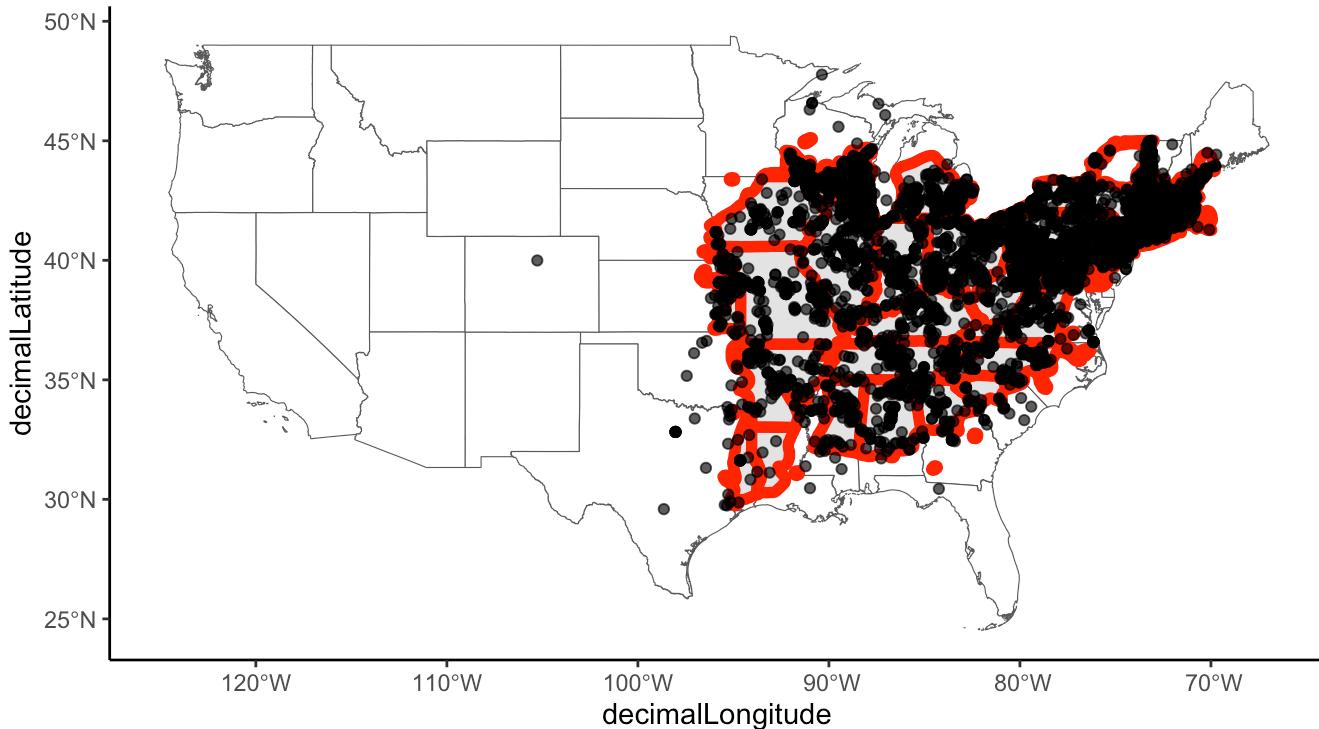
The projection is geographic with latitude and longitude. The datum is NAD27 which is EPSG:4267. The ellipsoid is Clarke 1866, and the transformation parameters

```
st_crs(CA0V2.range) <- 4267
```

```
CA0V2_clipped = st_intersection(CA0V2.range, states.map)
```

```
## Warning: attribute variables are assumed to be spatially constant throughout
## all geometries
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = CA0V2_clipped, col = "red", linewidth = 2)+
  geom_point(data = CA0V2.occ, aes(x = decimalLongitude, y = decimalLatitude), color =
"black", alpha = 0.7)+
  theme_classic()
```



```
CA0V2_clipped$species = "Carya ovata"
CA0V2_flag = cc_iucn(x = CA0V2.occ, range = CA0V2_clipped, lon = "decimalLongitude", lat =
"decimalLatitude",
                      value = "flagged", buffer = 50000)
```

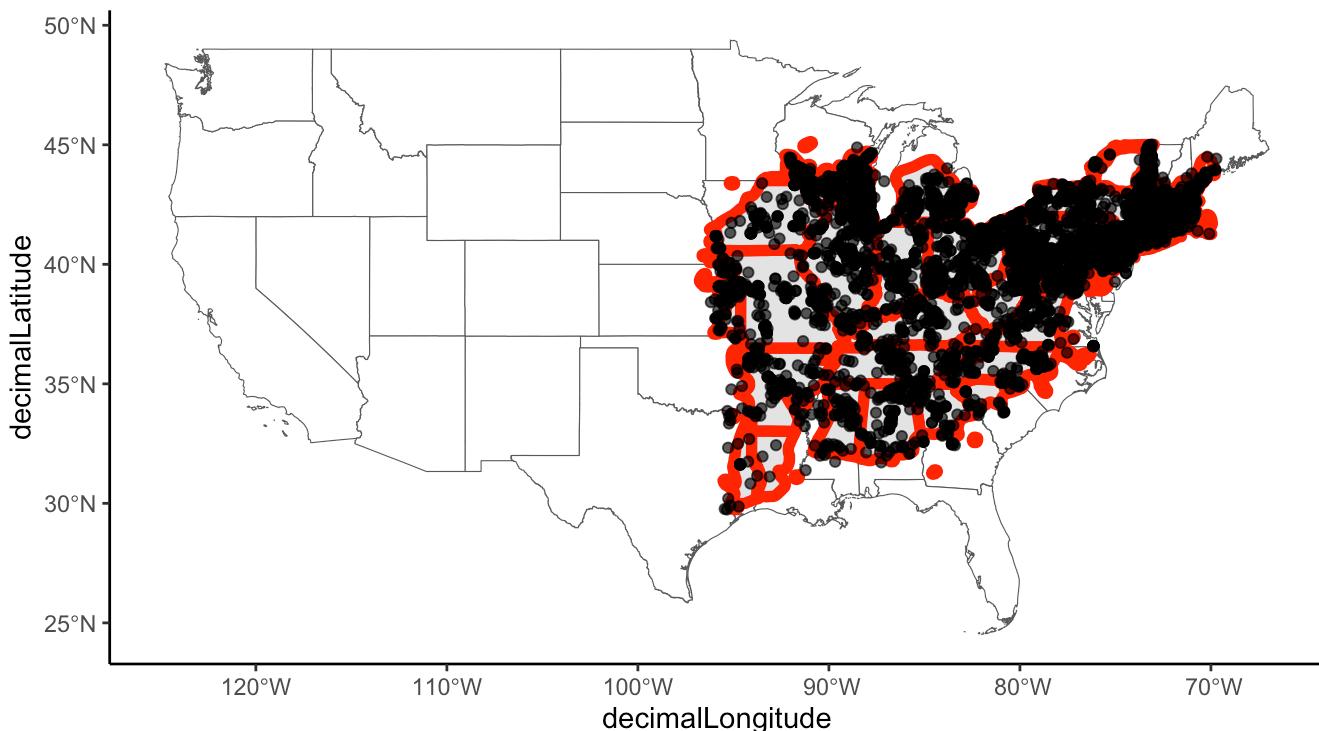
```
## Testing natural ranges
```

```
## Warning in cc_iucn(x = CA0V2.occ, range = CA0V2_clipped, lon =
## "decimalLongitude", : reprojecting reference to '+proj=longlat +datum=WGS84
## +no_defs'
```

```
## Flagged 41 records.
```

```
CA0V2_occ_final = CA0V2.occ[CA0V2_flag, ]
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = CA0V2_clipped, col = "red", linewidth = 2)+
  geom_point(data = CA0V2_occ_final, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
ggsave("../Plots/CA0V2.range.pdf", width = 12, height = 8)
```

Subset for *Carya texana*

```
CATE9.occ = gbif %>%
  filter(species == "Carya texana") %>%
  select(species,decimalLatitude,decimalLongitude)
```

Read in range map

```
CATE9.range = st_read("../USTreeAtlas/shp/carytexa/")
```

```
## Reading layer `carytexa' from data source
##   `/Users/samanthaworthy/Documents/GitHub/USTreeAtlas/shp/carytexa'
##   using driver `ESRI Shapefile'
## Simple feature collection with 10 features and 5 fields
## Geometry type: POLYGON
## Dimension:      XY
## Bounding box:  xmin: -99.2131 ymin: 28.6377 xmax: -87.35191 ymax: 40.45395
## CRS:           NA
```

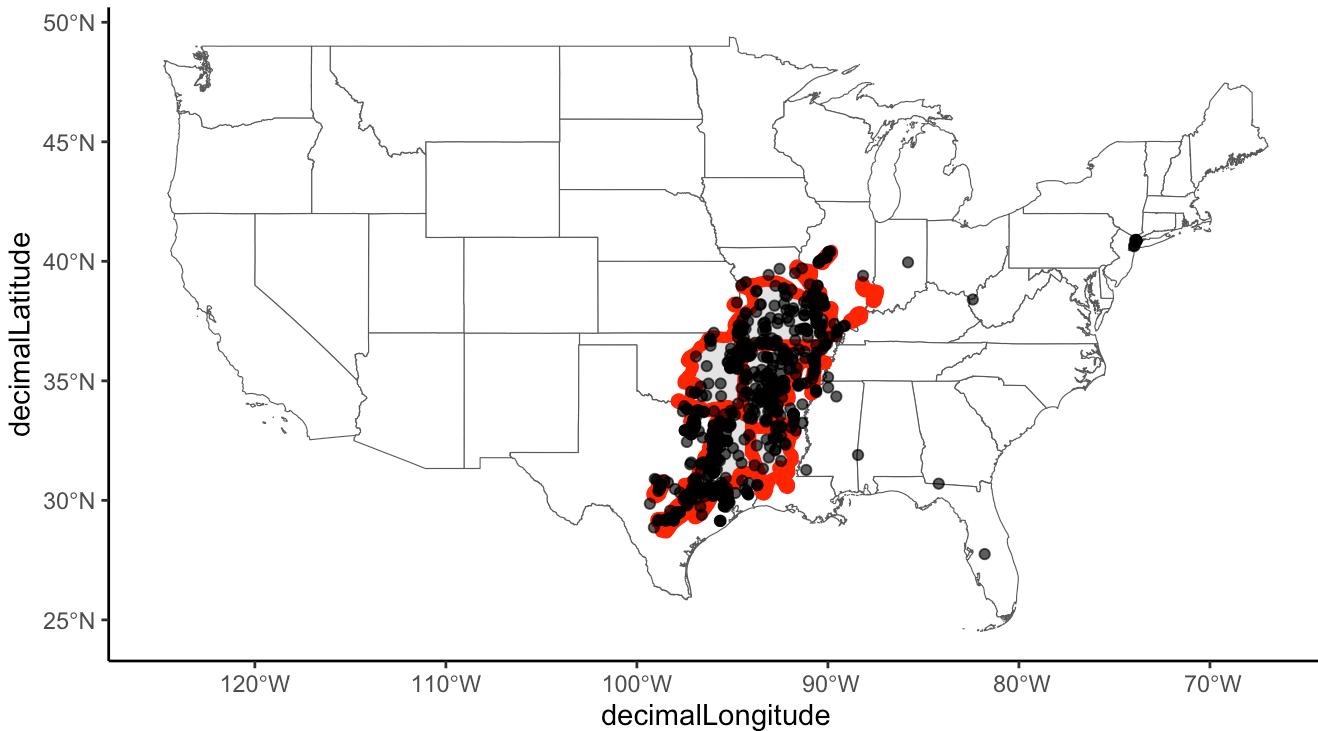
The projection is geographic with latitude and longitude. The datum is NAD27 which is EPSG:4267. The ellipsoid is Clarke 1866, and the transformation parameters

```
st_crs(CATE9.range) <- 4267
```

```
CATE9_clipped = st_intersection(CATE9.range, states.map)
```

```
## Warning: attribute variables are assumed to be spatially constant throughout
## all geometries
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = CATE9_clipped, col = "red", linewidth = 2)+
  geom_point(data = CATE9.occ, aes(x = decimalLongitude, y = decimalLatitude), color =
"black", alpha = 0.7)+
  theme_classic()
```



```
CATE9_clipped$species = "Carya texana"
CATE9_flag = cc_iucn(x = CATE9.occ, range = CATE9_clipped, lon = "decimalLongitude", lat = "decimalLatitude",
                      value = "flagged", buffer = 50000)
```

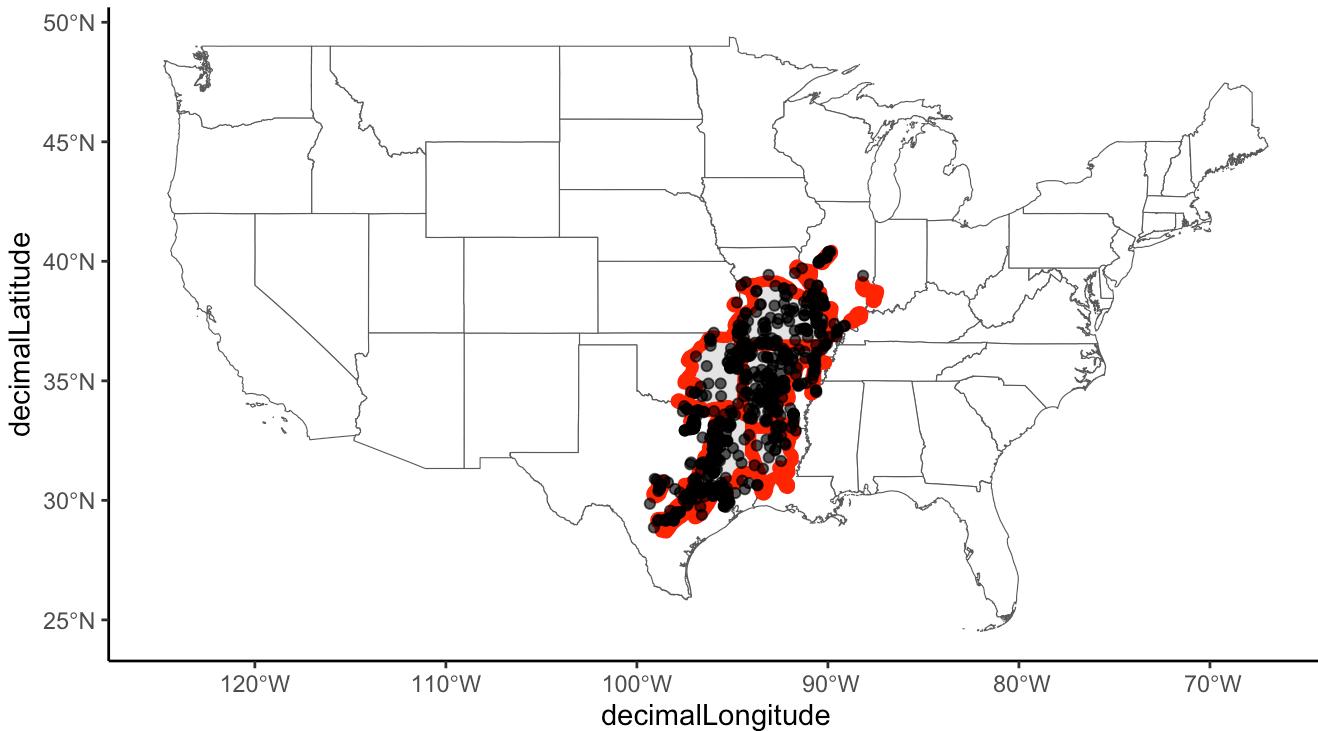
```
## Testing natural ranges
```

```
## Warning in cc_iucn(x = CATE9.occ, range = CATE9_clipped, lon =
## "decimalLongitude", : reprojecting reference to '+proj=longlat +datum=WGS84
## +no_defs'
```

```
## Flagged 35 records.
```

```
CATE9_occ_final = CATE9.occ[CATE9_flag, ]
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = CATE9_clipped, col = "red", linewidth = 2)+
  geom_point(data = CATE9_occ_final, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
ggsave("../Plots/CATE9.range.pdf", width = 12, height = 8)
```

Subset for *Castanea dentata*

```
CADE12.occ = gbif %>%
  filter(species == "Castanea dentata") %>%
  select(species,decimalLatitude,decimalLongitude)
```

Read in range map

```
CADE12.range = st_read("../USTreeAtlas/shp/castdent/")
```

```
## Reading layer `castdent' from data source
##   `/Users/samanthaworthy/Documents/GitHub/USTreeAtlas/shp/castdent'
##   using driver `ESRI Shapefile'
## Simple feature collection with 69 features and 5 fields
## Geometry type: POLYGON
## Dimension:     XY
## Bounding box:  xmin: -90.06321 ymin: 30.78233 xmax: -68.80517 ymax: 44.94212
## CRS:           NA
```

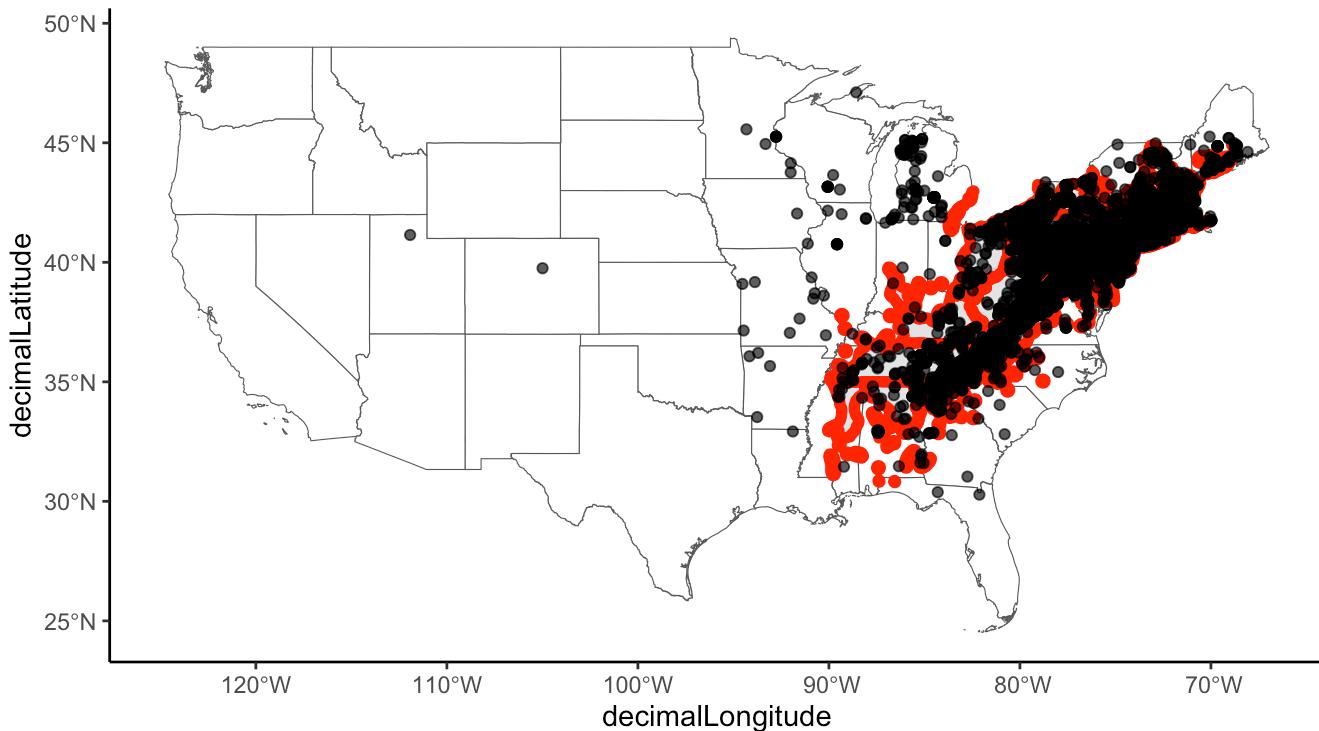
The projection is geographic with latitude and longitude. The datum is NAD27 which is EPSG:4267. The ellipsoid is Clarke 1866, and the transformation parameters

```
st_crs(CADE12.range) <- 4267
```

```
CADE12_clipped = st_intersection(CADE12.range, states.map)
```

```
## Warning: attribute variables are assumed to be spatially constant throughout
## all geometries
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = CADE12_clipped, col = "red", linewidth = 2)+
  geom_point(data = CADE12.occ, aes(x = decimalLongitude, y = decimalLatitude), color =
"black", alpha = 0.7)+
  theme_classic()
```



```
CADE12_clipped$species = "Castanea dentata"
CADE12_flag = cc_iucn(x = CADE12.occ, range = CADE12_clipped, lon = "decimalLongitude",
lat = "decimalLatitude",
value = "flagged", buffer = 50000)
```

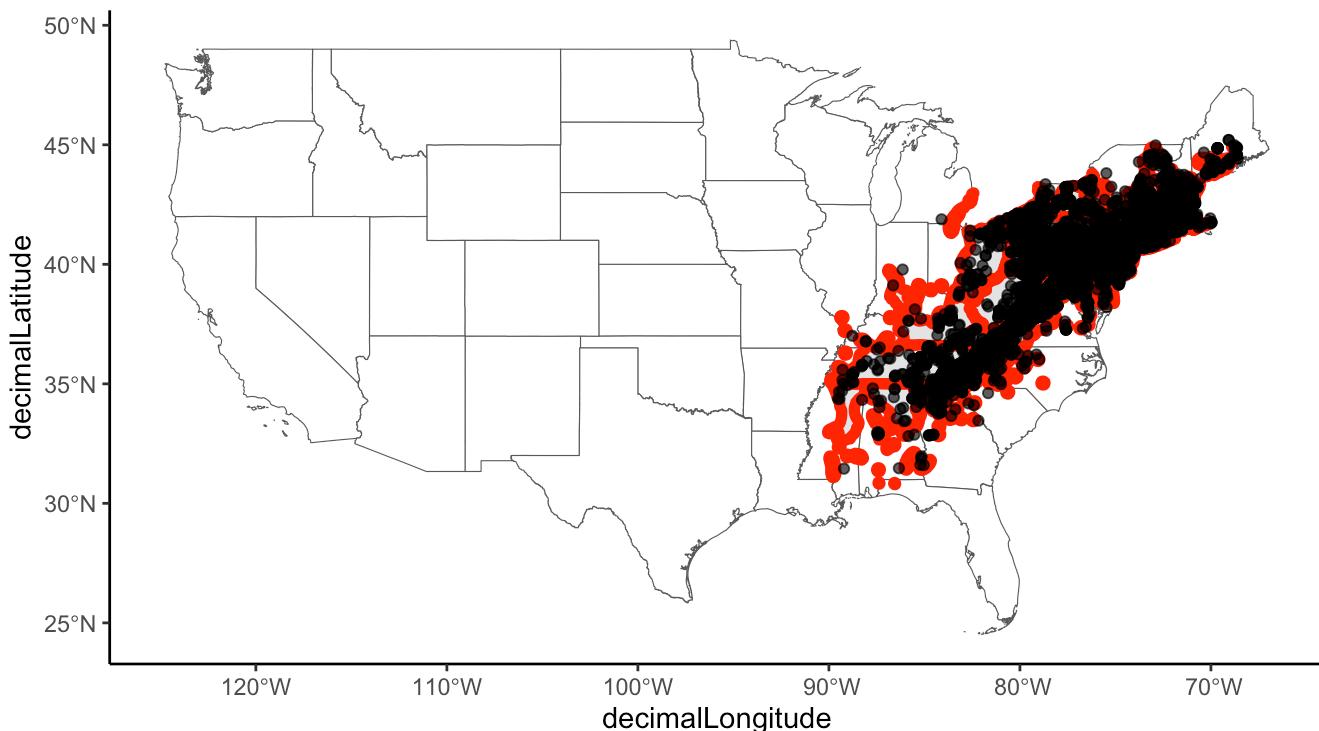
```
## Testing natural ranges
```

```
## Warning in cc_iucn(x = CADE12.occ, range = CADE12_clipped, lon =
## "decimalLongitude", : reprojecting reference to '+proj=longlat +datum=WGS84
## +no_defs'
```

```
## Flagged 137 records.
```

```
CADE12_occ_final = CADE12.occ[CADE12_flag, ]
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = CADE12_clipped, col = "red", linewidth = 2)+
  geom_point(data = CADE12_occ_final, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
ggsave("../Plots/CADE12.range.pdf", width = 12, height = 8)
```

Subset for *Celtis laevigata*

```
CELA.occ = gbif %>%
  filter(species == "Celtis laevigata") %>%
  select(species,decimalLatitude,decimalLongitude)
```

Read in range map

```
CELA.range = st_read("../USTreeAtlas/shp/celtlaev/")
```

```
## Reading layer `celtlaev' from data source
##   `/Users/samanthaworthy/Documents/GitHub/USTreeAtlas/shp/celtlaev'
##   using driver `ESRI Shapefile'
## Simple feature collection with 83 features and 5 fields
## Geometry type: POLYGON
## Dimension:      XY
## Bounding box:  xmin: -104.1844 ymin: 21.94096 xmax: -75.44749 ymax: 40.79288
## CRS:           NA
```

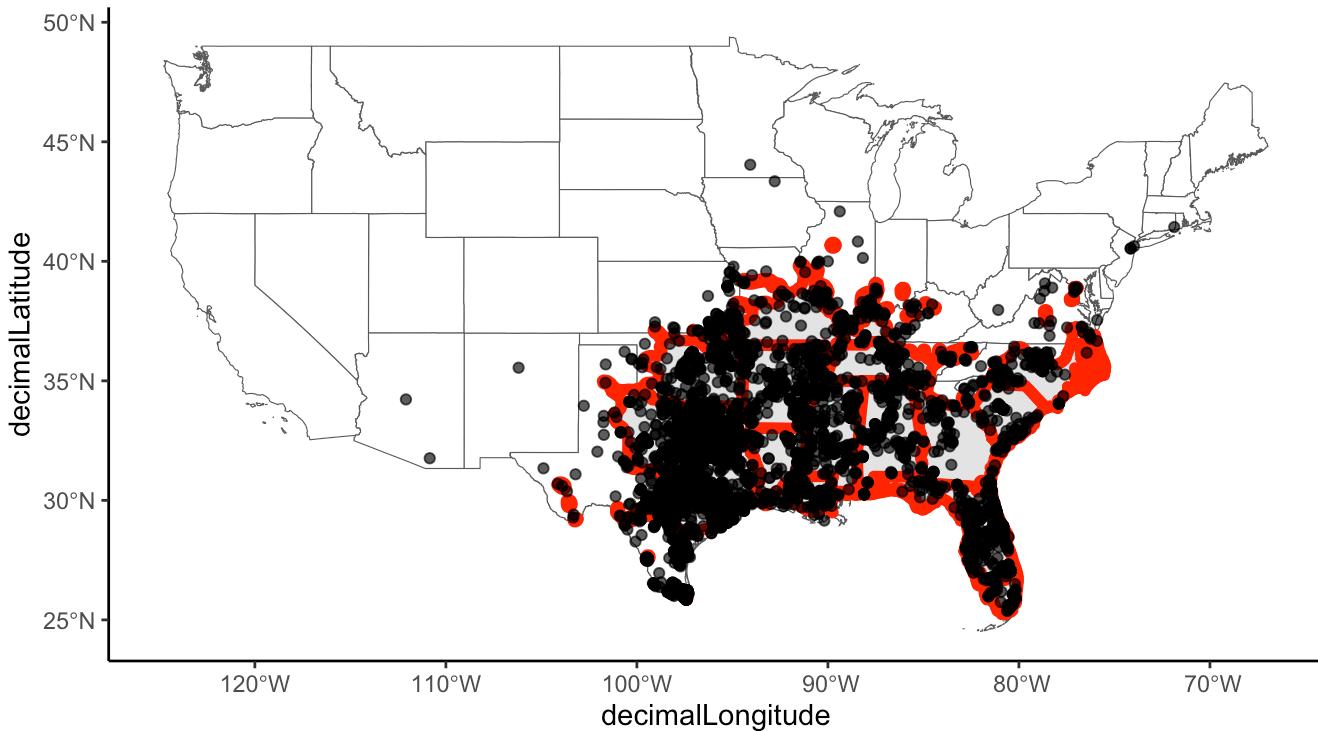
The projection is geographic with latitude and longitude. The datum is NAD27 which is EPSG:4267. The ellipsoid is Clarke 1866, and the transformation parameters

```
st_crs(CELA.range) <- 4267
```

```
CELA_clipped = st_intersection(CELA.range, states.map)
```

```
## Warning: attribute variables are assumed to be spatially constant throughout
## all geometries
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = CELA_clipped, col = "red", linewidth = 2)+
  geom_point(data = CELA.occ, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
CELA_clipped$species = "Celtis laevigata"
CELA_flag = cc_iucn(x = CELA.occ, range = CELA_clipped, lon = "decimalLongitude", lat =
"decimalLatitude",
                     value = "flagged", buffer = 50000)
```

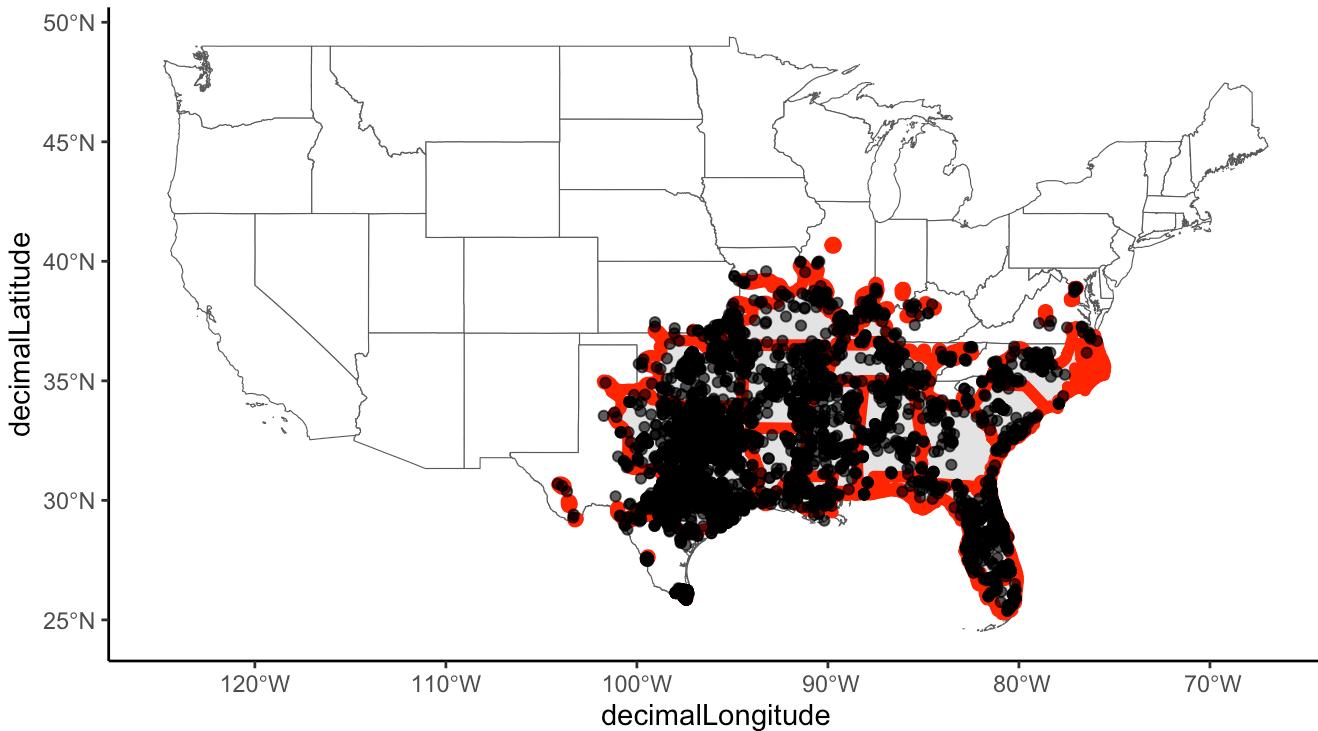
```
## Testing natural ranges
```

```
## Warning in cc_iucn(x = CELA.occ, range = CELA_clipped, lon =
## "decimalLongitude", : reprojecting reference to '+proj=longlat +datum=WGS84
## +no_defs'
```

```
## Flagged 298 records.
```

```
CELA_occ_final = CELA.occ[CELA_flag, ]
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = CELA_clipped, col = "red", linewidth = 2)+
  geom_point(data = CELA_occ_final, aes(x = decimalLongitude, y = decimalLatitude), colo
r = "black", alpha = 0.7)+
  theme_classic()
```



```
ggsave("../Plots/CELA.range.pdf", width = 12, height = 8)
```

Subset for *Celtis occidentalis*

```
CEOCC.occ = gbif %>%
  filter(species == "Celtis occidentalis") %>%
  select(species,decimalLatitude,decimalLongitude)
```

Read in range map

```
CEOCC.range = st_read("../USTreeAtlas/shp/celtocci/")
```

```
## Reading layer `celtocci' from data source
##   `/Users/samanthaworthy/Documents/GitHub/USTreeAtlas/shp/celtocci'
##   using driver `ESRI Shapefile'
## Simple feature collection with 63 features and 5 fields
## Geometry type: POLYGON
## Dimension:     XY
## Bounding box:  xmin: -104.591 ymin: 32.21578 xmax: -71.17735 ymax: 50.1872
## CRS:           NA
```

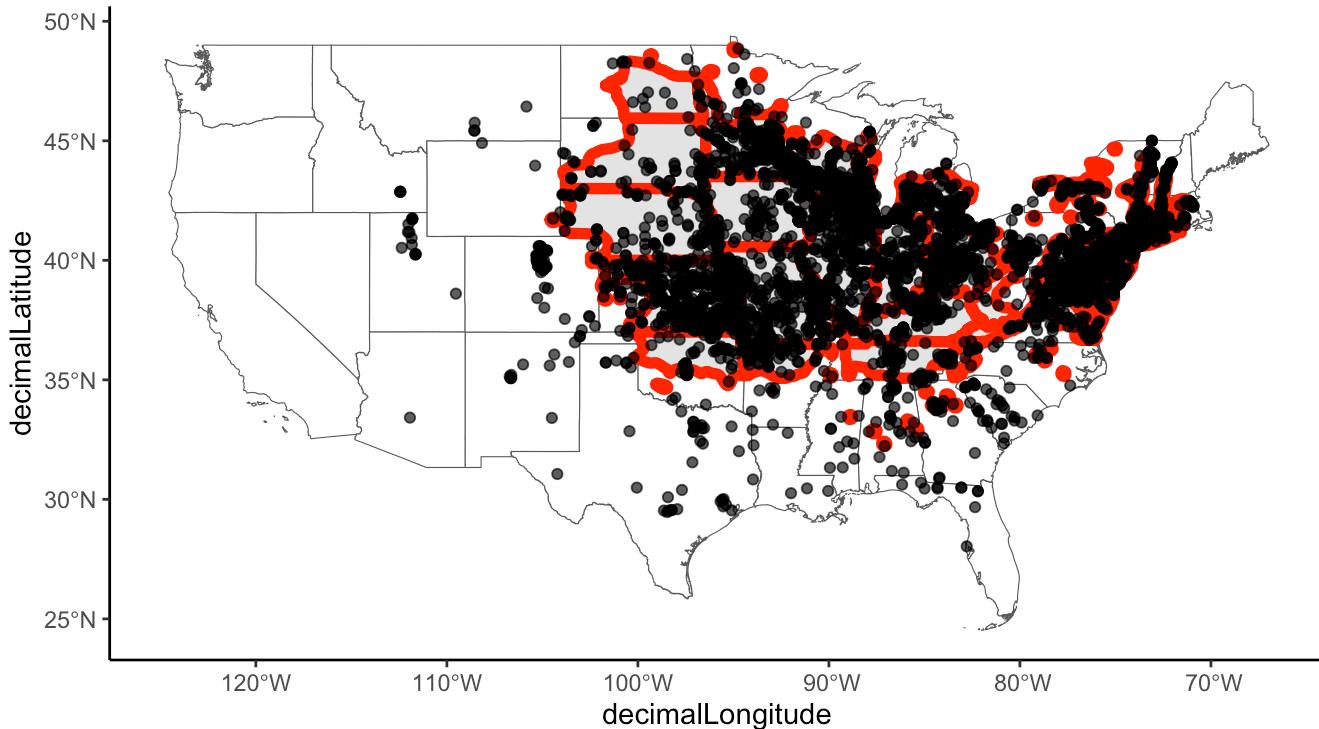
The projection is geographic with latitude and longitude. The datum is NAD27 which is EPSG:4267. The ellipsoid is Clarke 1866, and the transformation parameters

```
st_crs(CEOc.range) <- 4267
```

```
CEOc_clipped = st_intersection(CEOc.range, states.map)
```

```
## Warning: attribute variables are assumed to be spatially constant throughout
## all geometries
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = CEOc_clipped, col = "red", linewidth = 2)+
  geom_point(data = CEOc.occ, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
CEOc_clipped$species = "Celtis occidentalis"
CEOc_flag = cc_iucn(x = CEOc.occ, range = CEOc_clipped, lon = "decimalLongitude", lat =
"decimalLatitude",
                     value = "flagged", buffer = 50000)
```

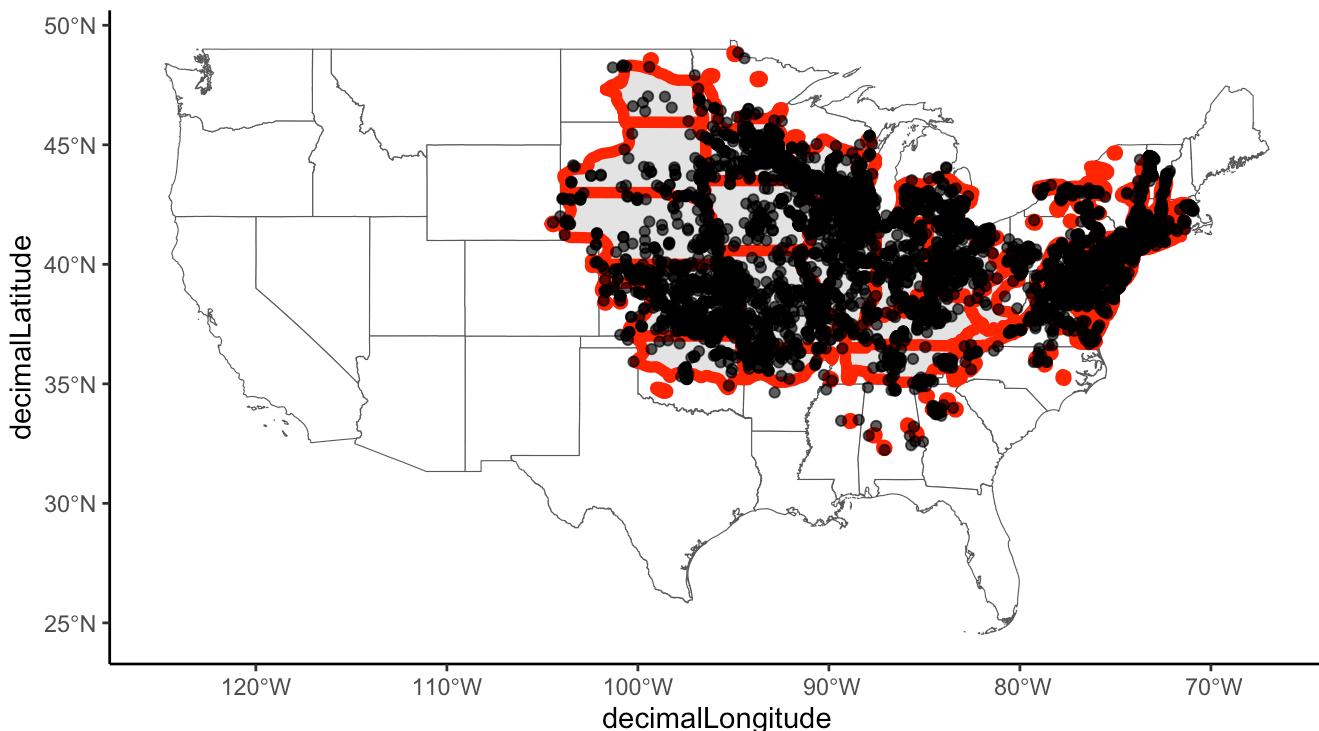
```
## Testing natural ranges
```

```
## Warning in cc_iucn(x = CEOC.occ, range = CEOC_clipped, lon =
## "decimalLongitude", : reprojecting reference to '+proj=longlat +datum=WGS84
## +no_defs'
```

```
## Flagged 288 records.
```

```
CEOCC_occ_final = CEOC.occ[CEOCC_flag, ]
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = CEOC_clipped, col = "red", linewidth = 2)+
  geom_point(data = CEOC_occ_final, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
ggsave("../Plots/CEOC.range.pdf", width = 12, height = 8)
```

Subset for *Cercis canadensis*. Little range map unavailable

```
CECA4.occ = gbif %>%
  filter(species == "Cercis canadensis") %>%
  select(species,decimalLatitude,decimalLongitude)
```

Get range map from BIEN

```
(CECA4.range.sf <- BIEN_ranges_load_species('Cercis canadensis'))
```

```
## Simple feature collection with 1 feature and 2 fields
## Geometry type: MULTIPOLYGON
## Dimension: XY
## Bounding box: xmin: -124.0033 ymin: 16.82999 xmax: -68.75321 ymax: 47.11917
## Geodetic CRS: WGS 84
##           species      gid      geometry
## 1 Cercis_canadensis 18148 MULTIPOLYGON (((-96.61393 1...
```

The projection is geographic with latitude and longitude. The datum is NAD27 which is EPSG:4267. The BIEN ranges are WG84.

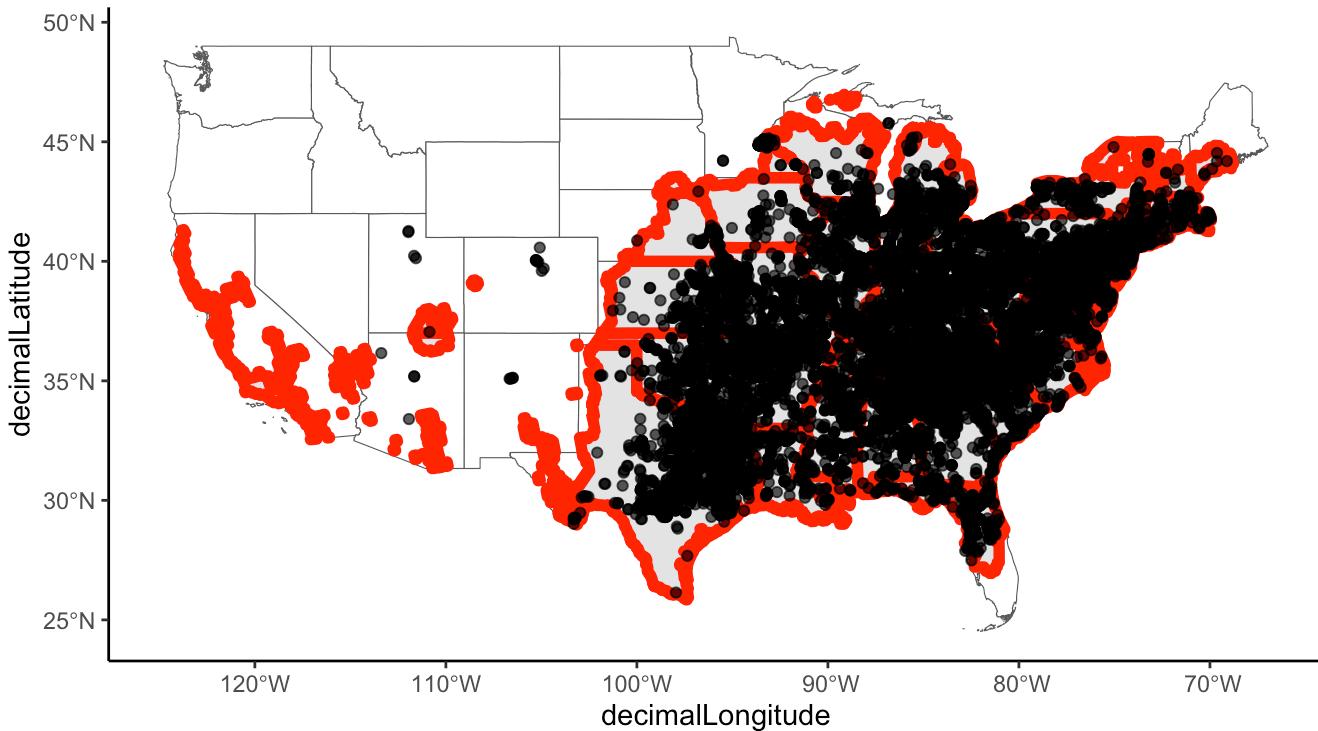
```
CECA4.range.2 = CECA4.range.sf %>%
  st_transform(st_crs(states.map))
```

```
CECA4.range.3 = terra::vect(CECA4.range.2)
states.map.2 = terra::vect(states.map)
```

```
CECA4.range.4 = terra::intersect(CECA4.range.3, states.map.2)
```

```
CECA4.range.5 = st_as_sf(CECA4.range.4)
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(dat = CECA4.range.5, col = "red", linewidth = 2)+
  geom_point(data = CECA4.occ, aes(x = decimalLongitude, y = decimalLatitude), color =
"black", alpha = 0.7)+
  theme_classic()
```



```
CECA4.range.5$species = "Cercis canadensis"
CECA4_flag = cc_iucn(x = CECA4.occ, range = CECA4.range.5, lon = "decimalLongitude", lat = "decimalLatitude",
                      value = "flagged", buffer = 50000)
```

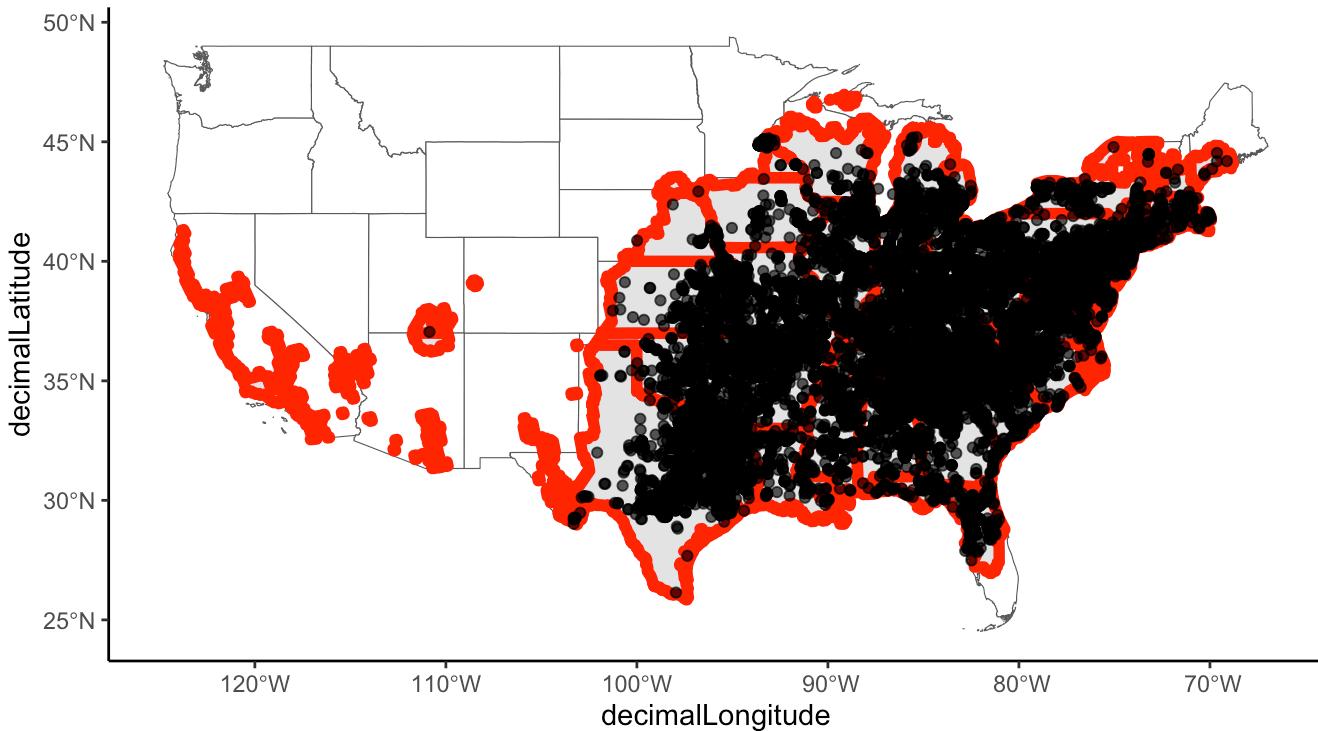
```
## Testing natural ranges
```

```
## Warning in cc_iucn(x = CECA4.occ, range = CECA4.range.5, lon =
## "decimalLongitude", : reprojecting reference to '+proj=longlat +datum=WGS84
## +no_defs'
```

```
## Flagged 24 records.
```

```
CECA4_occ_final = CECA4.occ[CECA4_flag, ]
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = CECA4.range.5, col = "red", linewidth = 2)+
  geom_point(data = CECA4_occ_final, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
ggsave("../Plots/CECA4.range.pdf", width = 12, height = 8)
```

Subset for *Chamaecyparis thyoides*

```
CHTH2.occ = gbif %>%
  filter(species == "Chamaecyparis thyoides") %>%
  select(species,decimalLatitude,decimalLongitude)
```

Read in range map

```
CHTH2.range = st_read("../USTreeAtlas/shp/chamthyo/")
```

```
## Reading layer `chamthyo' from data source
##   `/Users/samanthaworthy/Documents/GitHub/USTreeAtlas/shp/chamthyo'
##   using driver `ESRI Shapefile'
## Simple feature collection with 67 features and 5 fields
## Geometry type: POLYGON
## Dimension:     XY
## Bounding box:  xmin: -89.87479 ymin: 29.12146 xmax: -68.76874 ymax: 44.42347
## CRS:           NA
```

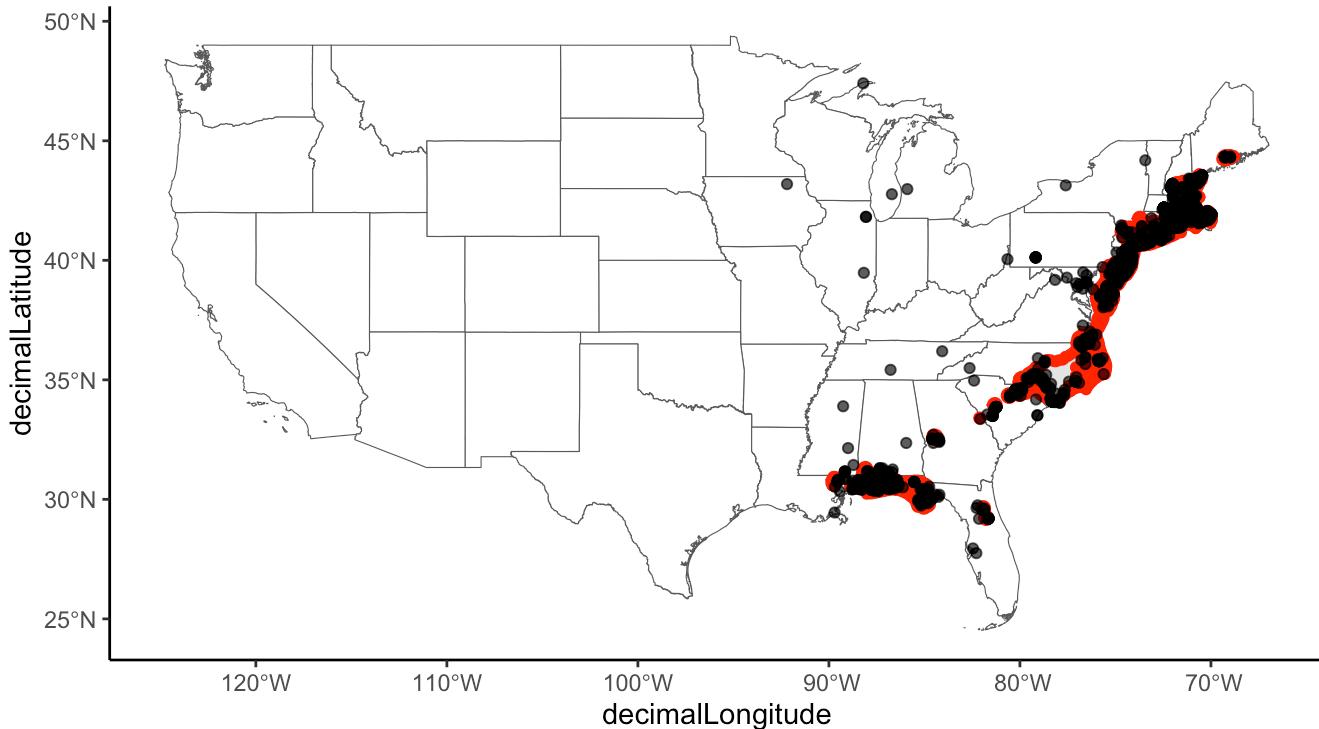
The projection is geographic with latitude and longitude. The datum is NAD27 which is EPSG:4267. The ellipsoid is Clarke 1866, and the transformation parameters

```
st_crs(CTH2.range) <- 4267
```

```
CTH2_clipped = st_intersection(CTH2.range, states.map)
```

```
## Warning: attribute variables are assumed to be spatially constant throughout
## all geometries
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = CTH2_clipped, col = "red", linewidth = 2)+
  geom_point(data = CTH2.occ, aes(x = decimalLongitude, y = decimalLatitude), color =
"black", alpha = 0.7)+
  theme_classic()
```



```
CTH2_clipped$species = "Chamaecyparis thyoides"
CTH2_flag = cc_iucn(x = CTH2.occ, range = CTH2_clipped, lon = "decimalLongitude", lat =
"decimalLatitude",
                     value = "flagged", buffer = 50000)
```

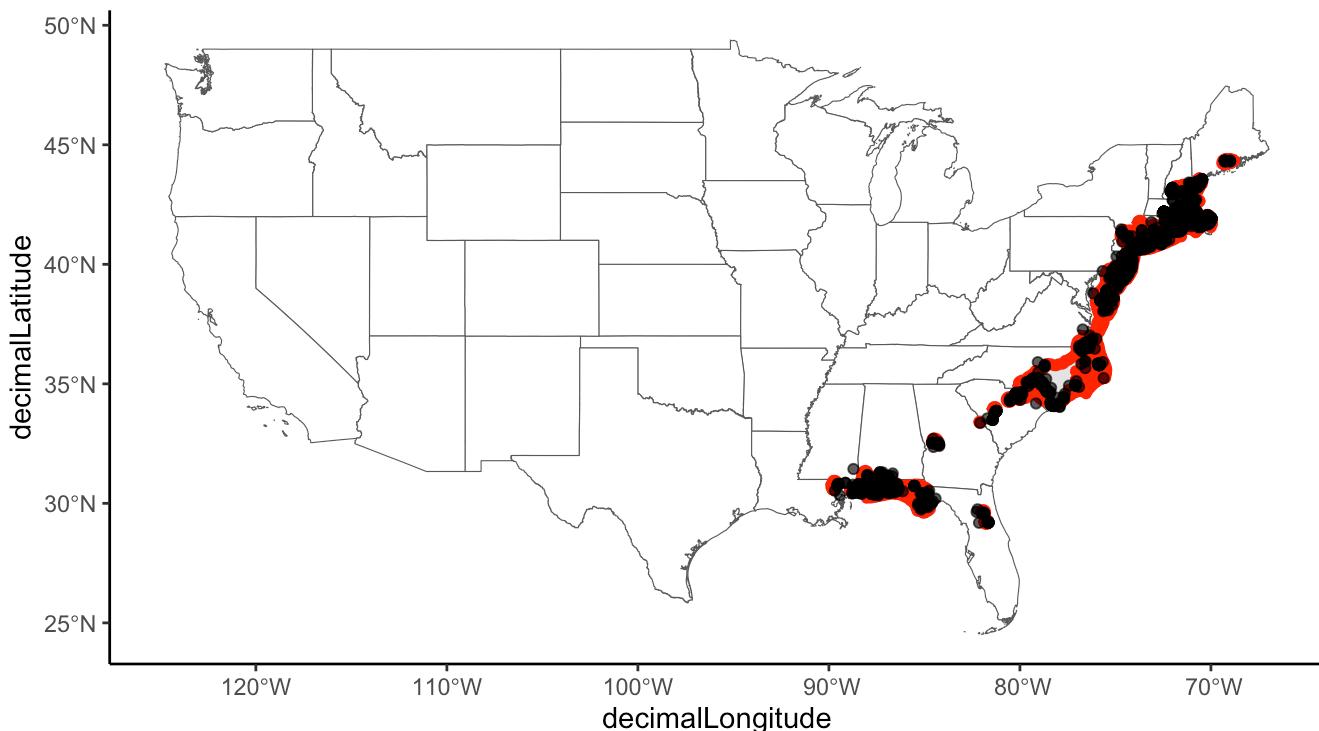
```
## Testing natural ranges
```

```
## Warning in cc_iucn(x = CHTH2.occ, range = CHTH2_clipped, lon =
## "decimalLongitude", : reprojecting reference to '+proj=longlat +datum=WGS84
## +no_defs'
```

```
## Flagged 49 records.
```

```
CHTH2_occ_final = CHTH2.occ[CHTH2_flag, ]
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = CHTH2_clipped, col = "red", linewidth = 2)+
  geom_point(data = CHTH2_occ_final, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
ggsave("../Plots/CHTH2.range.pdf", width = 12, height = 8)
```

Subset for *Cornus florida*

```
C0FL2.occ = gbif %>%
  filter(species == "Cornus florida") %>%
  select(species,decimalLatitude,decimalLongitude)
```

Read in range map

```
C0FL2.range = st_read("../USTreeAtlas/shp/cornflor/")
```

```
## Reading layer `cornflor' from data source
##   `/Users/samanthaworthy/Documents/GitHub/USTreeAtlas/shp/cornflor'
##   using driver `ESRI Shapefile'
## Simple feature collection with 84 features and 5 fields
## Geometry type: POLYGON
## Dimension:      XY
## Bounding box:  xmin: -100.8646 ymin: 18.52992 xmax: -69.92722 ymax: 43.94442
## CRS:           NA
```

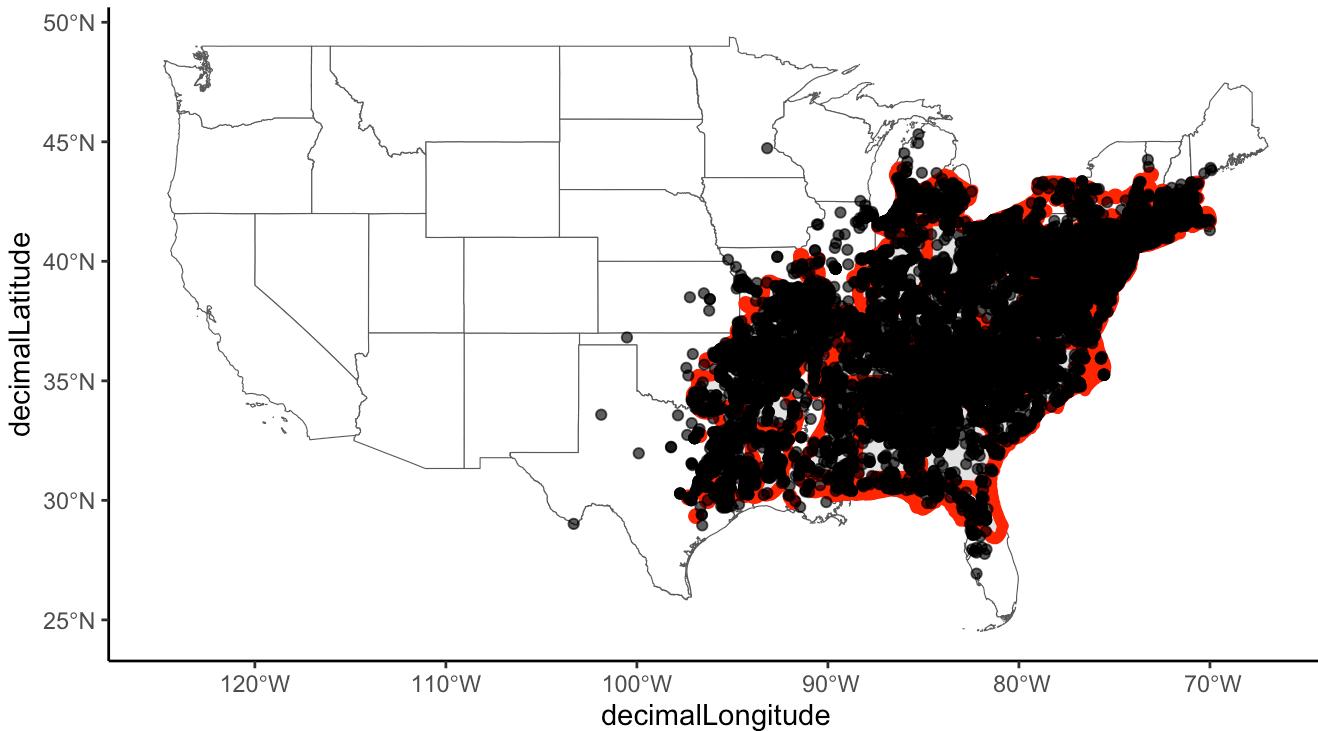
The projection is geographic with latitude and longitude. The datum is NAD27 which is EPSG:4267. The ellipsoid is Clarke 1866, and the transformation parameters

```
st_crs(C0FL2.range) <- 4267
```

```
C0FL2_clipped = st_intersection(C0FL2.range, states.map)
```

```
## Warning: attribute variables are assumed to be spatially constant throughout
## all geometries
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = C0FL2_clipped, col = "red", linewidth = 2)+
  geom_point(data = C0FL2.occ, aes(x = decimalLongitude, y = decimalLatitude), color =
"black", alpha = 0.7)+
  theme_classic()
```



```
C0FL2_clipped$species = "Cornus florida"
C0FL2_flag = cc_iucn(x = C0FL2.occ, range = C0FL2_clipped, lon = "decimalLongitude", lat = "decimalLatitude",
                      value = "flagged", buffer = 50000)
```

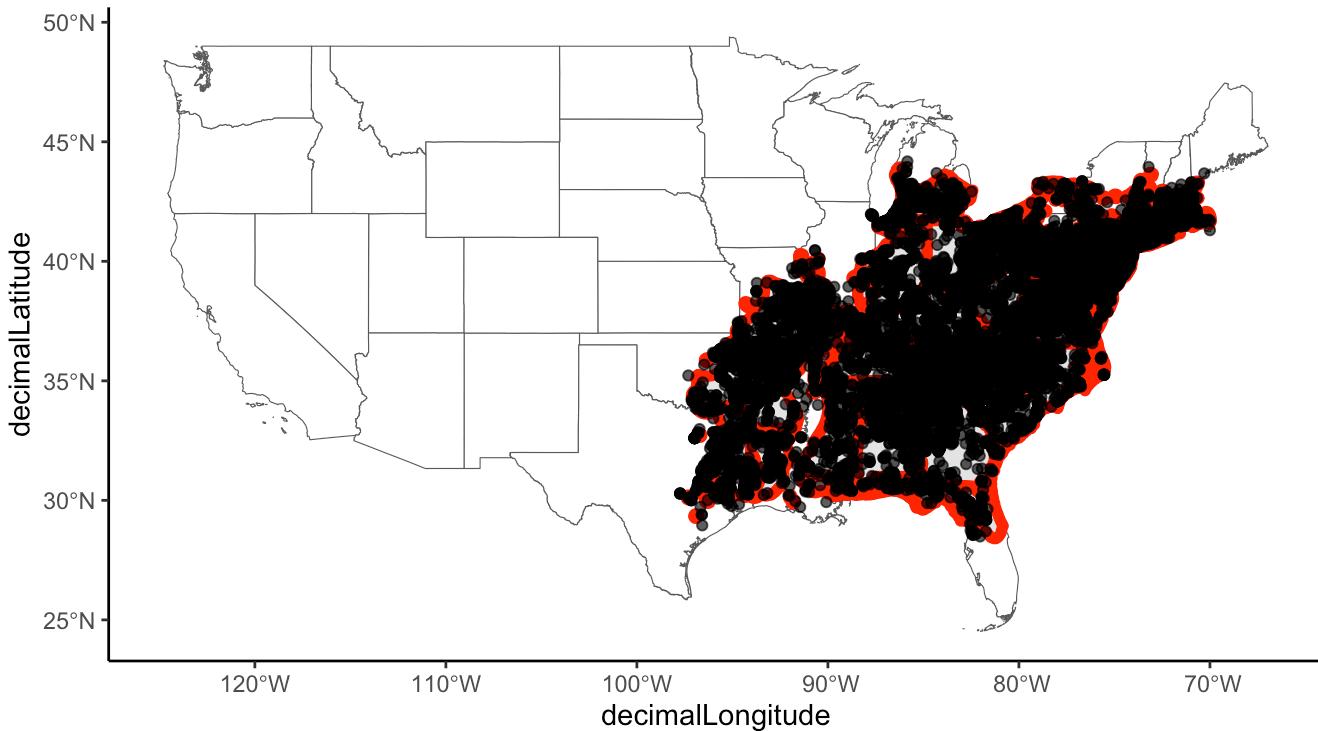
```
## Testing natural ranges
```

```
## Warning in cc_iucn(x = C0FL2.occ, range = C0FL2_clipped, lon =
## "decimalLongitude", : reprojecting reference to '+proj=longlat +datum=WGS84
## +no_defs'
```

```
## Flagged 125 records.
```

```
C0FL2_occ_final = C0FL2.occ[C0FL2_flag, ]
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = C0FL2_clipped, col = "red", linewidth = 2)+
  geom_point(data = C0FL2_occ_final, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
ggsave("../Plots/C0FL2.range.pdf", width = 12, height = 8)
```

Subset for *Diospyros virginiana*

```
DIVI5.occ = gbif %>%
  filter(species == "Diospyros virginiana") %>%
  select(species,decimalLatitude,decimalLongitude)
```

Read in range map

```
DIVI5.range = st_read("../USTreeAtlas/shp/diosviro/')
```

```
## Reading layer `diosviro' from data source
##   `/Users/samanthaworthy/Documents/GitHub/USTreeAtlas/shp/diosviro'
##   using driver `ESRI Shapefile'
## Simple feature collection with 100 features and 5 fields
## Geometry type: POLYGON
## Dimension:     XY
## Bounding box:  xmin: -99.25706 ymin: 25.02361 xmax: -72.77579 ymax: 41.37863
## CRS:           NA
```

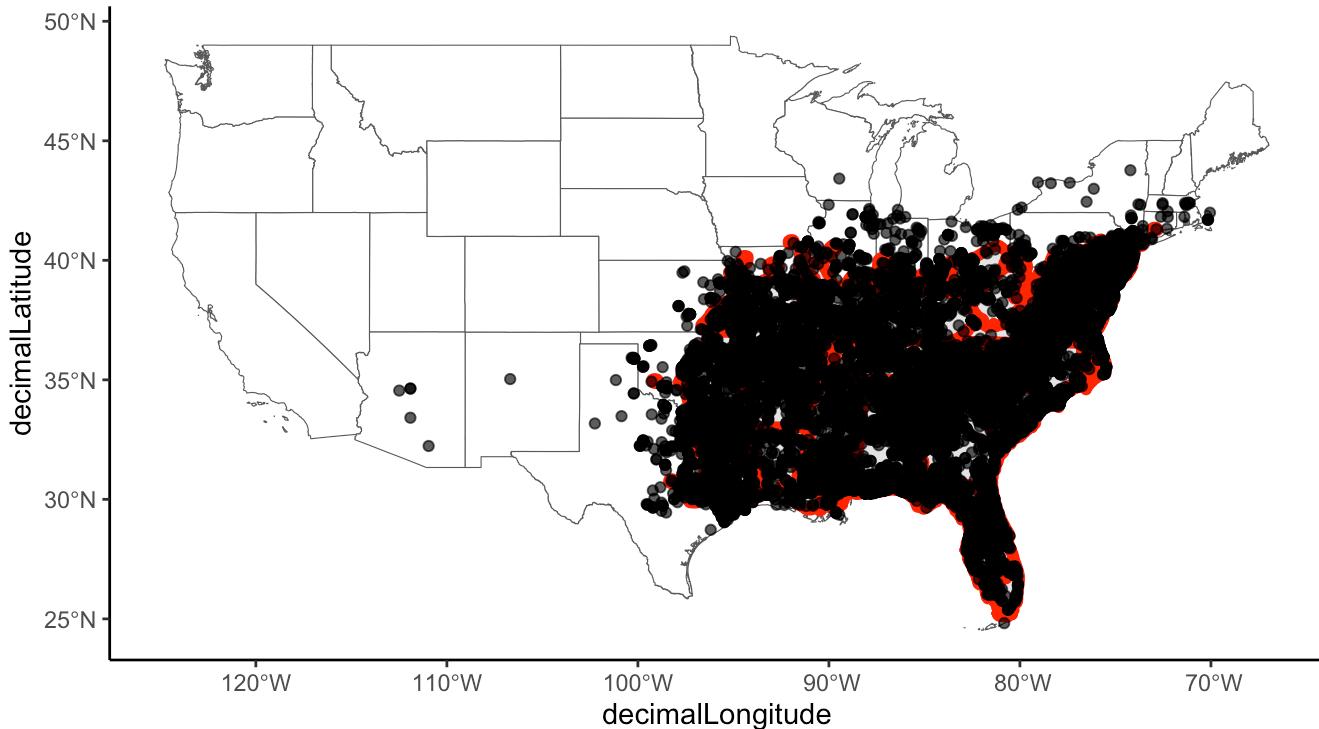
The projection is geographic with latitude and longitude. The datum is NAD27 which is EPSG:4267. The ellipsoid is Clarke 1866, and the transformation parameters

```
st_crs(DIVI5.range) <- 4267
```

```
DIVI5_clipped = st_intersection(DIVI5.range, states.map)
```

```
## Warning: attribute variables are assumed to be spatially constant throughout
## all geometries
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = DIVI5_clipped, col = "red", linewidth = 2)+
  geom_point(data = DIVI5.occ, aes(x = decimalLongitude, y = decimalLatitude), color =
"black", alpha = 0.7)+
  theme_classic()
```



```
DIVI5_clipped$species = "Diospyros virginiana"
DIVI5_flag = cc_iucn(x = DIVI5.occ, range = DIVI5_clipped, lon = "decimalLongitude", lat =
"decimalLatitude",
                      value = "flagged", buffer = 50000)
```

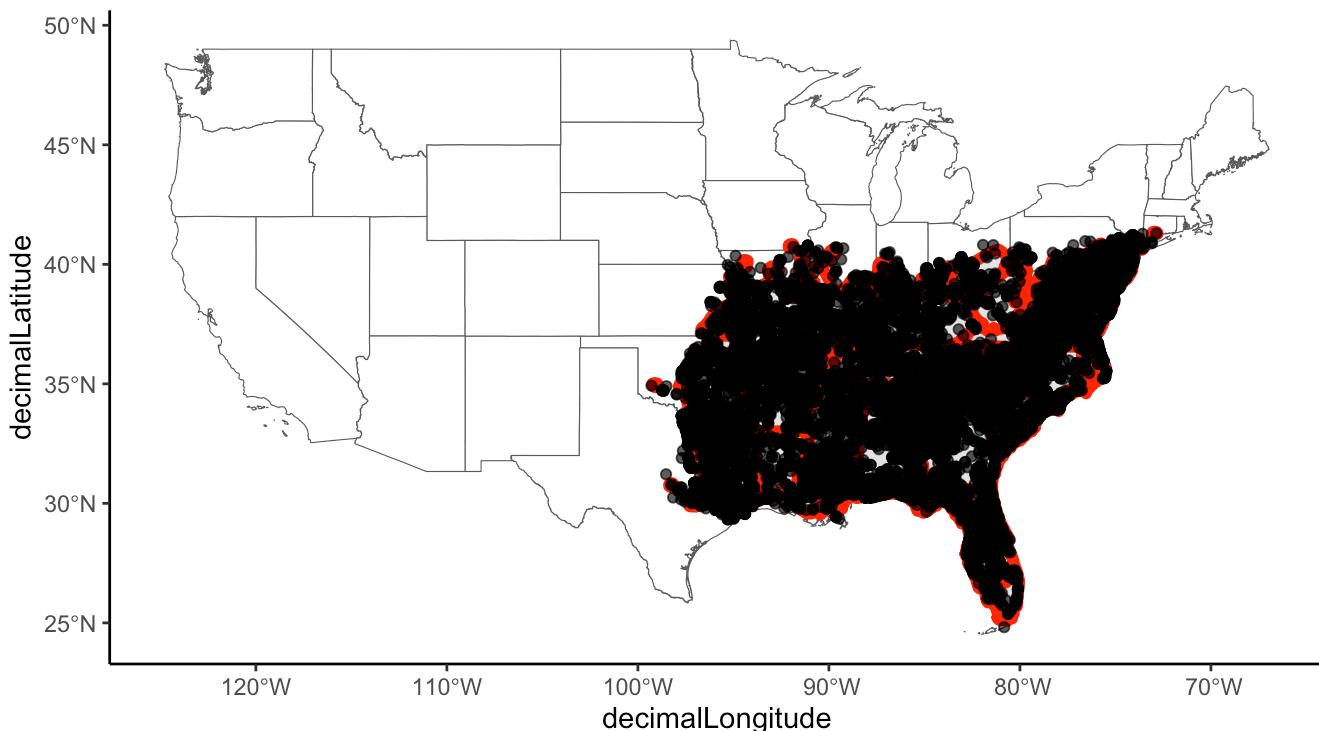
```
## Testing natural ranges
```

```
## Warning in cc_iucn(x = DIVI5.occ, range = DIVI5_clipped, lon =
## "decimalLongitude", : reprojecting reference to '+proj=longlat +datum=WGS84
## +no_defs'
```

```
## Flagged 531 records.
```

```
DIVI5_occ_final = DIVI5.occ[DIVI5_flag, ]
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = DIVI5_clipped, col = "red", linewidth = 2)+
  geom_point(data = DIVI5_occ_final, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
ggsave("../Plots/DIVI5.range.pdf", width = 12, height = 8)
```

Subset for *Fagus grandifolia*

```
FAGR.occ = gbif %>%
  filter(species == "Fagus grandifolia") %>%
  select(species,decimalLatitude,decimalLongitude)
```

Read in range map

```
FAGR.range = st_read("../USTreeAtlas/shp/fagugran/")
```

```
## Reading layer `fagugran' from data source
##   `/Users/samanthaworthy/Documents/GitHub/USTreeAtlas/shp/fagugran'
##   using driver `ESRI Shapefile'
## Simple feature collection with 171 features and 5 fields
## Geometry type: POLYGON
## Dimension:      XY
## Bounding box:  xmin: -99.64175 ymin: 19.44994 xmax: -59.68972 ymax: 47.92627
## CRS:           NA
```

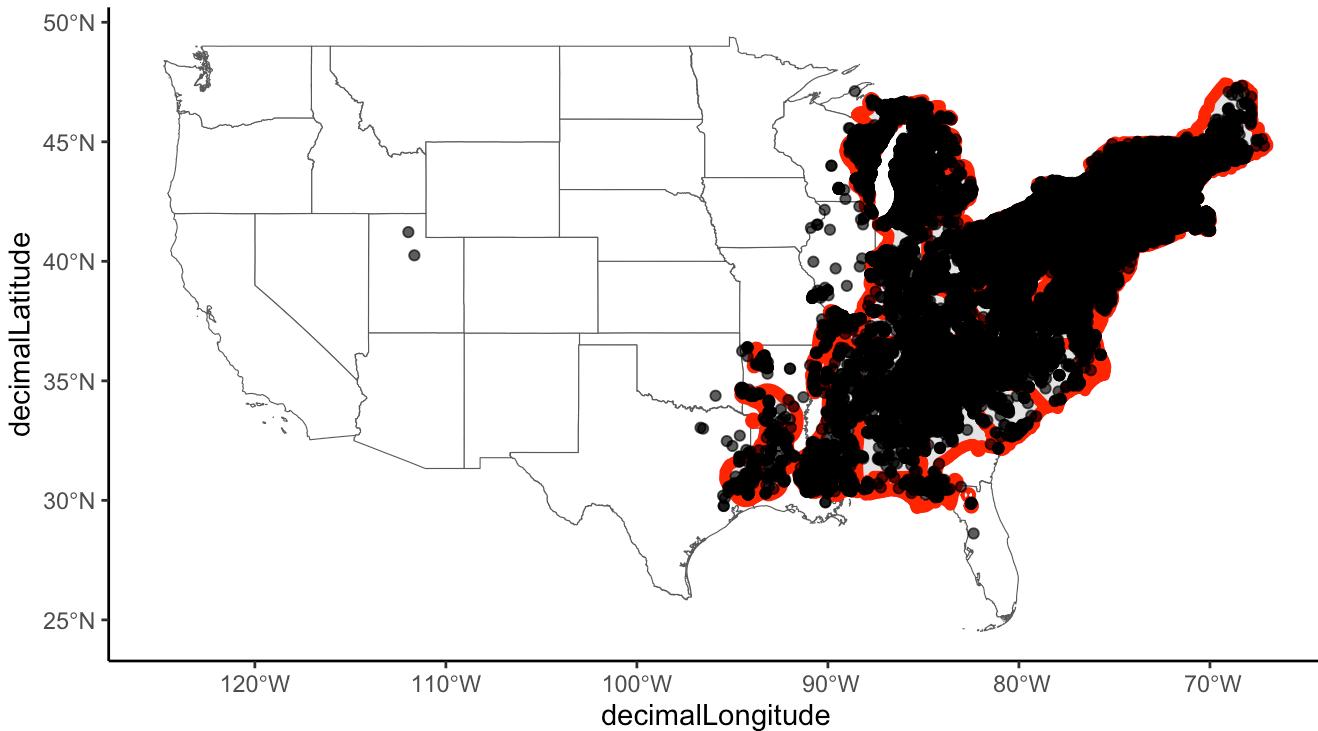
The projection is geographic with latitude and longitude. The datum is NAD27 which is EPSG:4267. The ellipsoid is Clarke 1866, and the transformation parameters

```
st_crs(FAGR.range) <- 4267
```

```
FAGR_clipped = st_intersection(FAGR.range, states.map)
```

```
## Warning: attribute variables are assumed to be spatially constant throughout
## all geometries
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = FAGR_clipped, col = "red", linewidth = 2)+
  geom_point(data = FAGR.occ, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
FAGR_clipped$species = "Fagus grandifolia"
FAGR_flag = cc_iucn(x = FAGR.occ, range = FAGR_clipped, lon = "decimalLongitude", lat =
"decimalLatitude",
value = "flagged", buffer = 50000)
```

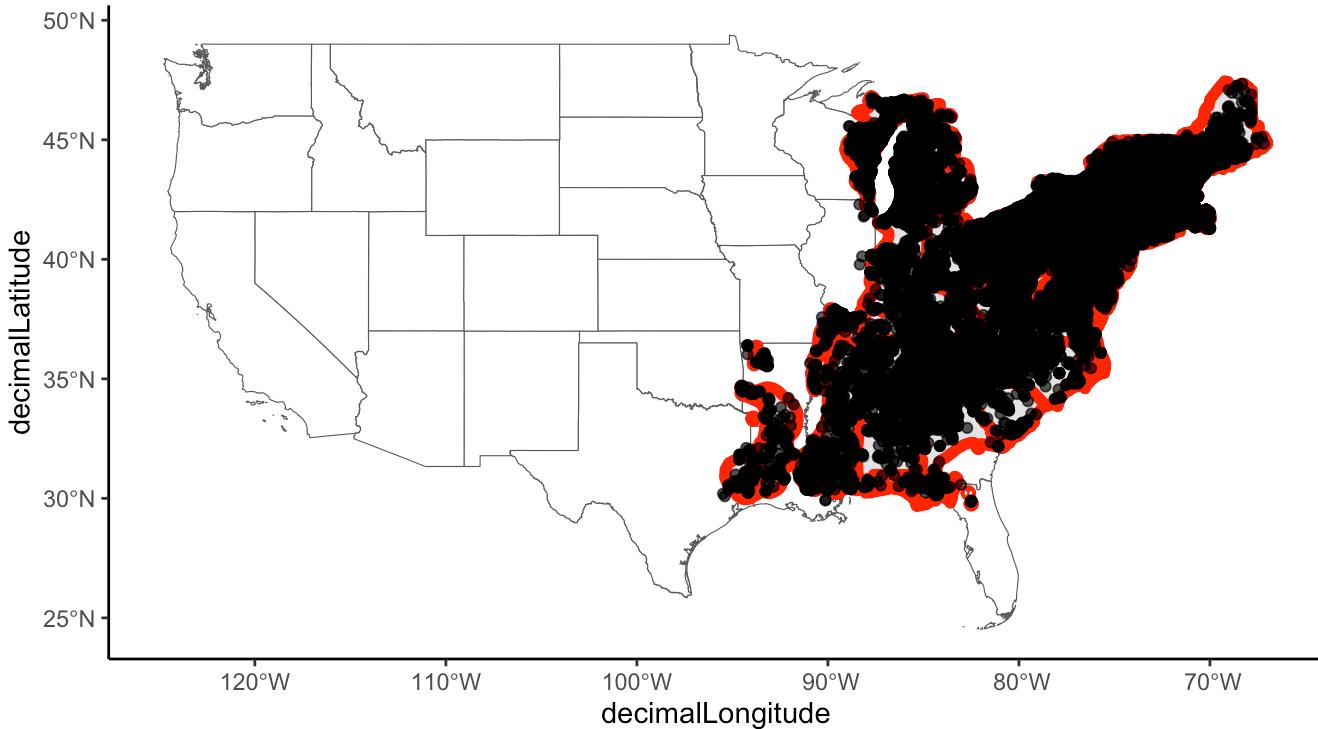
```
## Testing natural ranges
```

```
## Warning in cc_iucn(x = FAGR.occ, range = FAGR_clipped, lon =
## "decimalLongitude", : reprojecting reference to '+proj=longlat +datum=WGS84
## +no_defs'
```

```
## Flagged 106 records.
```

```
FAGR_occ_final = FAGR.occ[FAGR_flag, ]
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = FAGR_clipped, col = "red", linewidth = 2)+
  geom_point(data = FAGR_occ_final, aes(x = decimalLongitude, y = decimalLatitude), colo
r = "black", alpha = 0.7)+
  theme_classic()
```



```
ggsave("../Plots/FAGR.range.pdf", width = 12, height = 8)
```

Subset for *Fraxinus americana*

```
FRAM2.occ = gbif %>%
  filter(species == "Fraxinus americana") %>%
  select(species,decimalLatitude,decimalLongitude)
```

Read in range map

```
FRAM2.range = st_read("../USTreeAtlas/shp/fraxamer/")
```

```
## Reading layer `fraxamer' from data source
##   `/Users/samanthaworthy/Documents/GitHub/USTreeAtlas/shp/fraxamer'
##   using driver `ESRI Shapefile'
## Simple feature collection with 157 features and 5 fields
## Geometry type: POLYGON
## Dimension:     XY
## Bounding box:  xmin: -98.82271 ymin: 28.62632 xmax: -59.79973 ymax: 48.1909
## CRS:           NA
```

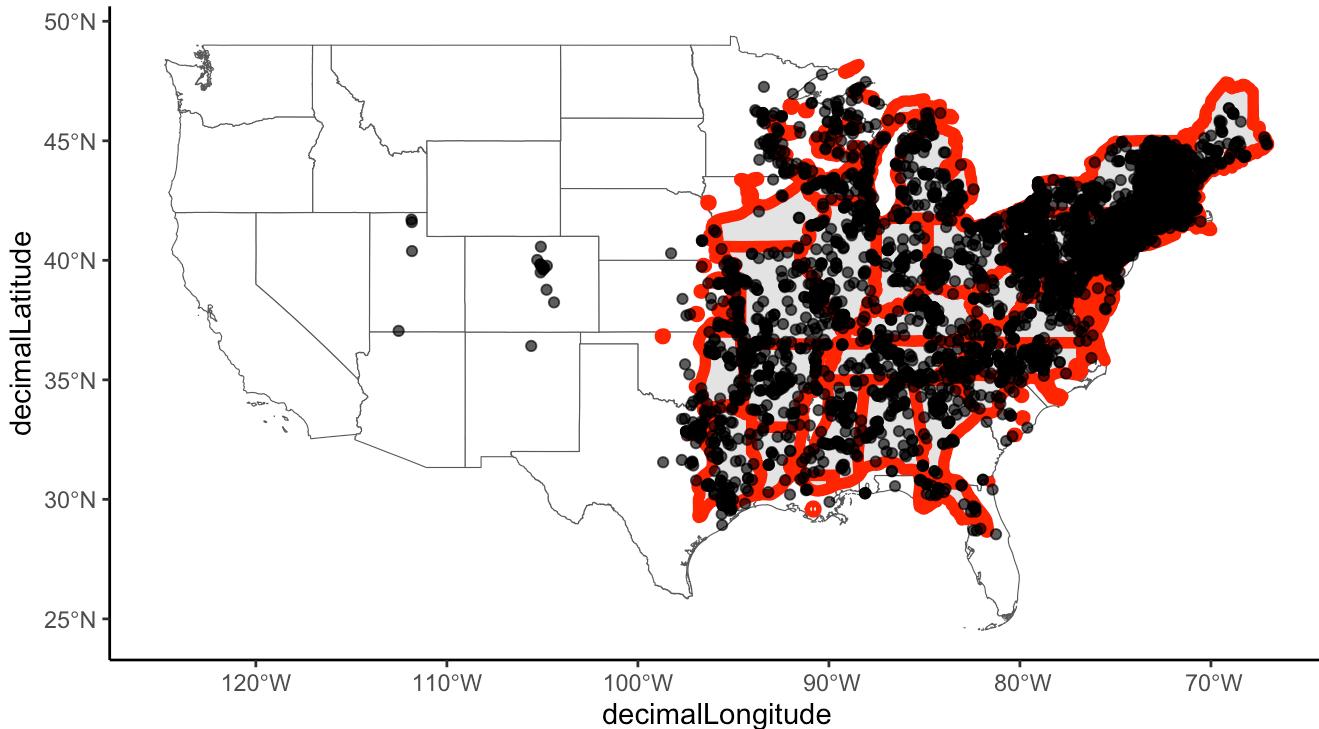
The projection is geographic with latitude and longitude. The datum is NAD27 which is EPSG:4267. The ellipsoid is Clarke 1866, and the transformation parameters

```
st_crs(FRAM2.range) <- 4267
```

```
FRAM2_clipped = st_intersection(FRAM2.range, states.map)
```

```
## Warning: attribute variables are assumed to be spatially constant throughout
## all geometries
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = FRAM2_clipped, col = "red", linewidth = 2)+
  geom_point(data = FRAM2.occ, aes(x = decimalLongitude, y = decimalLatitude), color =
"black", alpha = 0.7)+
  theme_classic()
```



```
FRAM2_clipped$species = "Fraxinus americana"
FRAM2_flag = cc_iucn(x = FRAM2.occ, range = FRAM2_clipped, lon = "decimalLongitude", lat =
"decimalLatitude",
                      value = "flagged", buffer = 50000)
```

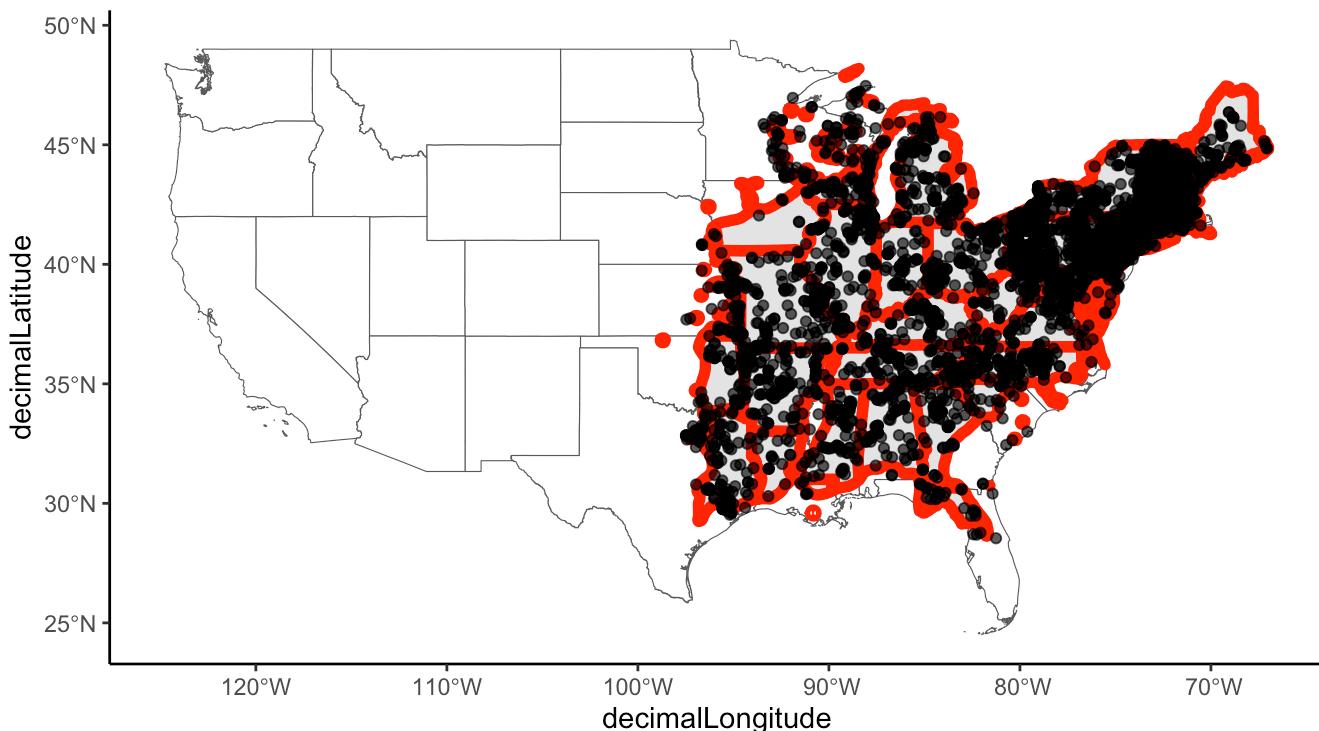
```
## Testing natural ranges
```

```
## Warning in cc_iucn(x = FRAM2.occ, range = FRAM2_clipped, lon =
## "decimalLongitude", : reprojecting reference to '+proj=longlat +datum=WGS84
## +no_defs'
```

```
## Flagged 77 records.
```

```
FRAM2_occ_final = FRAM2.occ[FRAM2_flag, ]
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = FRAM2_clipped, col = "red", linewidth = 2)+
  geom_point(data = FRAM2_occ_final, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
ggsave("../Plots/FRAM2.range.pdf", width = 12, height = 8)
```

Subset for *Fraxinus caroliniana*

```
FRCA3.occ = gbif %>%
  filter(species == "Fraxinus caroliniana") %>%
  select(species,decimalLatitude,decimalLongitude)
```

Read in range map

```
FRCA3.range = st_read("../USTreeAtlas/shp/fraxcaro/")
```

```
## Reading layer `fraxcaro' from data source
##   '/Users/samanthaworthy/Documents/GitHub/USTreeAtlas/shp/fraxcaro'
##   using driver 'ESRI Shapefile'
## Simple feature collection with 71 features and 5 fields
## Geometry type: POLYGON
## Dimension:      XY
## Bounding box:  xmin: -95.62966 ymin: 25.74786 xmax: -75.44749 ymax: 38.66853
## CRS:           NA
```

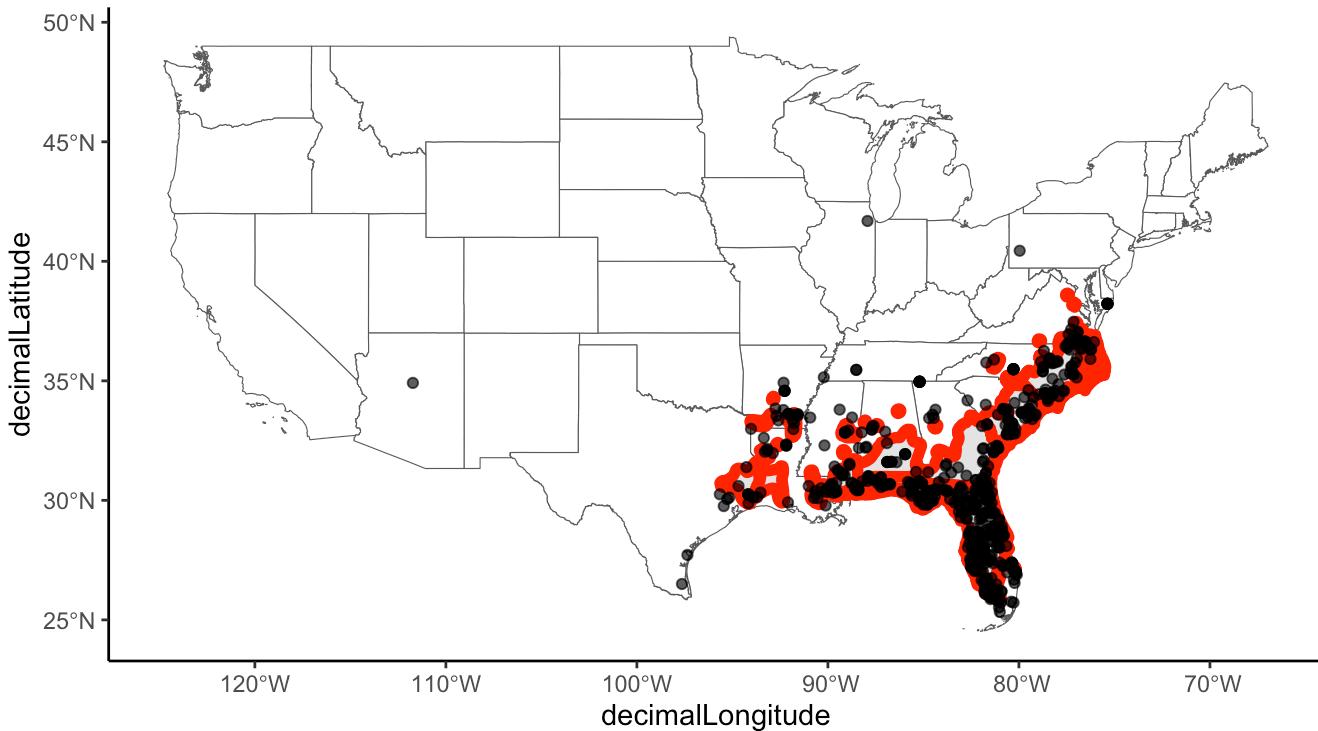
The projection is geographic with latitude and longitude. The datum is NAD27 which is EPSG:4267. The ellipsoid is Clarke 1866, and the transformation parameters

```
st_crs(FRCA3.range) <- 4267
```

```
FRCA3_clipped = st_intersection(FRCA3.range, states.map)
```

```
## Warning: attribute variables are assumed to be spatially constant throughout
## all geometries
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = FRCA3_clipped, col = "red", linewidth = 2)+
  geom_point(data = FRCA3.occ, aes(x = decimalLongitude, y = decimalLatitude), color =
"black", alpha = 0.7)+
  theme_classic()
```



```
FRCA3_clipped$species = "Fraxinus caroliniana"
FRCA3_flag = cc_iucn(x = FRCA3.occ, range = FRCA3_clipped, lon = "decimalLongitude", lat = "decimalLatitude",
                      value = "flagged", buffer = 50000)
```

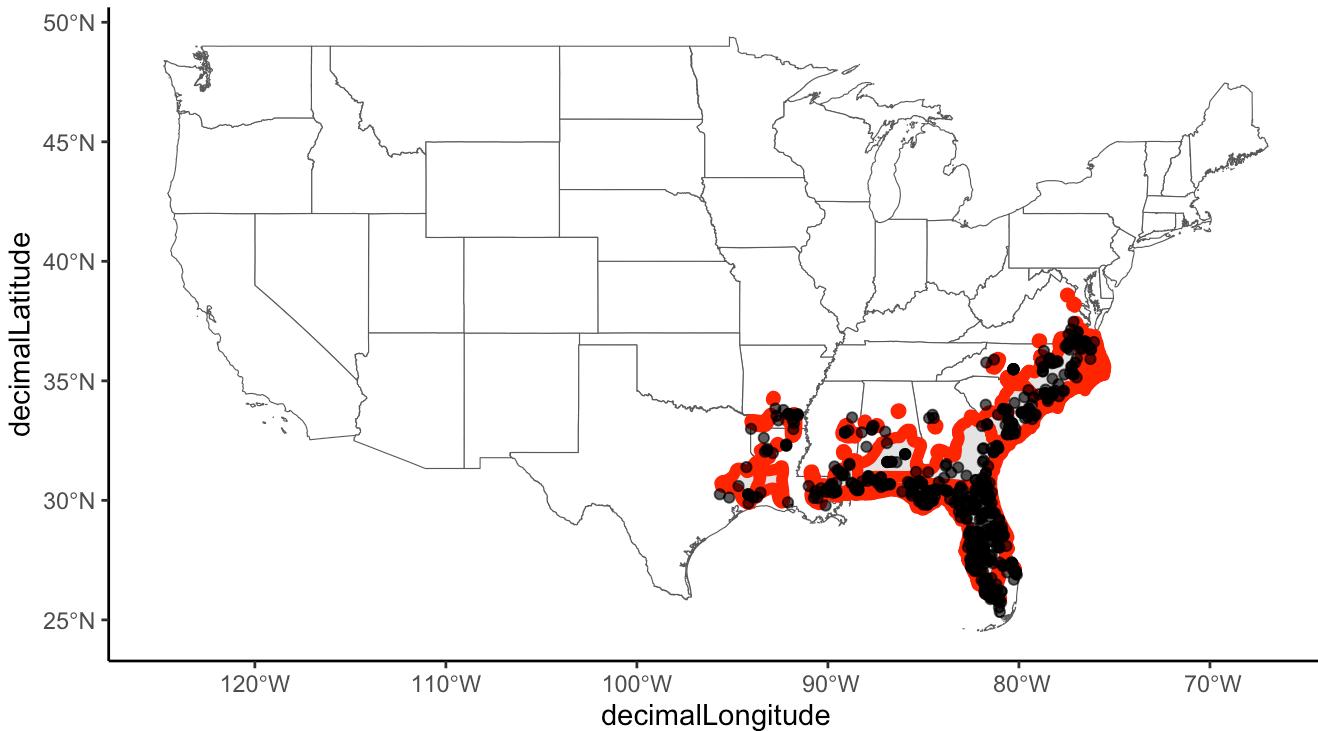
```
## Testing natural ranges
```

```
## Warning in cc_iucn(x = FRCA3.occ, range = FRCA3_clipped, lon =
## "decimalLongitude", : reprojecting reference to '+proj=longlat +datum=WGS84
## +no_defs'
```

```
## Flagged 35 records.
```

```
FRCA3_occ_final = FRCA3.occ[FRCA3_flag, ]
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = FRCA3_clipped, col = "red", linewidth = 2)+
  geom_point(data = FRCA3_occ_final, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
ggsave("../Plots/FRCA3.range.pdf", width = 12, height = 8)
```

Subset for *Fraxinus nigra*

```
FRNI.occ = gbif %>%
  filter(species == "Fraxinus nigra") %>%
  select(species,decimalLatitude,decimalLongitude)
```

Read in range map

```
FRNI.range = st_read("../USTreeAtlas/shp/fraxnigr/")
```

```
## Reading layer `fraxnigr' from data source
##   `/Users/samanthaworthy/Documents/GitHub/USTreeAtlas/shp/fraxnigr'
##   using driver `ESRI Shapefile'
## Simple feature collection with 144 features and 5 fields
## Geometry type: POLYGON
## Dimension:     XY
## Bounding box:  xmin: -97.86788 ymin: 37.5547 xmax: -57.8979 ymax: 51.50689
## CRS:           NA
```

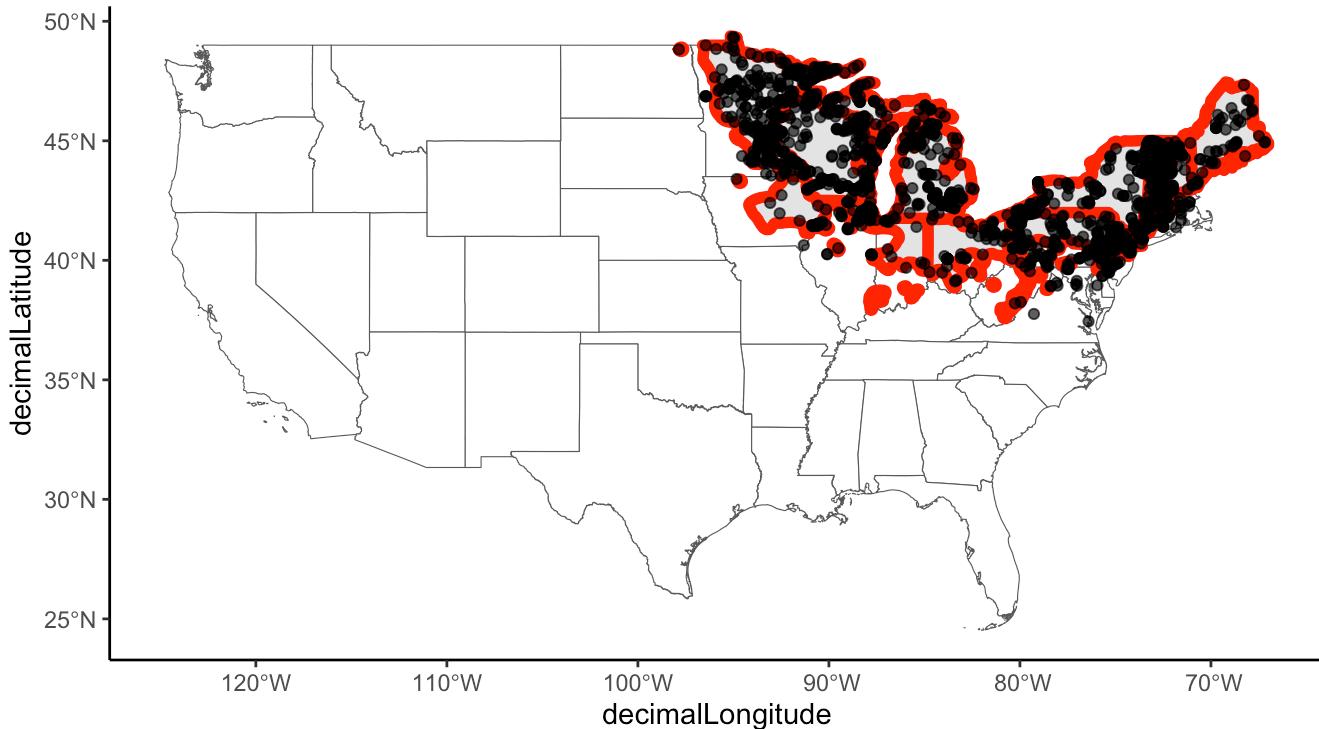
The projection is geographic with latitude and longitude. The datum is NAD27 which is EPSG:4267. The ellipsoid is Clarke 1866, and the transformation parameters

```
st_crs(FRNI.range) <- 4267
```

```
FRNI_clipped = st_intersection(FRNI.range, states.map)
```

```
## Warning: attribute variables are assumed to be spatially constant throughout
## all geometries
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = FRNI_clipped, col = "red", linewidth = 2)+
  geom_point(data = FRNI.occ, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
FRNI_clipped$species = "Fraxinus nigra"
FRNI_flag = cc_iucn(x = FRNI.occ, range = FRNI_clipped, lon = "decimalLongitude", lat =
"decimalLatitude",
                     value = "flagged", buffer = 50000)
```

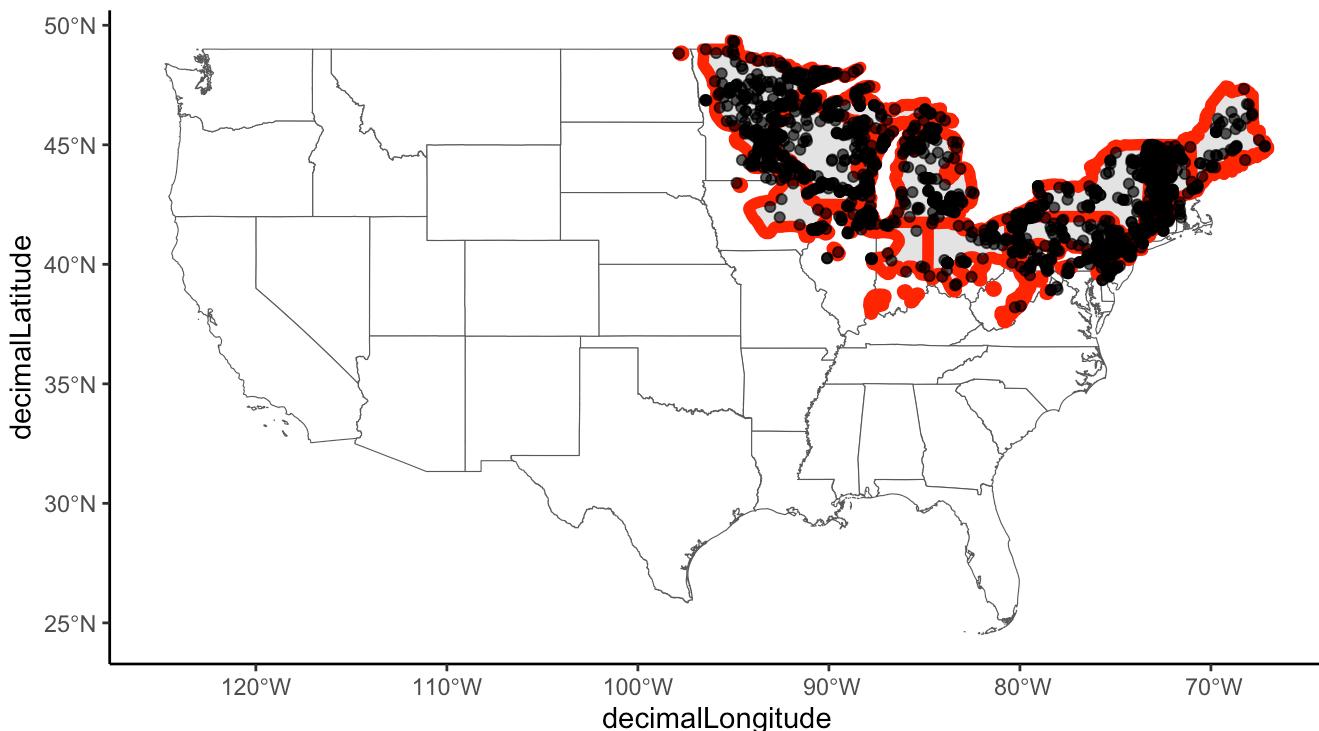
```
## Testing natural ranges
```

```
## Warning in cc_iucn(x = FRNI.occ, range = FRNI_clipped, lon =
## "decimalLongitude", : reprojecting reference to '+proj=longlat +datum=WGS84
## +no_defs'
```

```
## Flagged 13 records.
```

```
FRNI_occ_final = FRNI.occ[FRNI_flag, ]
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = FRNI_clipped, col = "red", linewidth = 2)+
  geom_point(data = FRNI_occ_final, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
ggsave("../Plots/FRNI.range.pdf", width = 12, height = 8)
```

Subset for *Fraxinus pennsylvanica*

```
FRPE.occ = gbif %>%
  filter(species == "Fraxinus pennsylvanica") %>%
  select(species,decimalLatitude,decimalLongitude)
```

Read in range map

```
FRPE.range = st_read("../USTreeAtlas/shp/fraxpenn/")
```

```
## Reading layer `fraxpenn' from data source
##   `/Users/samanthaworthy/Documents/GitHub/USTreeAtlas/shp/fraxpenn'
##   using driver `ESRI Shapefile'
## Simple feature collection with 188 features and 5 fields
## Geometry type: POLYGON
## Dimension:      XY
## Bounding box:  xmin: -111.6724 ymin: 28.31472 xmax: -59.68972 ymax: 54.27539
## CRS:           NA
```

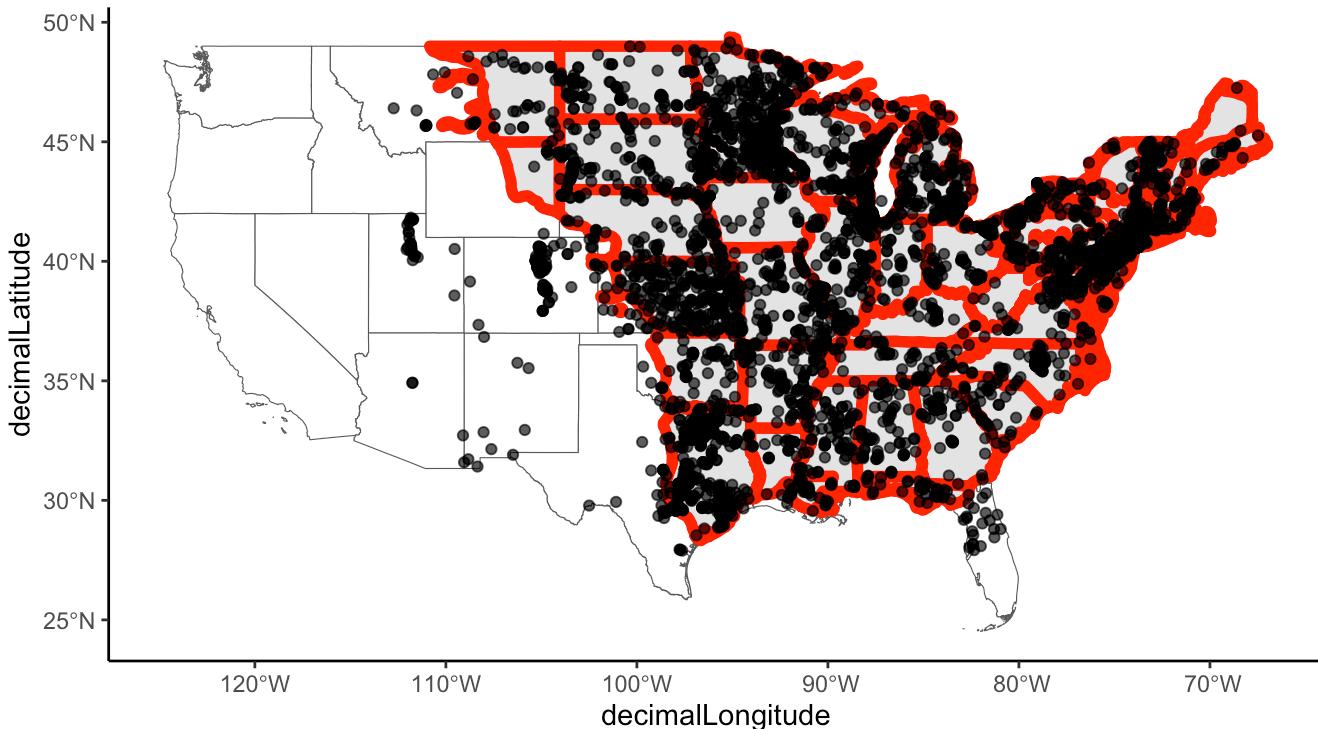
The projection is geographic with latitude and longitude. The datum is NAD27 which is EPSG:4267. The ellipsoid is Clarke 1866, and the transformation parameters

```
st_crs(FRPE.range) <- 4267
```

```
FRPE_clipped = st_intersection(FRPE.range, states.map)
```

```
## Warning: attribute variables are assumed to be spatially constant throughout
## all geometries
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = FRPE_clipped, col = "red", linewidth = 2)+
  geom_point(data = FRPE.occ, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
FRPE_clipped$species = "Fraxinus pennsylvanica"
FRPE_flag = cc_iucn(x = FRPE.occ, range = FRPE_clipped, lon = "decimalLongitude", lat =
"decimalLatitude",
                     value = "flagged", buffer = 50000)
```

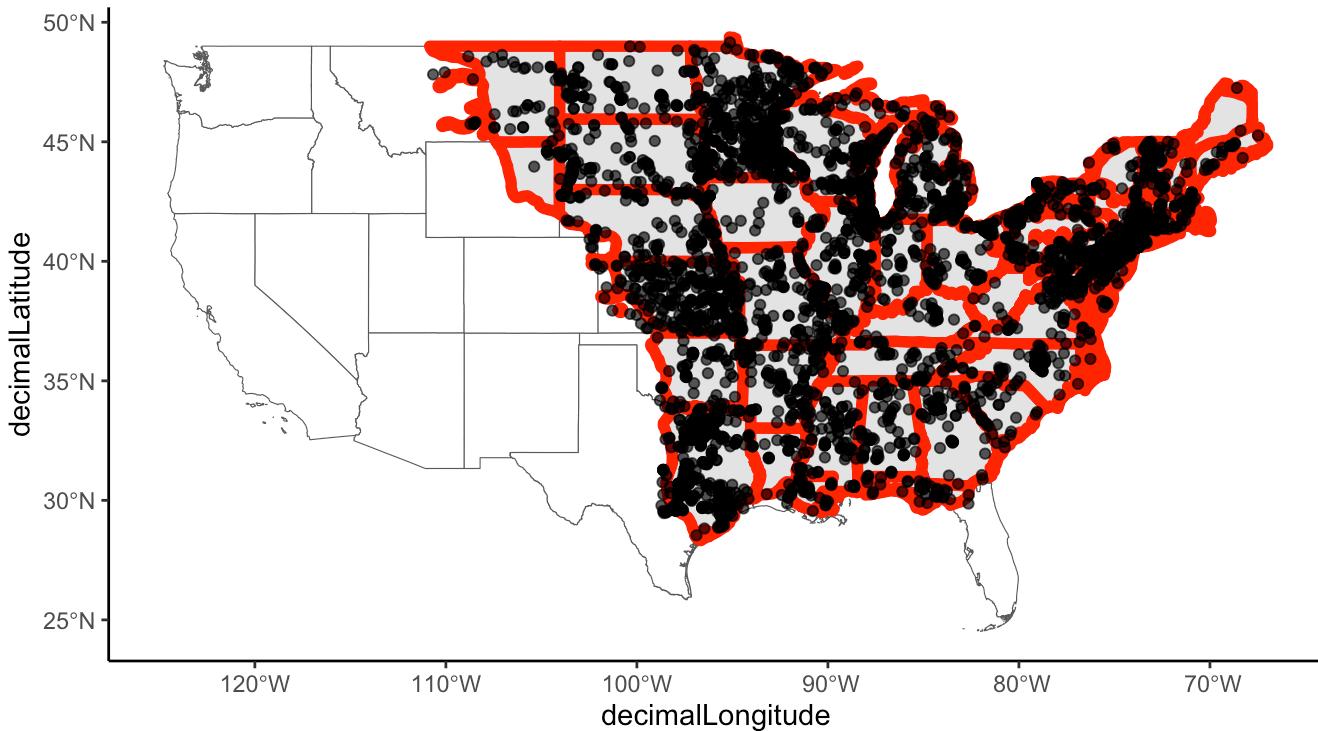
```
## Testing natural ranges
```

```
## Warning in cc_iucn(x = FRPE.occ, range = FRPE_clipped, lon =
## "decimalLongitude", : reprojecting reference to '+proj=longlat +datum=WGS84
## +no_defs'
```

```
## Flagged 228 records.
```

```
FRPE_occ_final = FRPE.occ[FRPE_flag, ]
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = FRPE_clipped, col = "red", linewidth = 2)+
  geom_point(data = FRPE_occ_final, aes(x = decimalLongitude, y = decimalLatitude), colo
r = "black", alpha = 0.7)+
  theme_classic()
```



```
ggsave("../Plots/FRPE.range.pdf", width = 12, height = 8)
```

Subset for *Fraxinus profunda*

```
FRPR.occ = gbif %>%
  filter(species == "Fraxinus profunda") %>%
  select(species,decimalLatitude,decimalLongitude)
```

Read in range map

```
FRPR.range = st_read("../USTreeAtlas/shp/fraxprof/")
```

```
## Reading layer `fraxprof' from data source
##   `/Users/samanthaworthy/Documents/GitHub/USTreeAtlas/shp/fraxprof'
##   using driver `ESRI Shapefile'
## Simple feature collection with 58 features and 5 fields
## Geometry type: POLYGON
## Dimension:     XY
## Bounding box:  xmin: -93.60954 ymin: 28.59934 xmax: -75.44749 ymax: 41.38225
## CRS:           NA
```

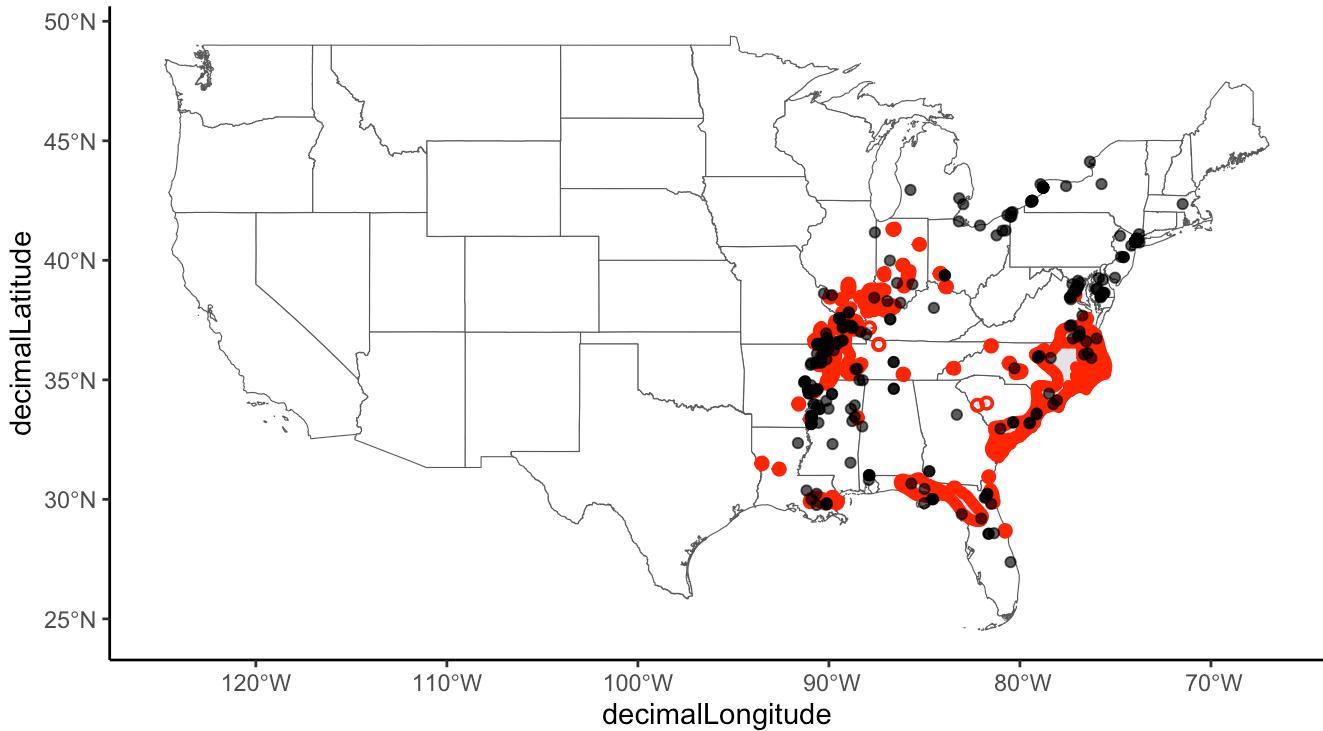
The projection is geographic with latitude and longitude. The datum is NAD27 which is EPSG:4267. The ellipsoid is Clarke 1866, and the transformation parameters

```
st_crs(FRPR.range) <- 4267
```

```
FRPR_clipped = st_intersection(FRPR.range, states.map)
```

```
## Warning: attribute variables are assumed to be spatially constant throughout
## all geometries
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = FRPR_clipped, col = "red", linewidth = 2)+
  geom_point(data = FRPR.occ, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
FRPR_clipped$species = "Fraxinus profunda"
FRPR_flag = cc_iucn(x = FRPR.occ, range = FRPR_clipped, lon = "decimalLongitude", lat =
"decimalLatitude",
                     value = "flagged", buffer = 50000)
```

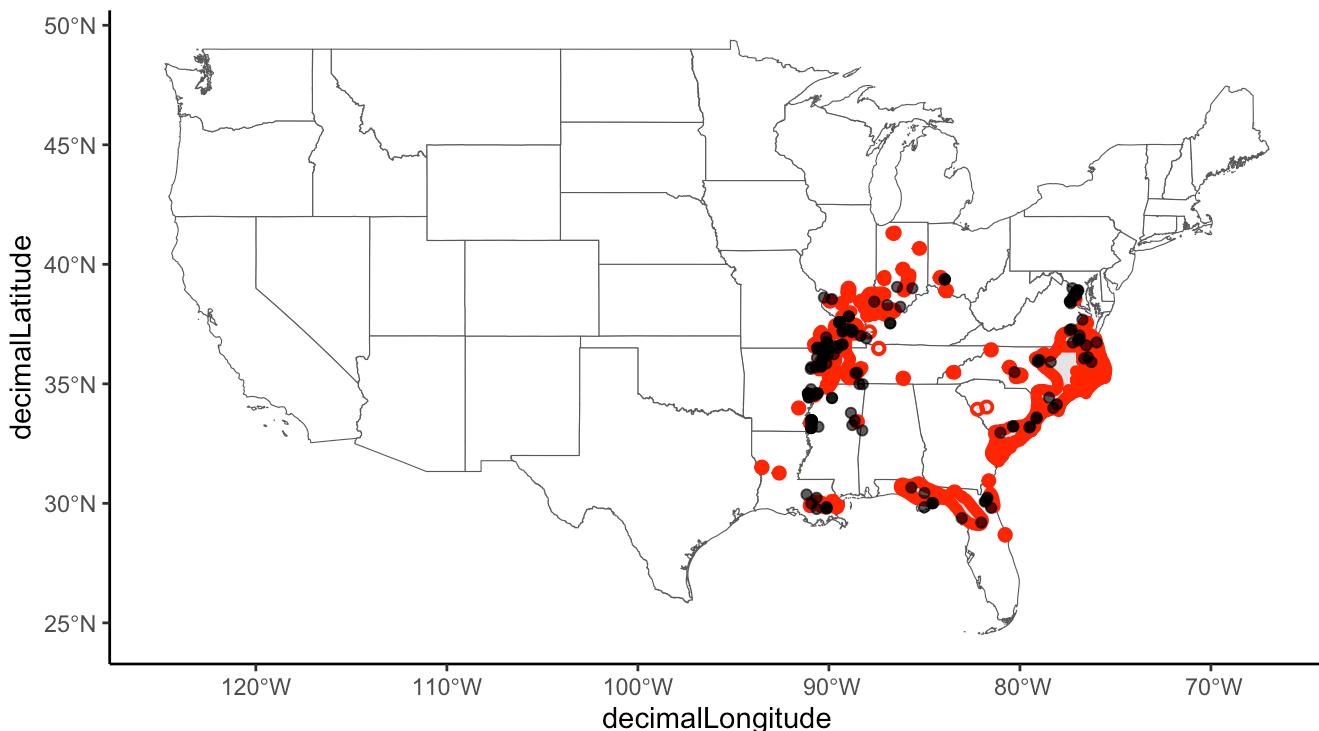
```
## Testing natural ranges
```

```
## Warning in cc_iucn(x = FRPR.occ, range = FRPR_clipped, lon =
## "decimalLongitude", : reprojecting reference to '+proj=longlat +datum=WGS84
## +no_defs'
```

```
## Flagged 161 records.
```

```
FRPR_occ_final = FRPR.occ[FRPR_flag, ]
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = FRPR_clipped, col = "red", linewidth = 2)+
  geom_point(data = FRPR_occ_final, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
ggsave("../Plots/FRPR.range.pdf", width = 12, height = 8)
```

Subset for *Fraxinus quadrangulata*

```
FRQU.occ = gbif %>%
  filter(species == "Fraxinus quadrangulata") %>%
  select(species,decimalLatitude,decimalLongitude)
```

Read in range map

```
FRQU.range = st_read("../USTreeAtlas/shp/fraxquad/")
```

```
## Reading layer `fraxquad' from data source
##   `/Users/samanthaworthy/Documents/GitHub/USTreeAtlas/shp/fraxquad'
##   using driver `ESRI Shapefile'
## Simple feature collection with 18 features and 5 fields
## Geometry type: POLYGON
## Dimension:      XY
## Bounding box:  xmin: -96.2248 ymin: 33.2491 xmax: -81.49872 ymax: 42.96199
## CRS:           NA
```

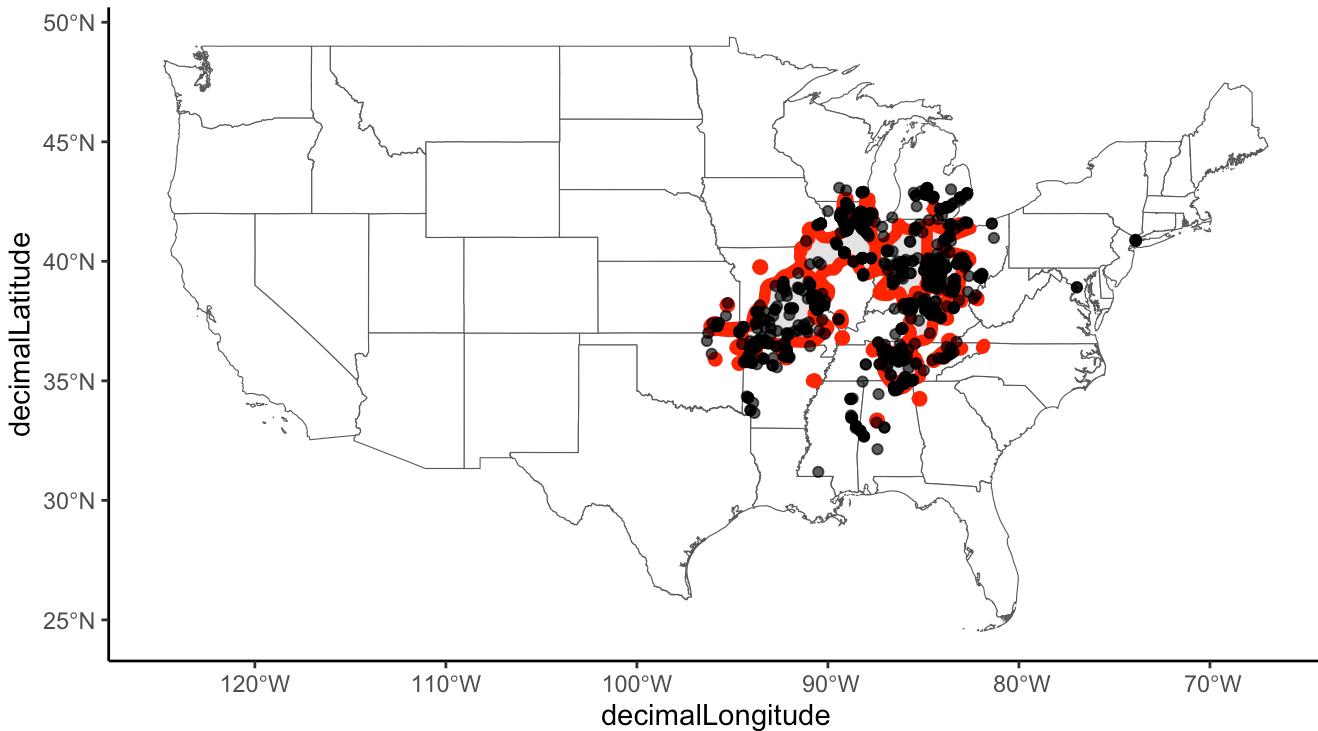
The projection is geographic with latitude and longitude. The datum is NAD27 which is EPSG:4267. The ellipsoid is Clarke 1866, and the transformation parameters

```
st_crs(FRQU.range) <- 4267
```

```
FRQU_clipped = st_intersection(FRQU.range, states.map)
```

```
## Warning: attribute variables are assumed to be spatially constant throughout
## all geometries
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = FRQU_clipped, col = "red", linewidth = 2)+
  geom_point(data = FRQU.occ, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
FRQU_clipped$species = "Fraxinus quadrangulata"
FRQU_flag = cc_iucn(x = FRQU.occ, range = FRQU_clipped, lon = "decimalLongitude", lat =
"decimalLatitude",
value = "flagged", buffer = 50000)
```

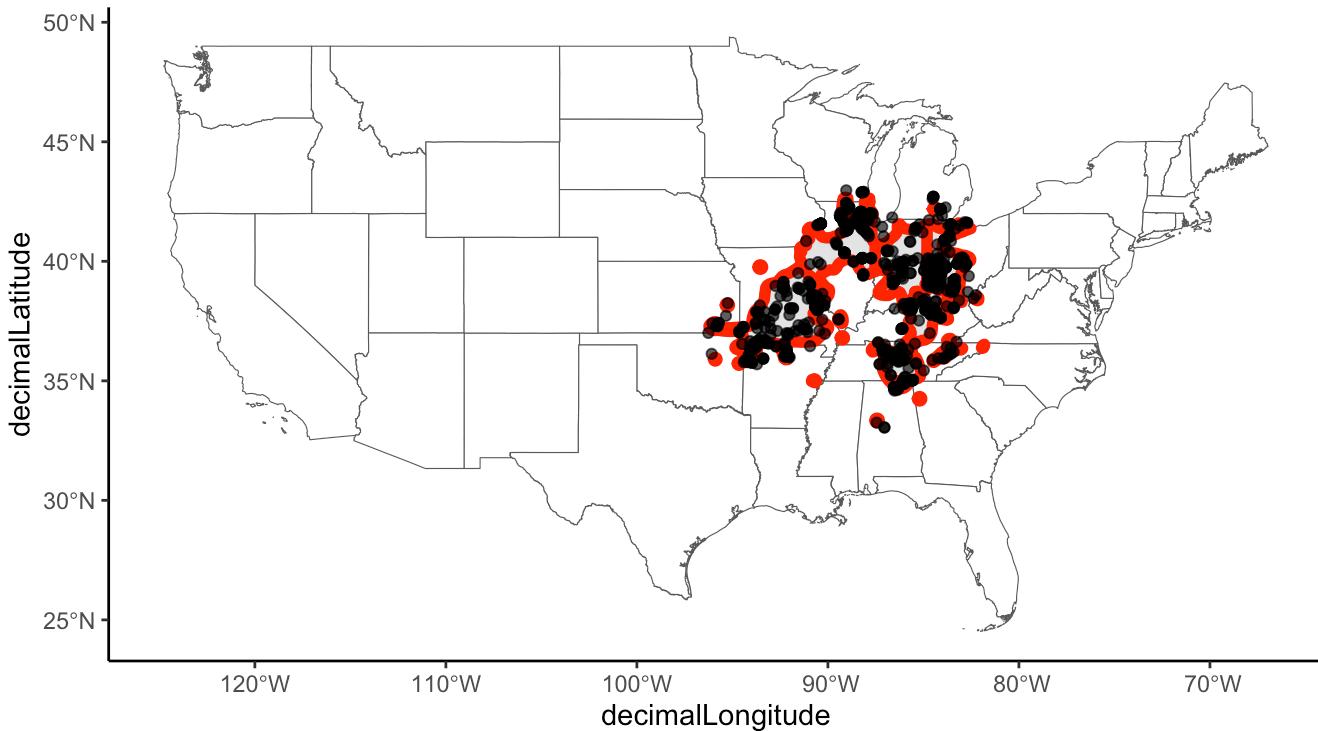
```
## Testing natural ranges
```

```
## Warning in cc_iucn(x = FRQU.occ, range = FRQU_clipped, lon =
## "decimalLongitude", : reprojecting reference to '+proj=longlat +datum=WGS84
## +no_defs'
```

```
## Flagged 122 records.
```

```
FRQU_occ_final = FRQU.occ[FRQU_flag, ]
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = FRQU_clipped, col = "red", linewidth = 2)+
  geom_point(data = FRQU_occ_final, aes(x = decimalLongitude, y = decimalLatitude), colo
r = "black", alpha = 0.7)+
  theme_classic()
```



```
ggsave("../Plots/FRQU.range.pdf", width = 12, height = 8)
```

Subset for *Fraxinus texensis*/*Fraxinus albicans* (gbif)

```
FRTE.occ = gbif %>%
  filter(species == "Fraxinus albicans") %>%
  select(species,decimalLatitude,decimalLongitude)
```

Read in range map

```
FRTE.range = st_read("../USTreeAtlas/shp/fraxtexe/")
```

```
## Reading layer `fraxtexe' from data source
##   `/Users/samanthaworthy/Documents/GitHub/USTreeAtlas/shp/fraxtexe'
##   using driver `ESRI Shapefile'
## Simple feature collection with 8 features and 5 fields
## Geometry type: POLYGON
## Dimension:     XY
## Bounding box:  xmin: -101.2223 ymin: 28.28765 xmax: -96.66921 ymax: 34.50977
## CRS:           NA
```

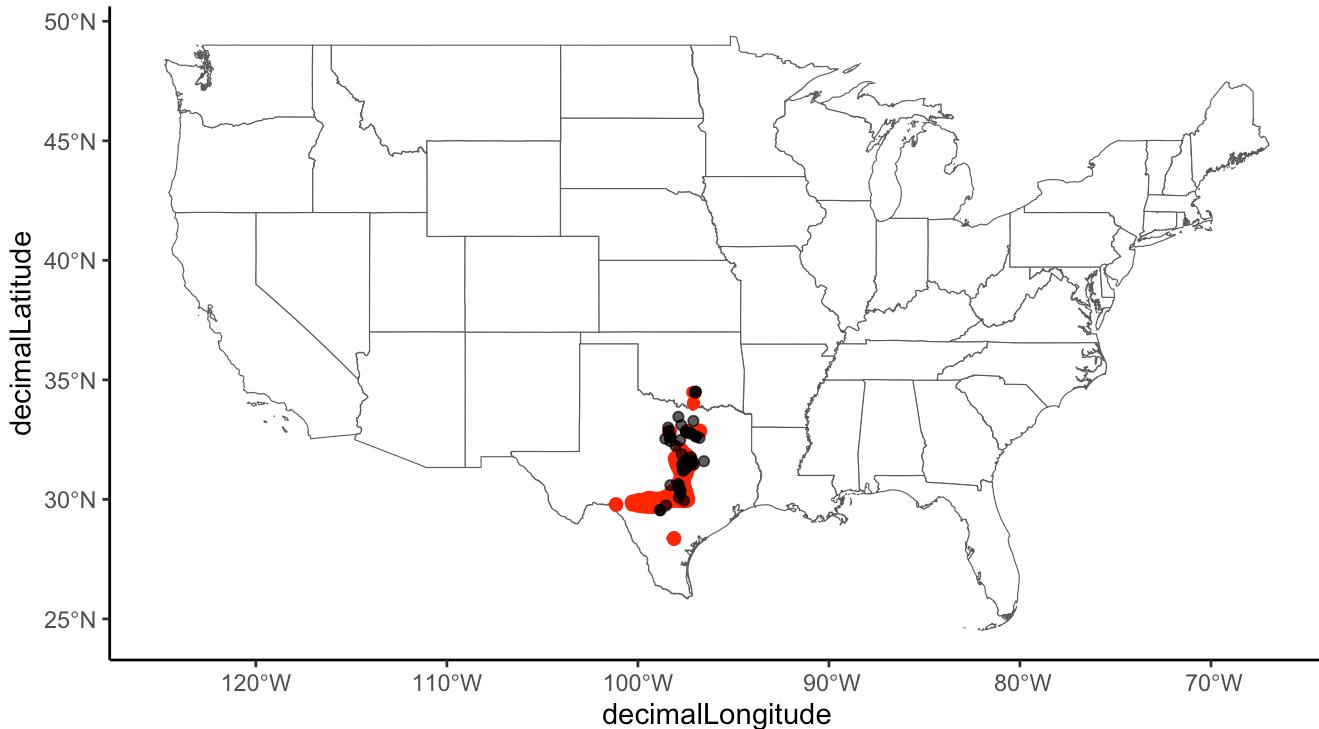
The projection is geographic with latitude and longitude. The datum is NAD27 which is EPSG:4267. The ellipsoid is Clarke 1866, and the transformation parameters

```
st_crs(FRTE.range) <- 4267
```

```
FRTE_clipped = st_intersection(FRTE.range, states.map)
```

```
## Warning: attribute variables are assumed to be spatially constant throughout
## all geometries
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = FRTE_clipped, col = "red", linewidth = 2)+
  geom_point(data = FRTE.occ, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
FRTE_clipped$species = "Fraxinus albicans"
FRTE_flag = cc_iucn(x = FRTE.occ, range = FRTE_clipped, lon = "decimalLongitude", lat =
"decimalLatitude",
                     value = "flagged", buffer = 50000)
```

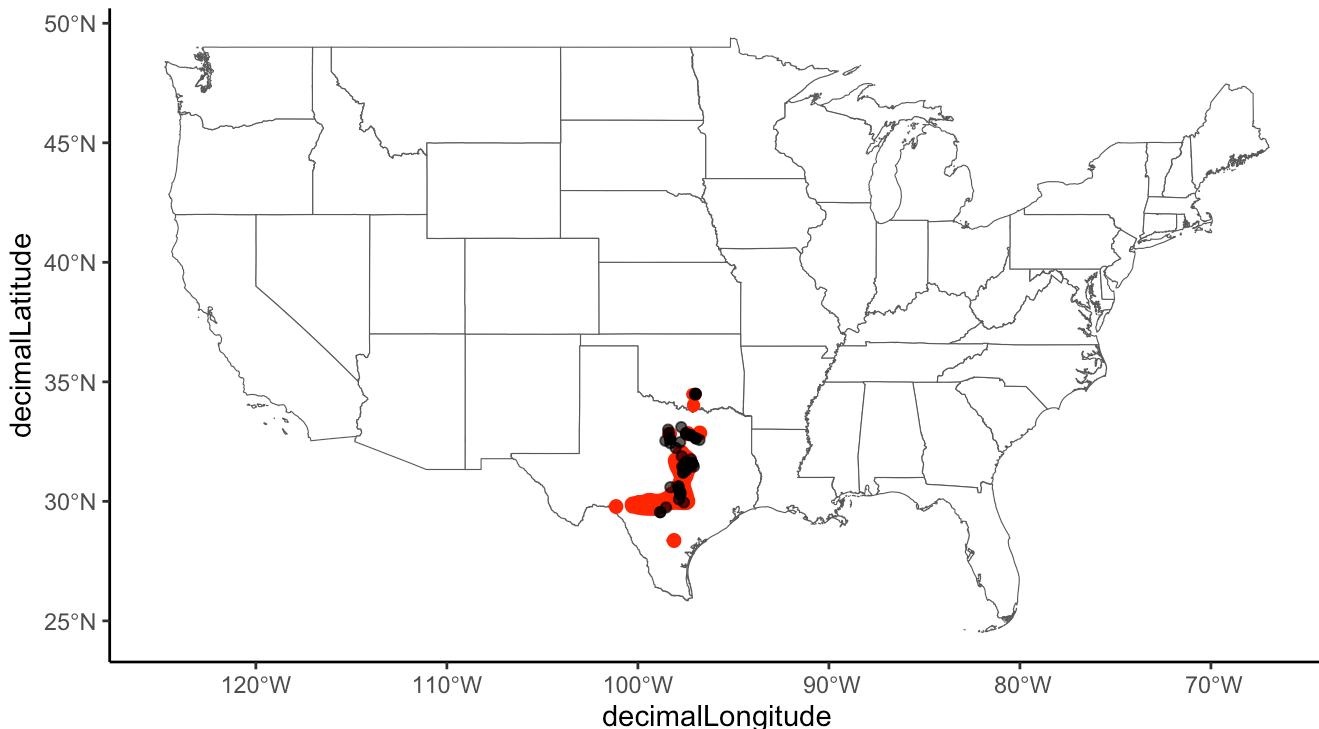
```
## Testing natural ranges
```

```
## Warning in cc_iucn(x = FRTE.occ, range = FRTE_clipped, lon =
## "decimalLongitude", : reprojecting reference to '+proj=longlat +datum=WGS84
## +no_defs'
```

```
## Flagged 3 records.
```

```
FRTE_occ_final = FRTE.occ[FRTE_flag, ]
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = FRTE_clipped, col = "red", linewidth = 2)+
  geom_point(data = FRTE_occ_final, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
ggsave("../Plots/FRTE.range.pdf", width = 12, height = 8)
```

Subset for *Gleditsia aquatica*

```
GLAQ.occ = gbif %>%
  filter(species == "Gleditsia aquatica") %>%
  select(species,decimalLatitude,decimalLongitude)
```

Read in range map

```
GLAQ.range = st_read("../USTreeAtlas/shp/gledaqua/")

## Reading layer `gledaqua' from data source
##   `/Users/samanthaworthy/Documents/GitHub/USTreeAtlas/shp/gledaqua'
##   using driver `ESRI Shapefile'
## Simple feature collection with 20 features and 5 fields
## Geometry type: POLYGON
## Dimension:      XY
## Bounding box:  xmin: -96.36879 ymin: 27.27744 xmax: -79.58623 ymax: 38.97958
## CRS:           NA
```

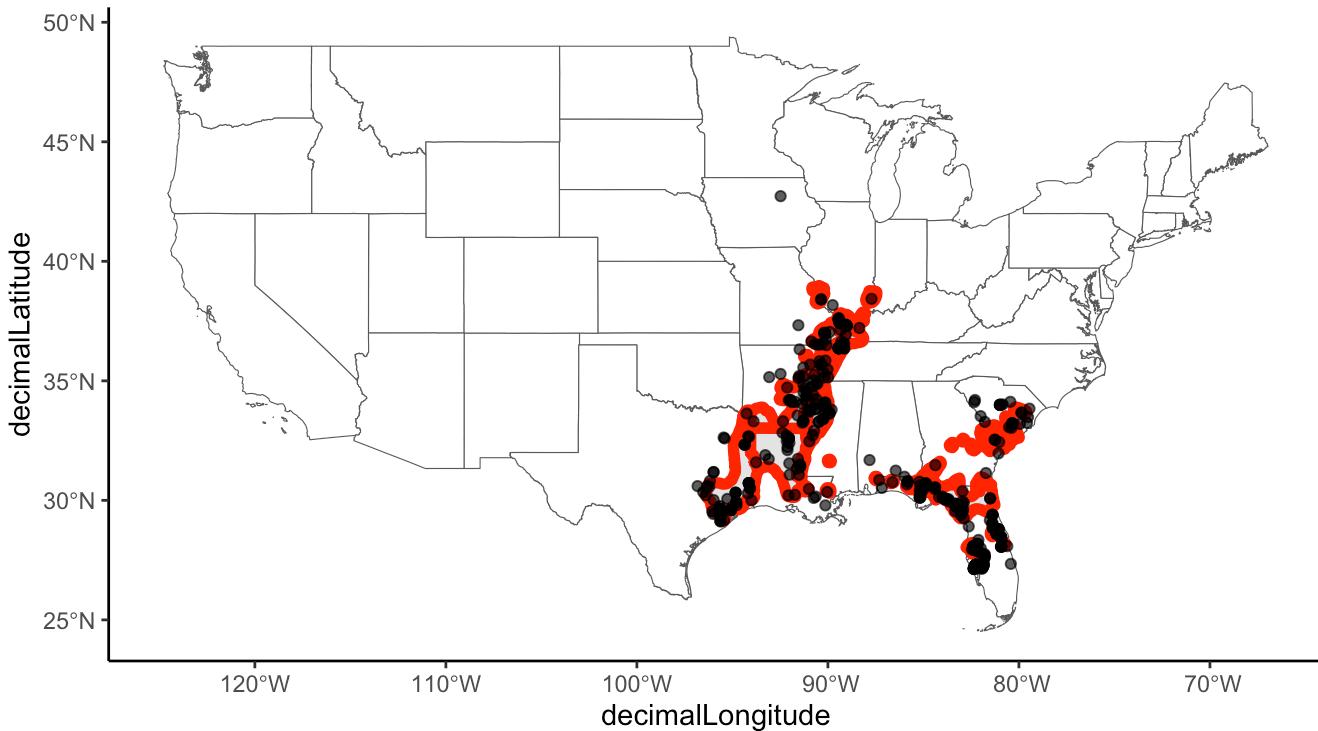
The projection is geographic with latitude and longitude. The datum is NAD27 which is EPSG:4267. The ellipsoid is Clarke 1866, and the transformation parameters

```
st_crs(GLAQ.range) <- 4267
```

```
GLAQ_clipped = st_intersection(GLAQ.range, states.map)
```

```
## Warning: attribute variables are assumed to be spatially constant throughout
## all geometries
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = GLAQ_clipped, col = "red", linewidth = 2)+
  geom_point(data = GLAQ.occ, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
GLAQ_clipped$species = "Gleditsia aquatica"
GLAQ_flag = cc_iucn(x = GLAQ.occ, range = GLAQ_clipped, lon = "decimalLongitude", lat =
"decimalLatitude",
value = "flagged", buffer = 50000)
```

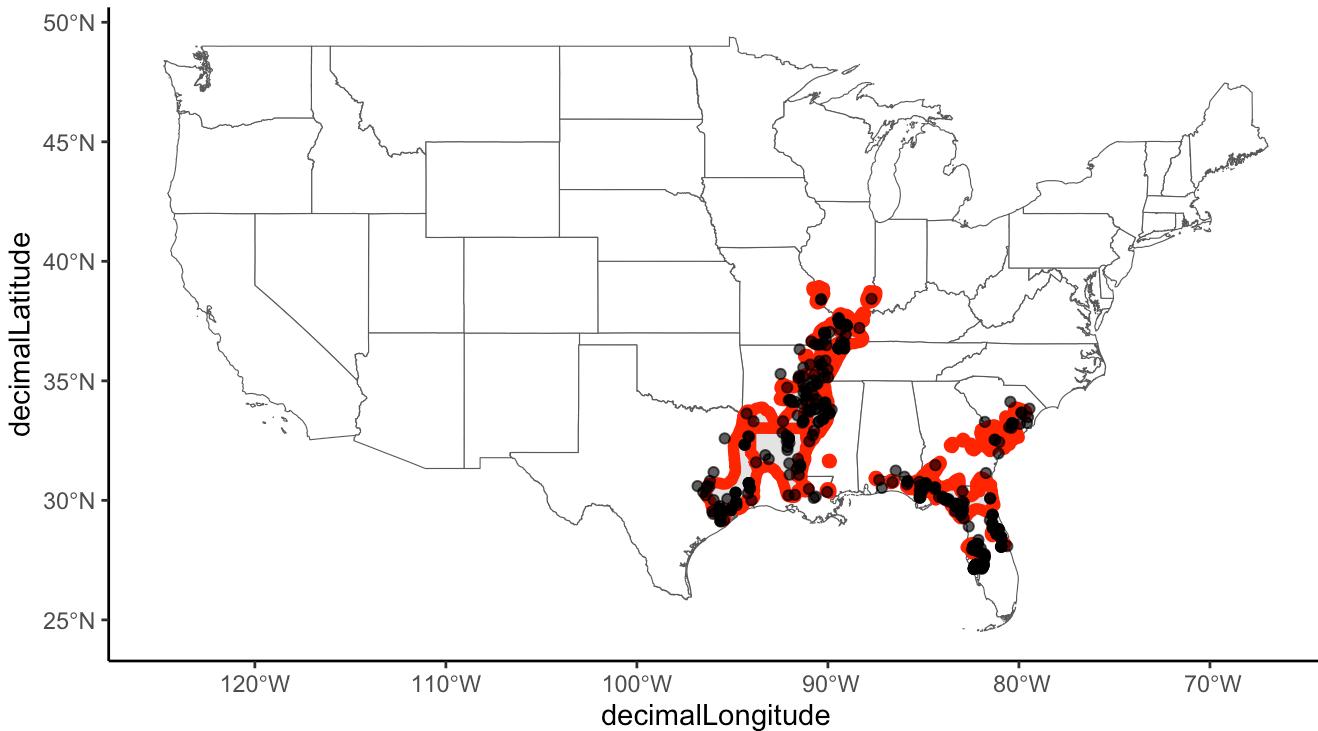
```
## Testing natural ranges
```

```
## Warning in cc_iucn(x = GLAQ.occ, range = GLAQ_clipped, lon =
## "decimalLongitude", : reprojecting reference to '+proj=longlat +datum=WGS84
## +no_defs'
```

```
## Flagged 18 records.
```

```
GLAQ_occ_final = GLAQ.occ[GLAQ_flag, ]
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = GLAQ_clipped, col = "red", linewidth = 2)+
  geom_point(data = GLAQ_occ_final, aes(x = decimalLongitude, y = decimalLatitude), colo
r = "black", alpha = 0.7)+
  theme_classic()
```



```
ggsave("../Plots/GLAQ.range.pdf", width = 12, height = 8)
```

Subset for *Gleditsia triacanthos*

```
GLTR.occ = gbif %>%
  filter(species == "Gleditsia triacanthos") %>%
  select(species,decimalLatitude,decimalLongitude)
```

Read in range map

```
GLTR.range = st_read("../USTreeAtlas/shp/gledtria/")
```

```
## Reading layer `gledtria' from data source
##   `/Users/samanthaworthy/Documents/GitHub/USTreeAtlas/shp/gledtria'
##   using driver `ESRI Shapefile'
## Simple feature collection with 18 features and 5 fields
## Geometry type: POLYGON
## Dimension:     XY
## Bounding box:  xmin: -101.5966 ymin: 28.73964 xmax: -76.56055 ymax: 43.67306
## CRS:           NA
```

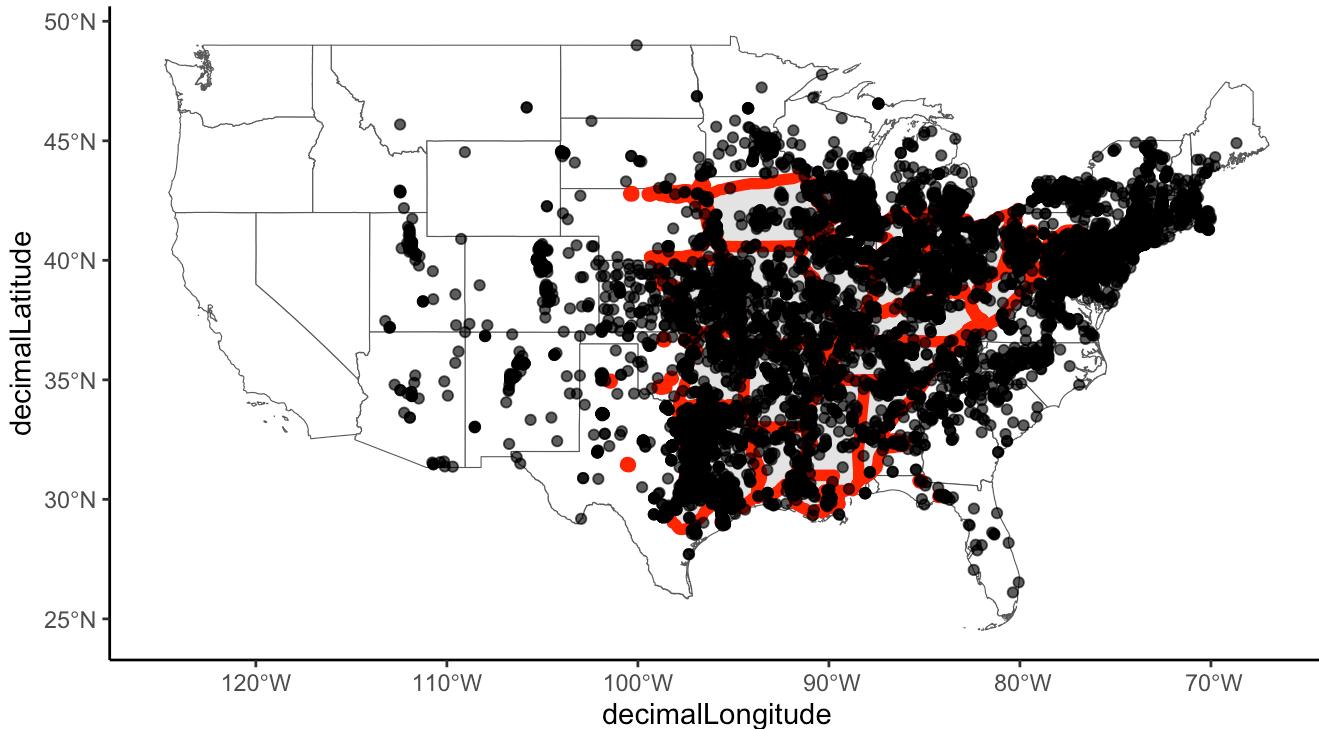
The projection is geographic with latitude and longitude. The datum is NAD27 which is EPSG:4267. The ellipsoid is Clarke 1866, and the transformation parameters

```
st_crs(GLTR.range) <- 4267
```

```
GLTR_clipped = st_intersection(GLTR.range, states.map)
```

```
## Warning: attribute variables are assumed to be spatially constant throughout
## all geometries
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = GLTR_clipped, col = "red", linewidth = 2)+
  geom_point(data = GLTR.occ, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
GLTR_clipped$species = "Gleditsia triacanthos"
GLTR_flag = cc_iucn(x = GLTR.occ, range = GLTR_clipped, lon = "decimalLongitude", lat =
"decimalLatitude",
                     value = "flagged", buffer = 50000)
```

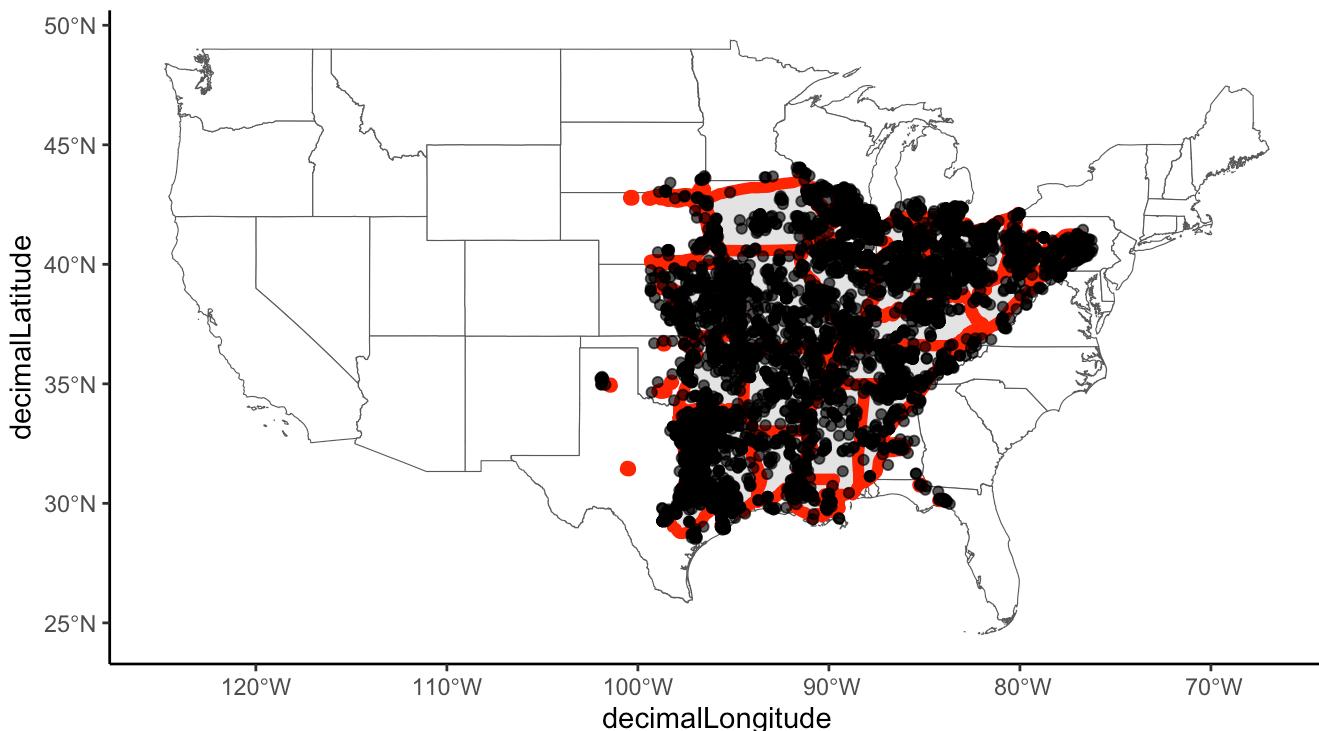
```
## Testing natural ranges
```

```
## Warning in cc_iucn(x = GLTR.occ, range = GLTR_clipped, lon =
## "decimalLongitude", : reprojecting reference to '+proj=longlat +datum=WGS84
## +no_defs'
```

```
## Flagged 44611 records.
```

```
GLTR_occ_final = GLTR.occ[GLTR_flag, ]
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = GLTR_clipped, col = "red", linewidth = 2)+
  geom_point(data = GLTR_occ_final, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
ggsave("../Plots/GLTR.range.pdf", width = 12, height = 8)
```

Subset for *Gordonia lasianthus*

```
GOLA.occ = gbif %>%
  filter(species == "Gordonia lasianthus") %>%
  select(species,decimalLatitude,decimalLongitude)
```

Read in range map

```
GOLA.range = st_read("../USTreeAtlas/shp/gordlasi/")

## Reading layer `gordlasi' from data source
##   `/Users/samanthaworthy/Documents/GitHub/USTreeAtlas/shp/gordlasi'
##   using driver `ESRI Shapefile'
## Simple feature collection with 29 features and 5 fields
## Geometry type: POLYGON
## Dimension:      XY
## Bounding box:  xmin: -89.66769 ymin: 27.00125 xmax: -75.71973 ymax: 35.99722
## CRS:           NA
```

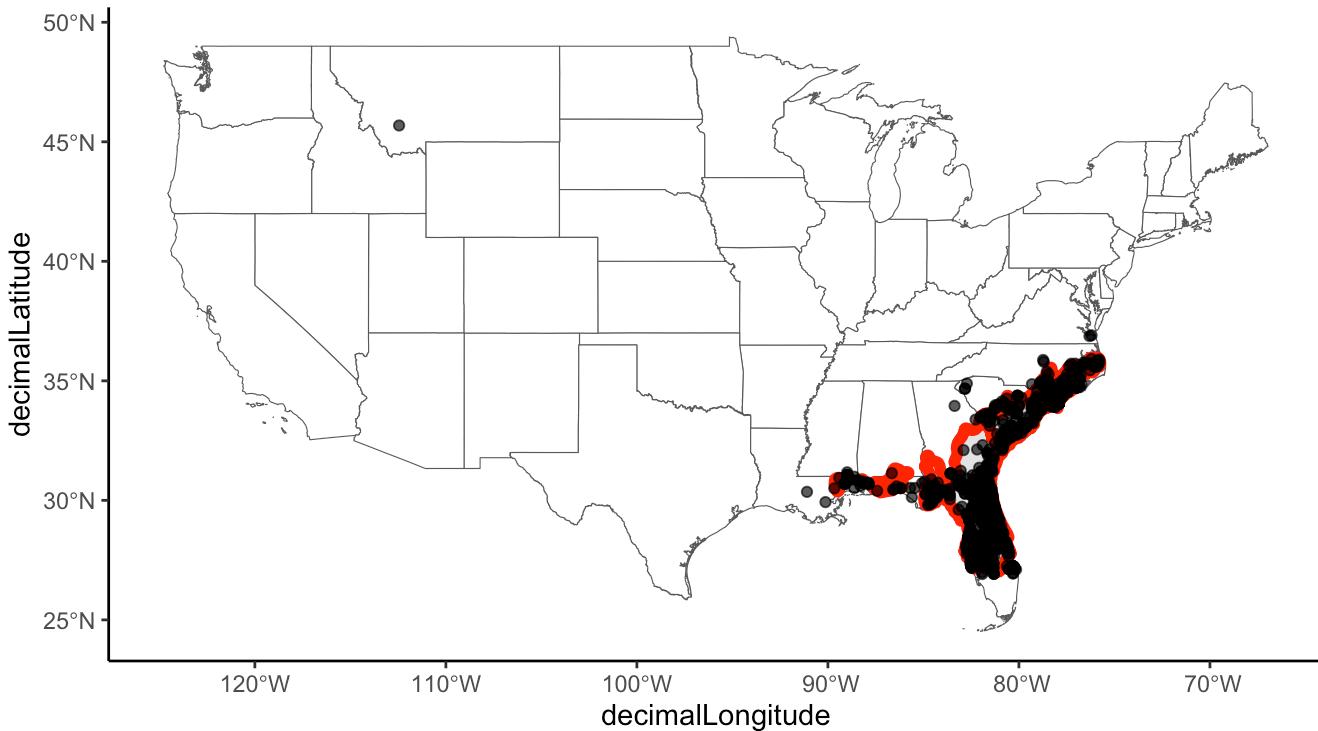
The projection is geographic with latitude and longitude. The datum is NAD27 which is EPSG:4267. The ellipsoid is Clarke 1866, and the transformation parameters

```
st_crs(GOLA.range) <- 4267
```

```
GOLA_clipped = st_intersection(GOLA.range, states.map)
```

```
## Warning: attribute variables are assumed to be spatially constant throughout
## all geometries
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = GOLA_clipped, col = "red", linewidth = 2)+
  geom_point(data = GOLA.occ, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
GOLA_clipped$species = "Gordonia lasianthus"
GOLA_flag = cc_iucn(x = GOLA.occ, range = GOLA_clipped, lon = "decimalLongitude", lat =
"decimalLatitude",
value = "flagged", buffer = 50000)
```

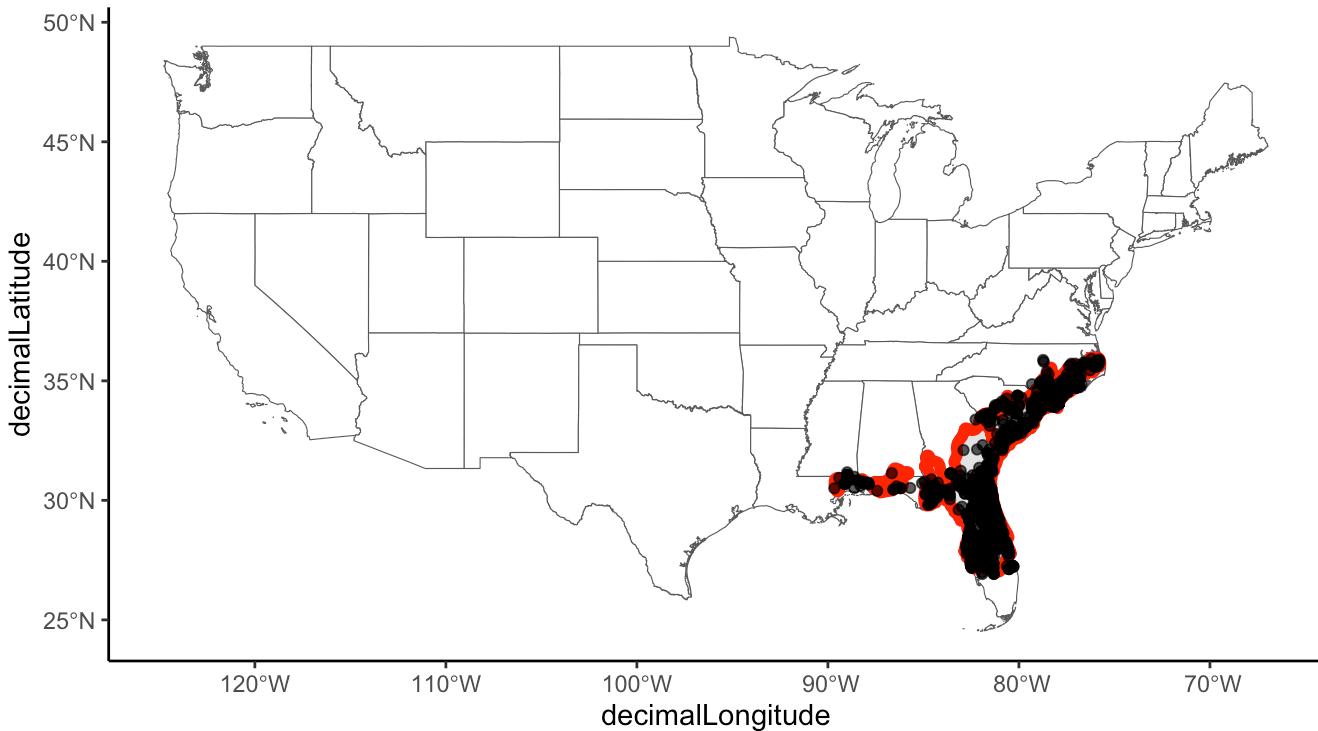
```
## Testing natural ranges
```

```
## Warning in cc_iucn(x = GOLA.occ, range = GOLA_clipped, lon =
## "decimalLongitude", : reprojecting reference to '+proj=longlat +datum=WGS84
## +no_defs'
```

```
## Flagged 44 records.
```

```
GOLA_occ_final = GOLA.occ[GOLA_flag, ]
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = GOLA_clipped, col = "red", linewidth = 2)+
  geom_point(data = GOLA_occ_final, aes(x = decimalLongitude, y = decimalLatitude), colo
r = "black", alpha = 0.7)+
  theme_classic()
```



```
ggsave("../Plots/GOLA.range.pdf", width = 12, height = 8)
```

Subset for *Gymnocladus dioicus*

```
GYDI.occ = gbif %>%
  filter(species == "Gymnocladus dioicus") %>%
  select(species,decimalLatitude,decimalLongitude)
```

Read in range map

```
GYDI.range = st_read("../USTreeAtlas/shp/gymndioi/")
```

```
## Reading layer `gymndioi` from data source
##   `/Users/samanthaworthy/Documents/GitHub/USTreeAtlas/shp/gymndioi'
##   using driver `ESRI Shapefile'
## Simple feature collection with 44 features and 5 fields
## Geometry type: POLYGON
## Dimension:     XY
## Bounding box:  xmin: -99.97971 ymin: 33.98936 xmax: -76.18254 ymax: 45.07224
## CRS:           NA
```

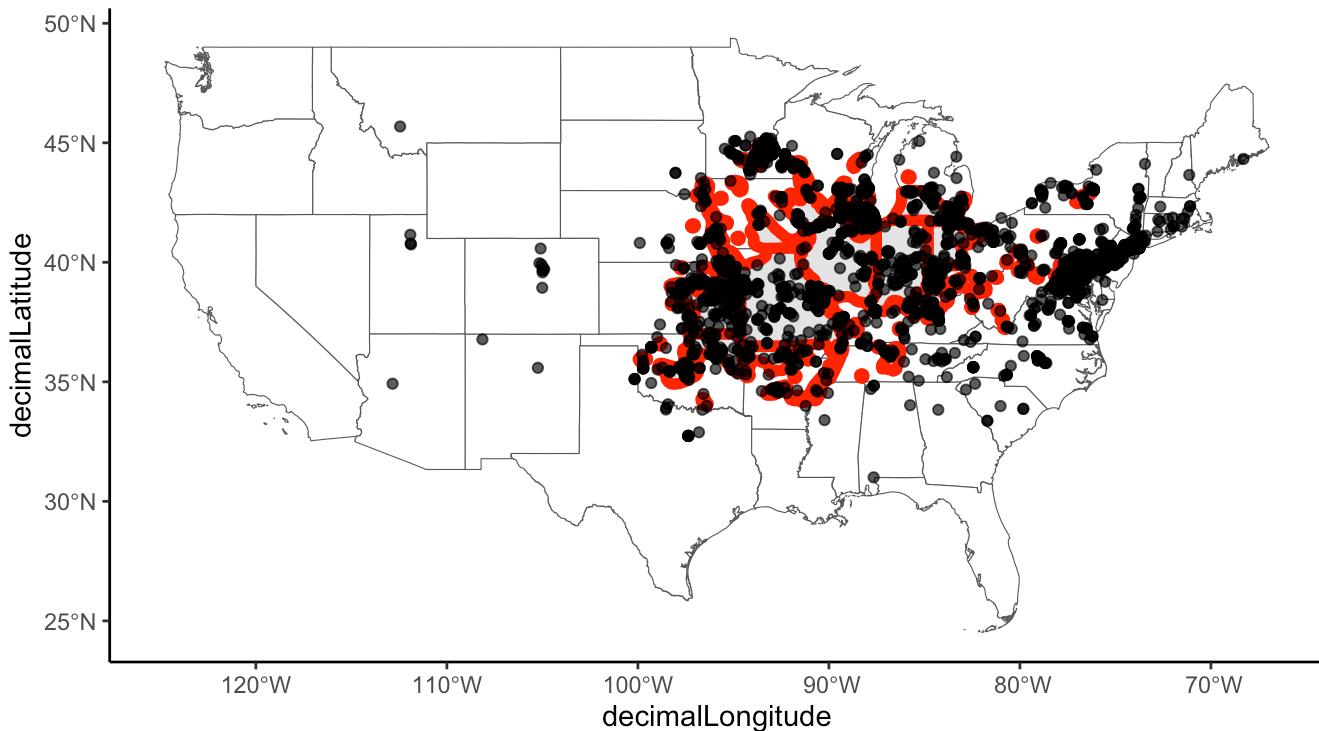
The projection is geographic with latitude and longitude. The datum is NAD27 which is EPSG:4267. The ellipsoid is Clarke 1866, and the transformation parameters

```
st_crs(GYDI.range) <- 4267
```

```
GYDI_clipped = st_intersection(GYDI.range, states.map)
```

```
## Warning: attribute variables are assumed to be spatially constant throughout
## all geometries
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = GYDI_clipped, col = "red", linewidth = 2)+
  geom_point(data = GYDI.occ, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
GYDI_clipped$species = "Gymnocladus dioicus"
GYDI_flag = cc_iucn(x = GYDI.occ, range = GYDI_clipped, lon = "decimalLongitude", lat =
"decimalLatitude",
                     value = "flagged", buffer = 50000)
```

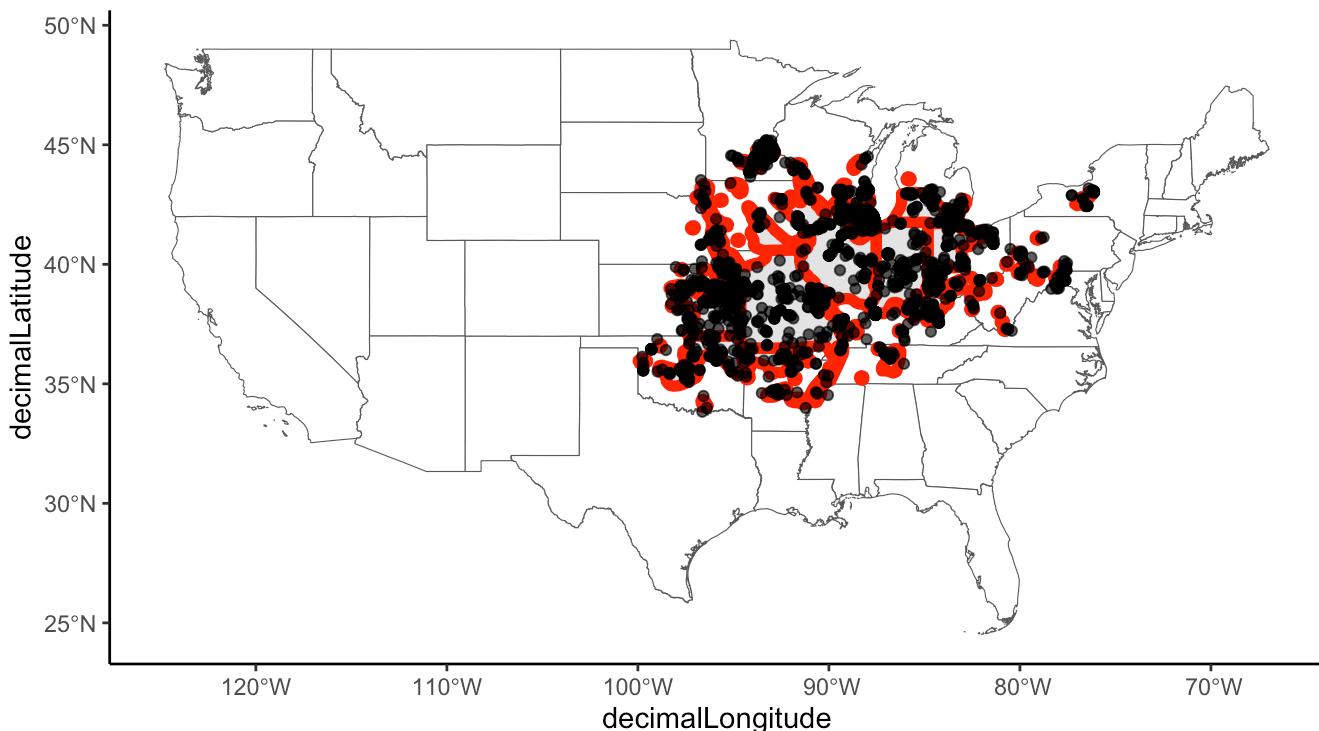
```
## Testing natural ranges
```

```
## Warning in cc_iucn(x = GYDI.occ, range = GYDI_clipped, lon =
## "decimalLongitude", : reprojecting reference to '+proj=longlat +datum=WGS84
## +no_defs'
```

```
## Flagged 3909 records.
```

```
GYDI_occ_final = GYDI.occ[GYDI_flag, ]
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = GYDI_clipped, col = "red", linewidth = 2)+
  geom_point(data = GYDI_occ_final, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
ggsave("../Plots/GYDI.range.pdf", width = 12, height = 8)
```

Subset for *Ilex opaca*

```
ILOP.occ = gbif %>%
  filter(species == "Ilex opaca") %>%
  select(species,decimalLatitude,decimalLongitude)
```

Read in range map

```
ILOP.range = st_read("../USTreeAtlas/shp/ilexopac/")

## Reading layer `ilexopac' from data source
##   `/Users/samanthaworthy/Documents/GitHub/USTreeAtlas/shp/ilexopac'
##   using driver `ESRI Shapefile'
## Simple feature collection with 67 features and 5 fields
## Geometry type: POLYGON
## Dimension:      XY
## Bounding box:  xmin: -98.05645 ymin: 27.40893 xmax: -70.25293 ymax: 42.31931
## CRS:           NA
```

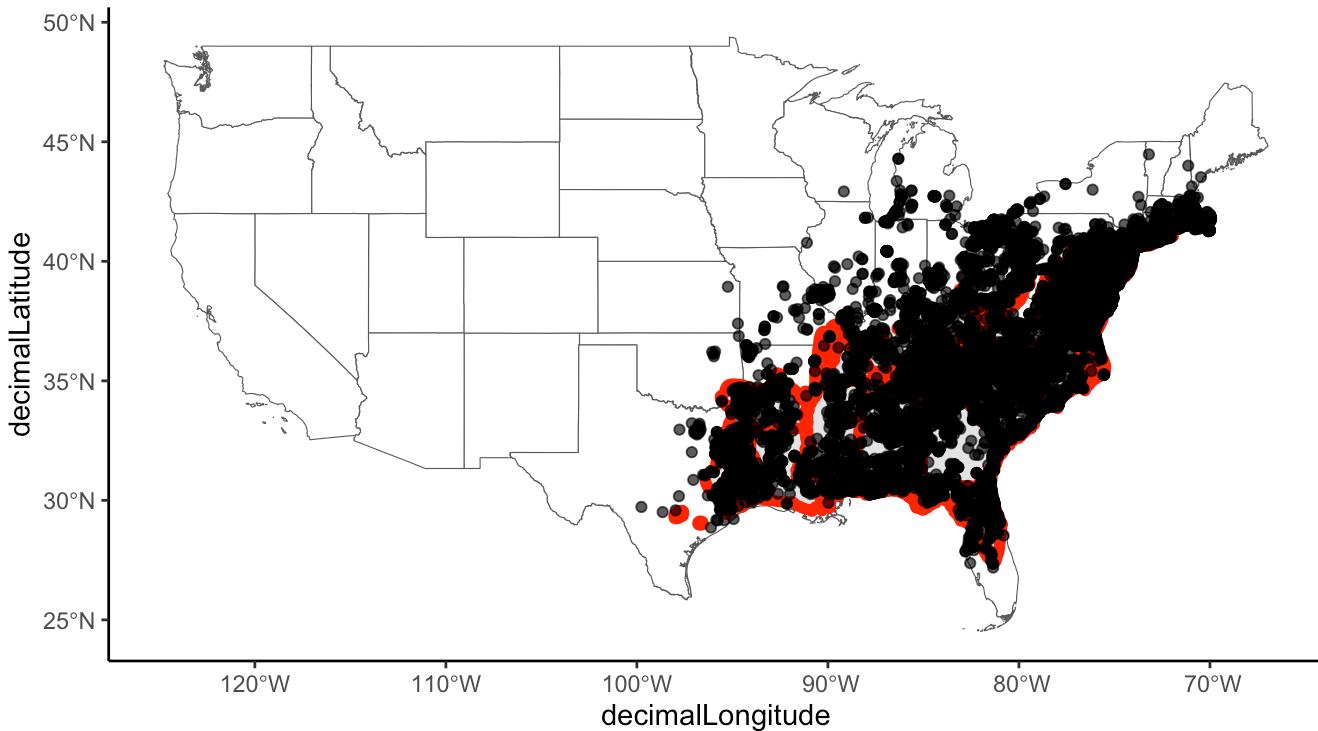
The projection is geographic with latitude and longitude. The datum is NAD27 which is EPSG:4267. The ellipsoid is Clarke 1866, and the transformation parameters

```
st_crs(ILOP.range) <- 4267
```

```
ILOP_clipped = st_intersection(ILOP.range, states.map)
```

```
## Warning: attribute variables are assumed to be spatially constant throughout
## all geometries
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = ILOP_clipped, col = "red", linewidth = 2)+
  geom_point(data = ILOP.occ, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
ILOP_clipped$species = "Ilex opaca"
ILOP_flag = cc_iucn(x = ILOP.occ, range = ILOP_clipped, lon = "decimalLongitude", lat =
"decimalLatitude",
value = "flagged", buffer = 50000)
```

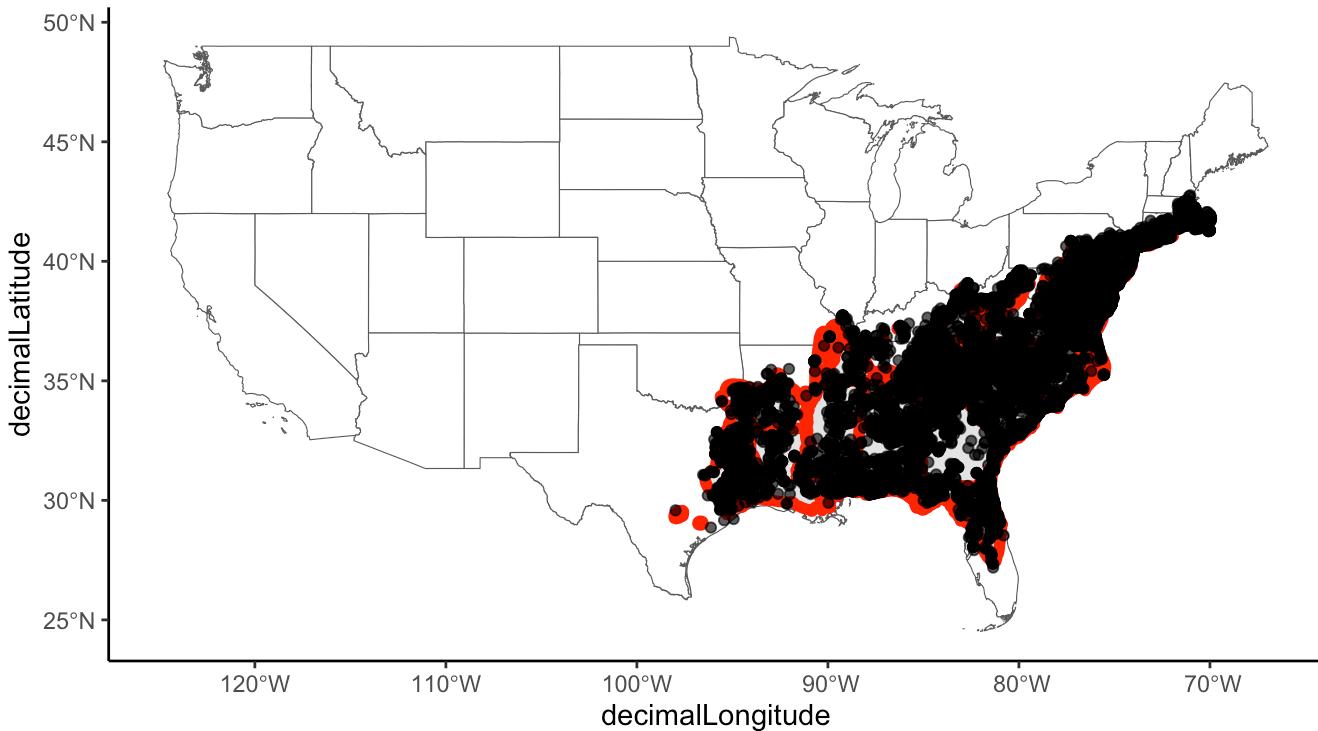
```
## Testing natural ranges
```

```
## Warning in cc_iucn(x = ILOP.occ, range = ILOP_clipped, lon =
## "decimalLongitude", : reprojecting reference to '+proj=longlat +datum=WGS84
## +no_defs'
```

```
## Flagged 2109 records.
```

```
ILOP_occ_final = ILOP.occ[ILOP_flag, ]
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = ILOP_clipped, col = "red", linewidth = 2)+
  geom_point(data = ILOP_occ_final, aes(x = decimalLongitude, y = decimalLatitude), colo
r = "black", alpha = 0.7)+
  theme_classic()
```



```
ggsave("../Plots/IL0P.range.pdf", width = 12, height = 8)
```

Subset for *Juglans cinerea*

```
JUCI.occ = gbif %>%
  filter(species == "Juglans cinerea") %>%
  select(species,decimalLatitude,decimalLongitude)
```

Read in range map

```
JUCI.range = st_read("../USTreeAtlas/shp/juglcine/")
```

```
## Reading layer `juglcine' from data source
##   `/Users/samanthaworthy/Documents/GitHub/USTreeAtlas/shp/juglcine'
##   using driver `ESRI Shapefile'
## Simple feature collection with 44 features and 5 fields
## Geometry type: POLYGON
## Dimension:     XY
## Bounding box:  xmin: -94.84976 ymin: 33.36165 xmax: -65.67808 ymax: 47.24971
## CRS:           NA
```

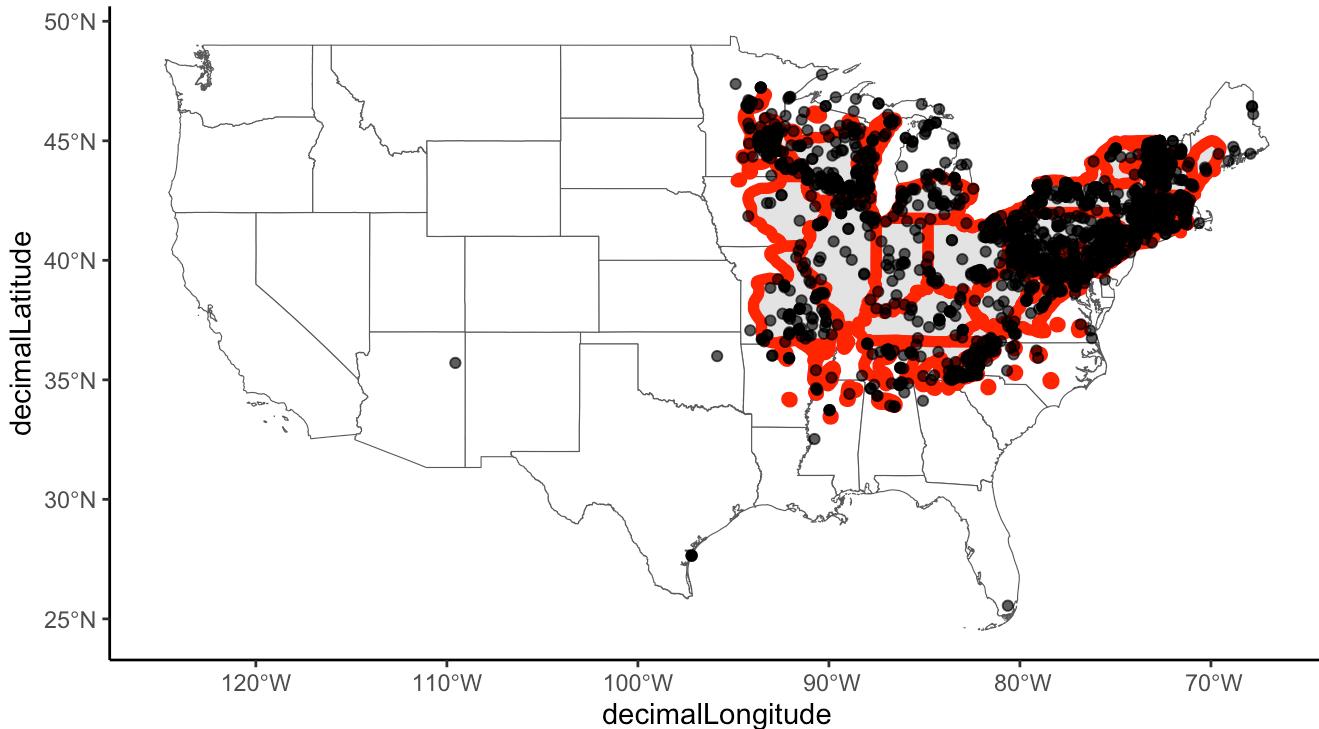
The projection is geographic with latitude and longitude. The datum is NAD27 which is EPSG:4267. The ellipsoid is Clarke 1866, and the transformation parameters

```
st_crs(JUCI.range) <- 4267
```

```
JUCI_clipped = st_intersection(JUCI.range, states.map)
```

```
## Warning: attribute variables are assumed to be spatially constant throughout
## all geometries
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = JUCI_clipped, col = "red", linewidth = 2)+
  geom_point(data = JUCI.occ, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
JUCI_clipped$species = "Juglans cinerea"
JUCI_flag = cc_iucn(x = JUCI.occ, range = JUCI_clipped, lon = "decimalLongitude", lat =
"decimalLatitude",
                     value = "flagged", buffer = 50000)
```

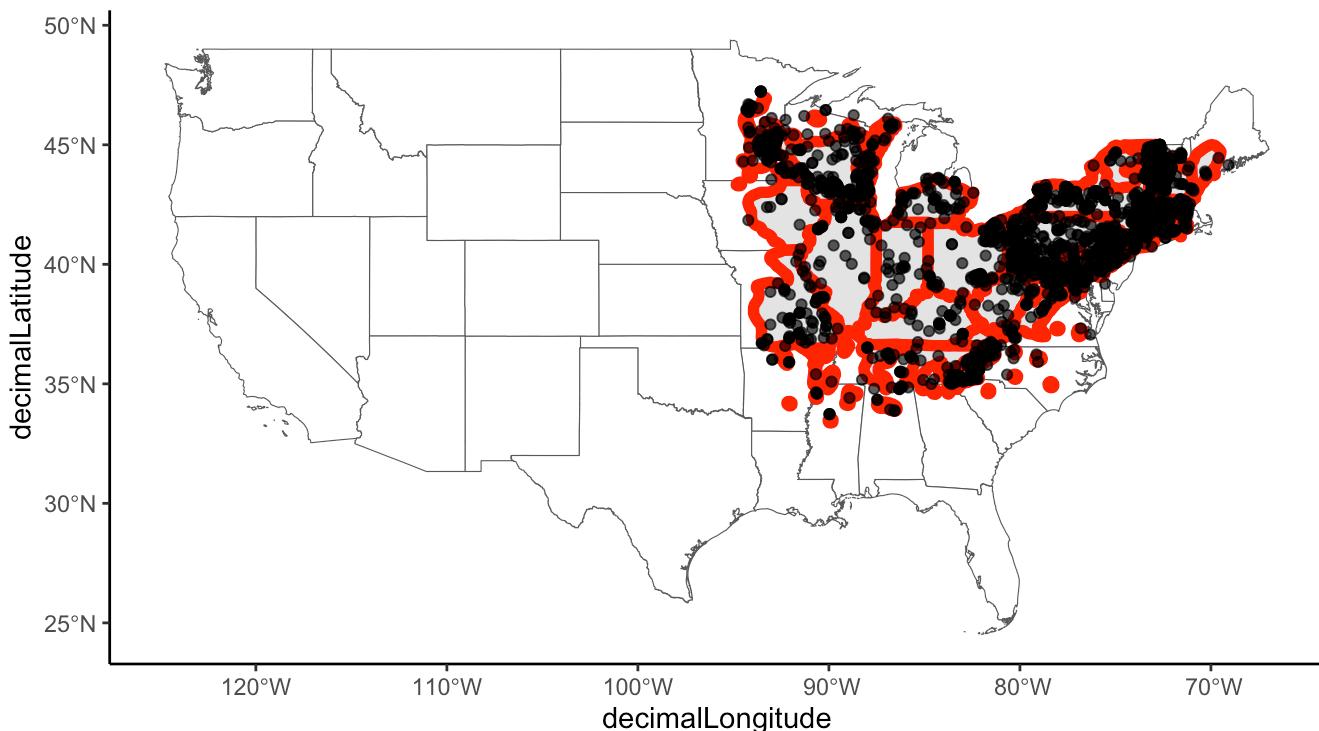
```
## Testing natural ranges
```

```
## Warning in cc_iucn(x = JUCI.occ, range = JUCI_clipped, lon =
## "decimalLongitude", : reprojecting reference to '+proj=longlat +datum=WGS84
## +no_defs'
```

```
## Flagged 52 records.
```

```
JUCI_occ_final = JUCI.occ[JUCI_flag, ]
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = JUCI_clipped, col = "red", linewidth = 2)+
  geom_point(data = JUCI_occ_final, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
ggsave("../Plots/JUCI.range.pdf", width = 12, height = 8)
```

Subset for *Juglans nigra*

```
JUNI.occ = gbif %>%
  filter(species == "Juglans nigra") %>%
  select(species,decimalLatitude,decimalLongitude)
```

Read in range map

```
JUNI.range = st_read("../USTreeAtlas/shp/juglnigr/")
```

```
## Reading layer `juglnigr' from data source
##   `/Users/samanthaworthy/Documents/GitHub/USTreeAtlas/shp/juglnigr'
##   using driver `ESRI Shapefile'
## Simple feature collection with 61 features and 5 fields
## Geometry type: POLYGON
## Dimension:      XY
## Bounding box:  xmin: -100.5016 ymin: 28.65753 xmax: -71.5475 ymax: 45.06173
## CRS:           NA
```

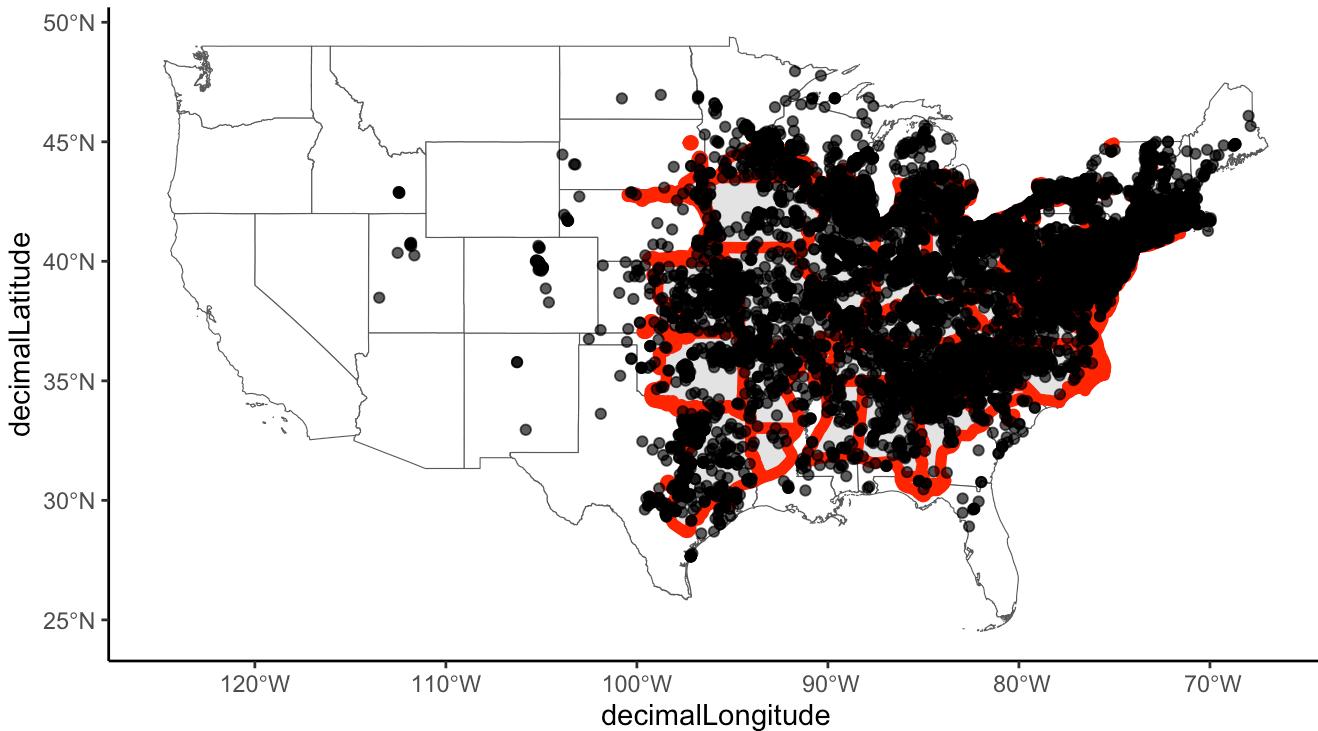
The projection is geographic with latitude and longitude. The datum is NAD27 which is EPSG:4267. The ellipsoid is Clarke 1866, and the transformation parameters

```
st_crs(JUNI.range) <- 4267
```

```
JUNI_clipped = st_intersection(JUNI.range, states.map)
```

```
## Warning: attribute variables are assumed to be spatially constant throughout
## all geometries
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = JUNI_clipped, col = "red", linewidth = 2)+
  geom_point(data = JUNI.occ, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
JUNI_clipped$species = "Juglans nigra"
JUNI_flag = cc_iucn(x = JUNI.occ, range = JUNI_clipped, lon = "decimalLongitude", lat =
"decimalLatitude",
                     value = "flagged", buffer = 50000)
```

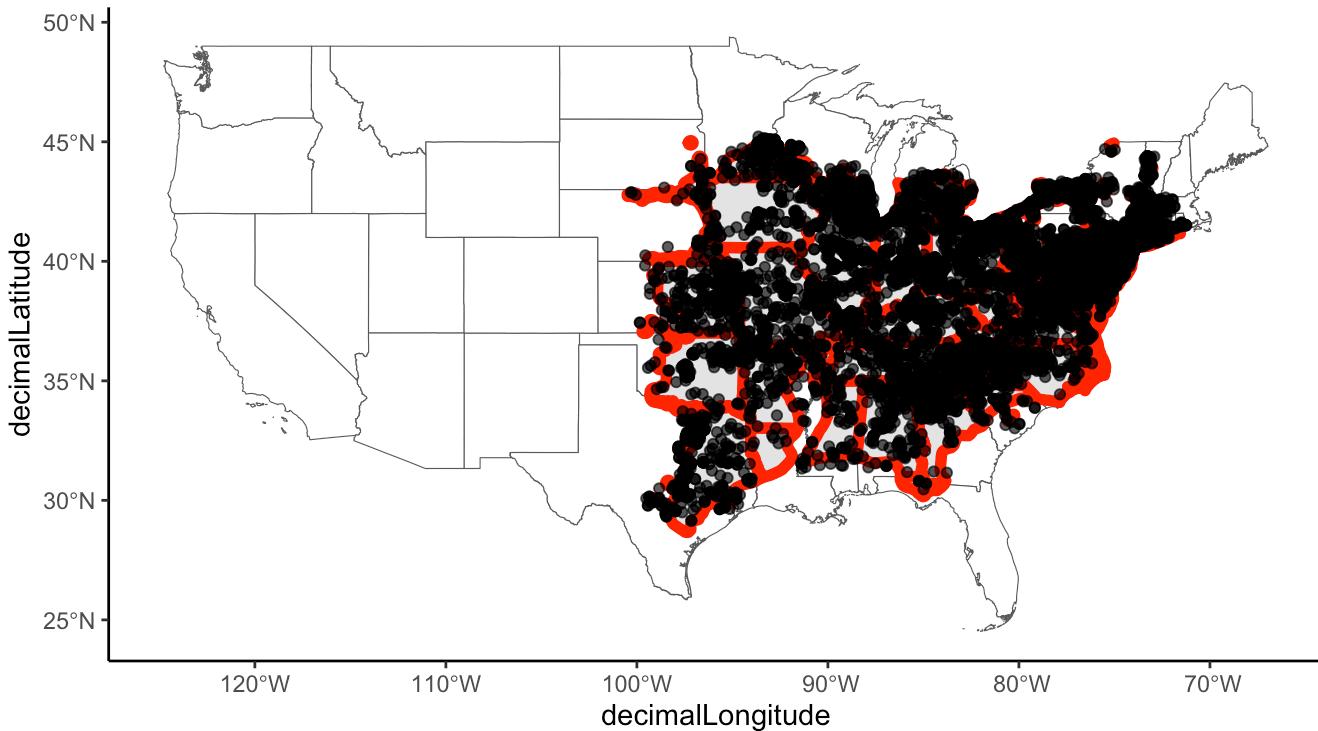
```
## Testing natural ranges
```

```
## Warning in cc_iucn(x = JUNI.occ, range = JUNI_clipped, lon =
## "decimalLongitude", : reprojecting reference to '+proj=longlat +datum=WGS84
## +no_defs'
```

```
## Flagged 856 records.
```

```
JUNI_occ_final = JUNI.occ[JUNI_flag, ]
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = JUNI_clipped, col = "red", linewidth = 2)+
  geom_point(data = JUNI_occ_final, aes(x = decimalLongitude, y = decimalLatitude), colo
r = "black", alpha = 0.7)+
  theme_classic()
```



```
ggsave("../Plots/JUNI.range.pdf", width = 12, height = 8)
```

Subset for *Juniperus virginiana*

```
JUVI.occ = gbif %>%
  filter(species == "Juniperus virginiana") %>%
  select(species,decimalLatitude,decimalLongitude)
```

Read in range map

```
JUVI.range = st_read("../USTreeAtlas/shp/junivirg/")
```

```
## Reading layer `junivirg` from data source
##   `/Users/samanthaworthy/Documents/GitHub/USTreeAtlas/shp/junivirg'
##   using driver `ESRI Shapefile'
## Simple feature collection with 60 features and 5 fields
## Geometry type: POLYGON
## Dimension:     XY
## Bounding box:  xmin: -103.5662 ymin: 29.45831 xmax: -69.77362 ymax: 47.07206
## CRS:           NA
```

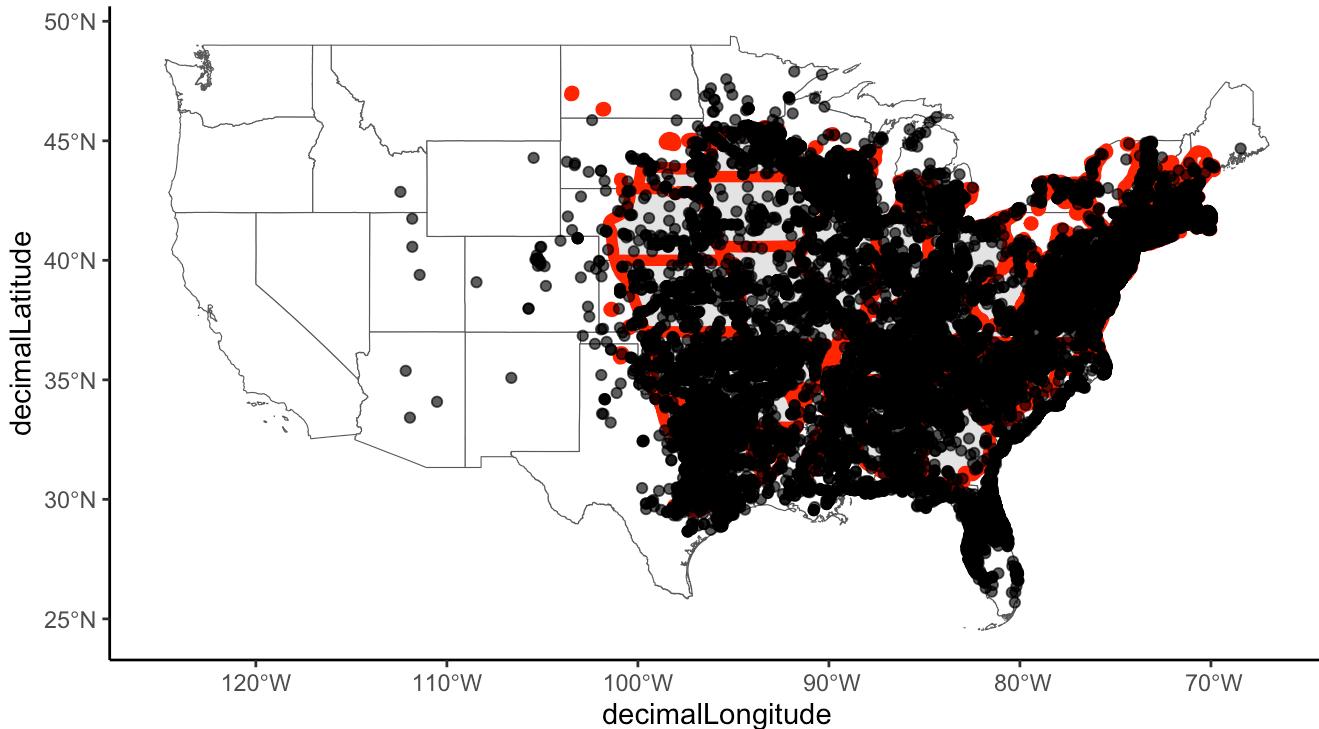
The projection is geographic with latitude and longitude. The datum is NAD27 which is EPSG:4267. The ellipsoid is Clarke 1866, and the transformation parameters

```
st_crs(JUVI.range) <- 4267
```

```
JUVI_clipped = st_intersection(JUVI.range, states.map)
```

```
## Warning: attribute variables are assumed to be spatially constant throughout
## all geometries
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = JUVI_clipped, col = "red", linewidth = 2)+
  geom_point(data = JUVI.occ, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
JUVI_clipped$species = "Juniperus virginiana"
JUVI_flag = cc_iucn(x = JUVI.occ, range = JUVI_clipped, lon = "decimalLongitude", lat =
"decimalLatitude",
                     value = "flagged", buffer = 50000)
```

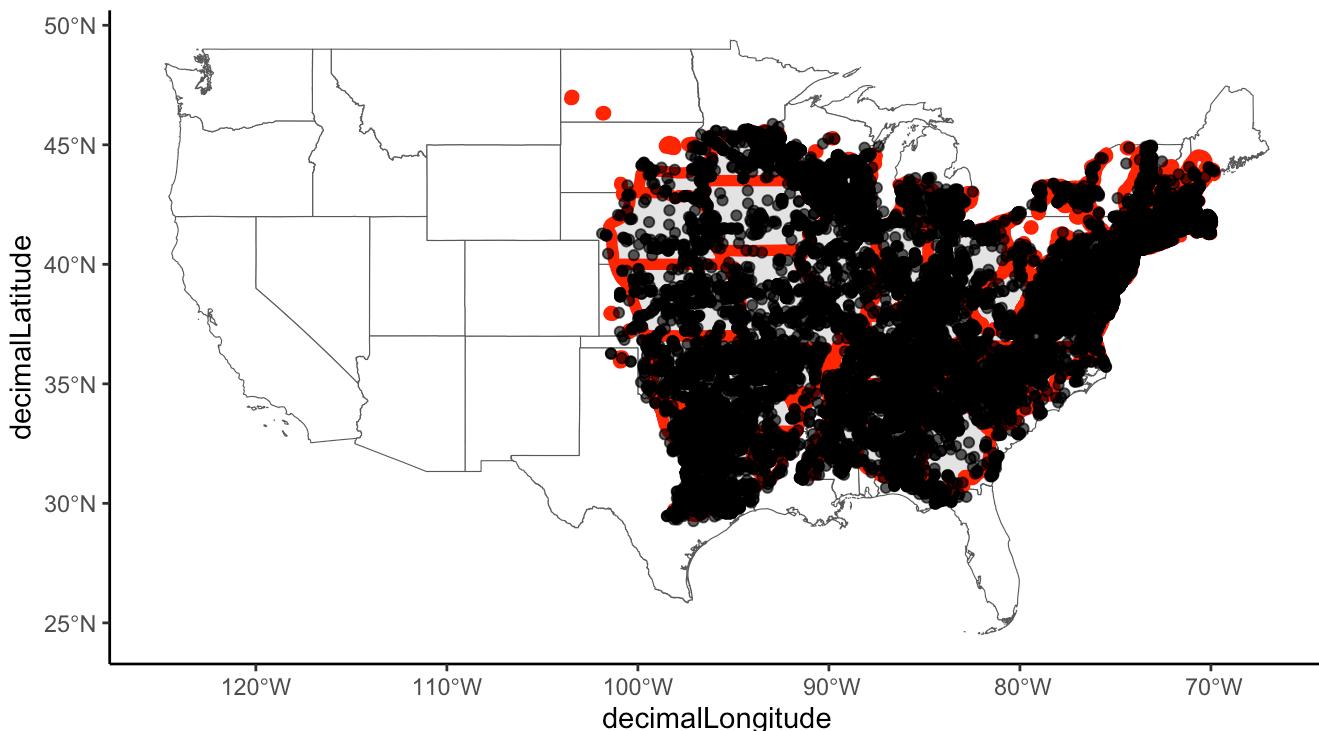
```
## Testing natural ranges
```

```
## Warning in cc_iucn(x = JUVI.occ, range = JUVI_clipped, lon =
## "decimalLongitude", : reprojecting reference to '+proj=longlat +datum=WGS84
## +no_defs'
```

```
## Flagged 1819 records.
```

```
JUVI_occ_final = JUVI.occ[JUVI_flag, ]
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = JUVI_clipped, col = "red", linewidth = 2)+
  geom_point(data = JUVI_occ_final, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
ggsave("../Plots/JUVI.range.pdf", width = 12, height = 8)
```

Subset for Larix laricina

```
LALA.occ = gbif %>%
  filter(species == "Larix laricina") %>%
  select(species,decimalLatitude,decimalLongitude)
```

Read in range map

```
LALA.range = st_read("../USTreeAtlas/shp/larilari/")
```

```
## Reading layer `larilari' from data source
##   `/Users/samanthaworthy/Documents/GitHub/USTreeAtlas/shp/larilari'
##   using driver `ESRI Shapefile'
## Simple feature collection with 471 features and 5 fields
## Geometry type: POLYGON
## Dimension:      XY
## Bounding box:  xmin: -160.2373 ymin: 39.14292 xmax: -52.61445 ymax: 67.67176
## CRS:           NA
```

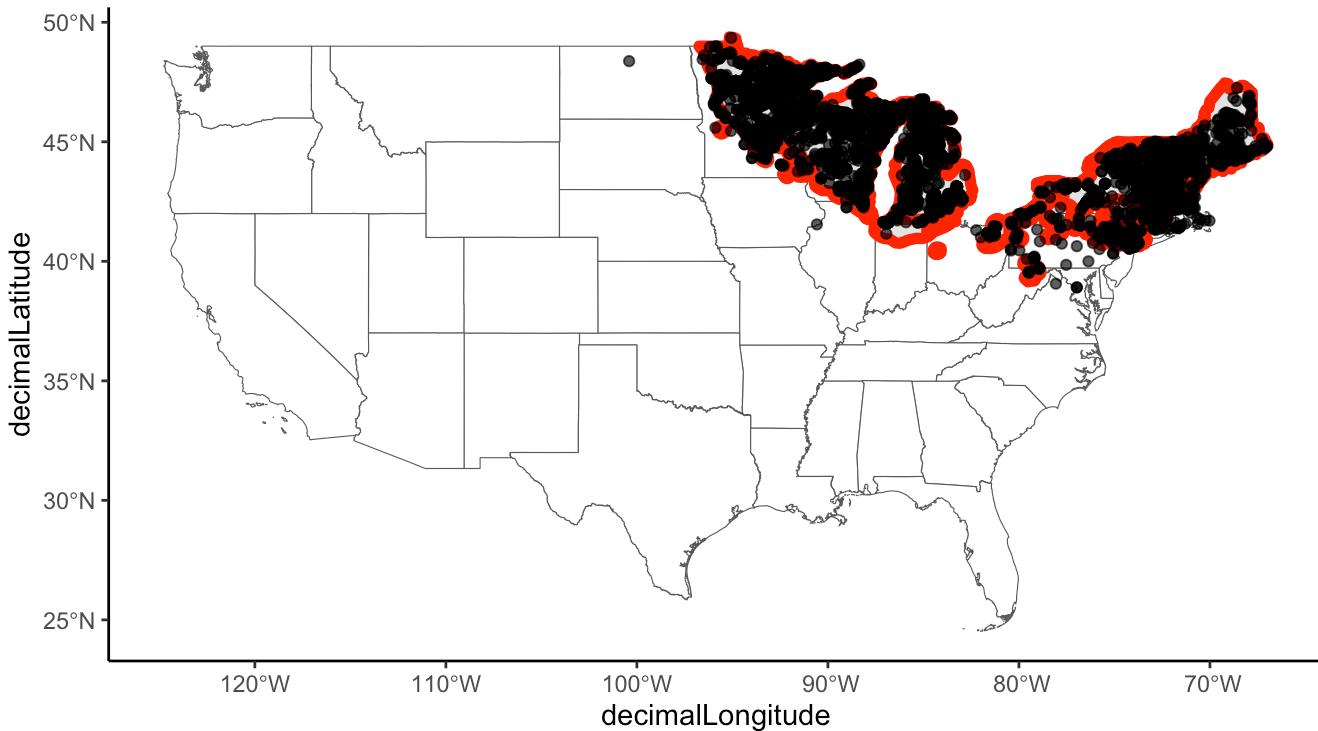
The projection is geographic with latitude and longitude. The datum is NAD27 which is EPSG:4267. The ellipsoid is Clarke 1866, and the transformation parameters

```
st_crs(LALA.range) <- 4267
```

```
LALA_clipped = st_intersection(LALA.range, states.map)
```

```
## Warning: attribute variables are assumed to be spatially constant throughout
## all geometries
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = LALA_clipped, col = "red", linewidth = 2)+
  geom_point(data = LALA.occ, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
LALA_clipped$species = "Larix laricina"
LALA_flag = cc_iucn(x = LALA.occ, range = LALA_clipped, lon = "decimalLongitude", lat =
"decimalLatitude",
value = "flagged", buffer = 50000)
```

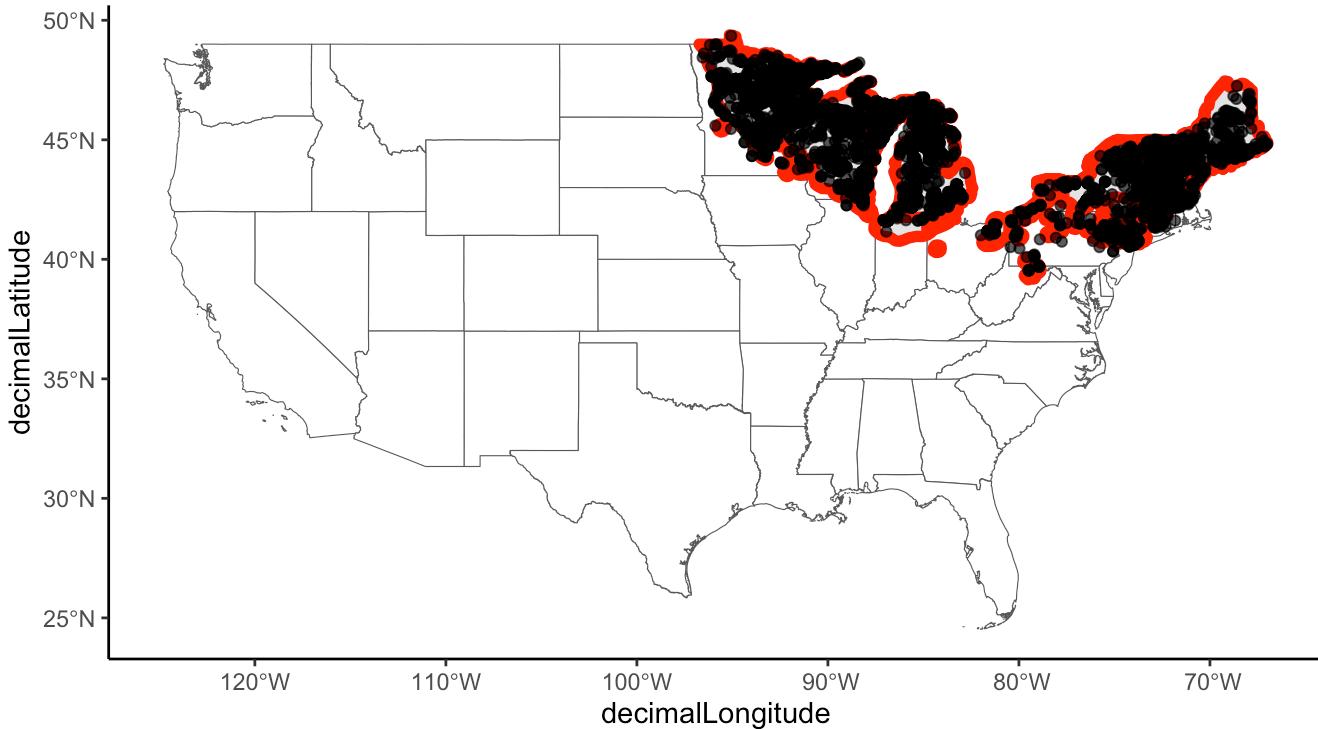
```
## Testing natural ranges
```

```
## Warning in cc_iucn(x = LALA.occ, range = LALA_clipped, lon =
## "decimalLongitude", : reprojecting reference to '+proj=longlat +datum=WGS84
## +no_defs'
```

```
## Flagged 35 records.
```

```
LALA_occ_final = LALA.occ[LALA_flag, ]
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = LALA_clipped, col = "red", linewidth = 2)+
  geom_point(data = LALA_occ_final, aes(x = decimalLongitude, y = decimalLatitude), colo
r = "black", alpha = 0.7)+
  theme_classic()
```



```
ggsave("../Plots/LALA.range.pdf", width = 12, height = 8)
```

Subset for *Liquidambar styraciflua*

```
LIST2.occ = gbif %>%
  filter(species == "Liquidambar styraciflua") %>%
  select(species, decimalLatitude, decimalLongitude)
```

Read in range map

```
LIST2.range = st_read("../USTreeAtlas/shp/liqustyr/")
```

```
## Reading layer `liqustyr` from data source
##   `/Users/samanthaworthy/Documents/GitHub/USTreeAtlas/shp/liqustyr'
##   using driver `ESRI Shapefile'
## Simple feature collection with 81 features and 5 fields
## Geometry type: POLYGON
## Dimension:     XY
## Bounding box:  xmin: -99.09172 ymin: 13.20806 xmax: -73.26896 ymax: 41.15219
## CRS:           NA
```

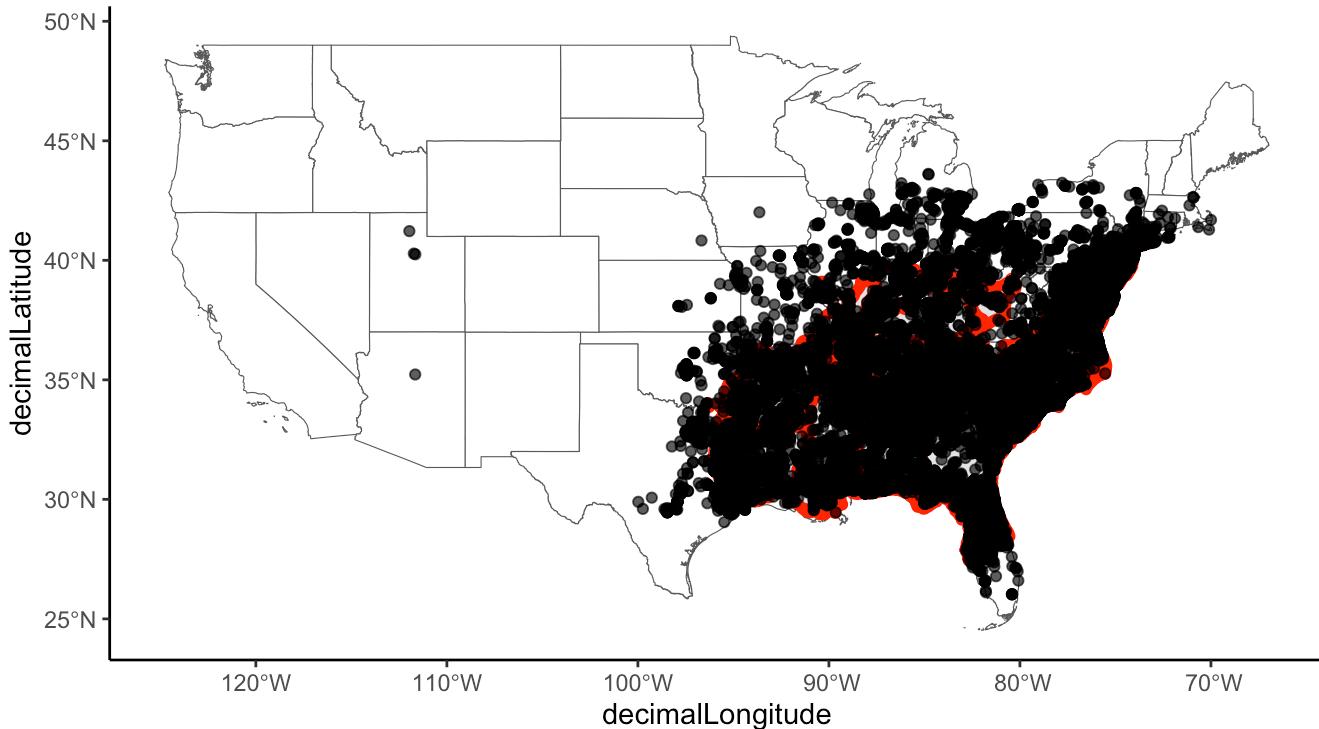
The projection is geographic with latitude and longitude. The datum is NAD27 which is EPSG:4267. The ellipsoid is Clarke 1866, and the transformation parameters

```
st_crs(LIST2.range) <- 4267
```

```
LIST2_clipped = st_intersection(LIST2.range, states.map)
```

```
## Warning: attribute variables are assumed to be spatially constant throughout
## all geometries
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = LIST2_clipped, col = "red", linewidth = 2)+
  geom_point(data = LIST2.occ, aes(x = decimalLongitude, y = decimalLatitude), color =
"black", alpha = 0.7)+
  theme_classic()
```



```
LIST2_clipped$species = "Liquidambar styraciflua"
LIST2_flag = cc_iucn(x = LIST2.occ, range = LIST2_clipped, lon = "decimalLongitude", lat =
"decimalLatitude",
                     value = "flagged", buffer = 50000)
```

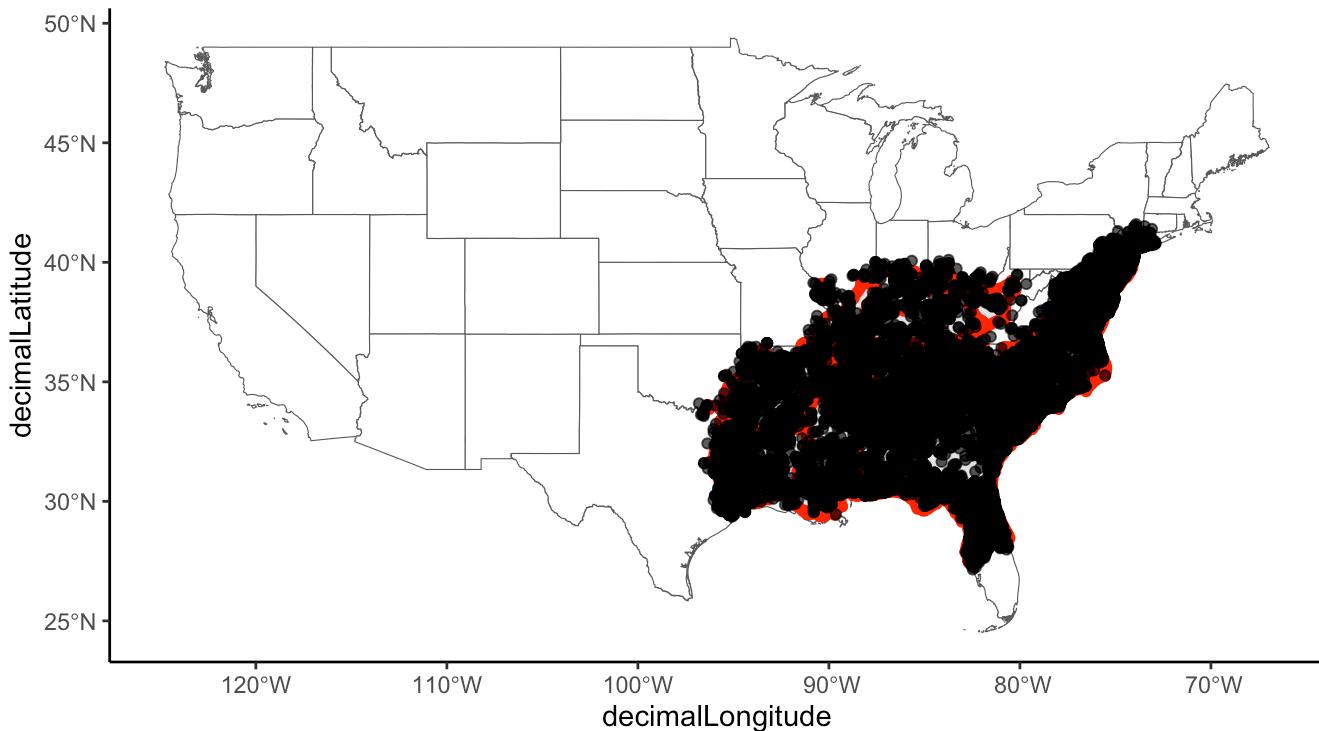
```
## Testing natural ranges
```

```
## Warning in cc_iucn(x = LIST2.occ, range = LIST2_clipped, lon =
## "decimalLongitude", : reprojecting reference to '+proj=longlat +datum=WGS84
## +no_defs'
```

```
## Flagged 2828 records.
```

```
LIST2_occ_final = LIST2.occ[LIST2_flag, ]
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = LIST2_clipped, col = "red", linewidth = 2)+
  geom_point(data = LIST2_occ_final, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
ggsave("../Plots/LIST2.range.pdf", width = 12, height = 8)
```

Subset for *Liriodendron tulipifera*

```
LITU.occ = gbif %>%
  filter(species == "Liriodendron tulipifera") %>%
  select(species,decimalLatitude,decimalLongitude)
```

Read in range map

```
LITU.range = st_read("../USTreeAtlas/shp/lirituli/")
```

```
## Reading layer `lirituli' from data source  
##   `/Users/samanthaworthy/Documents/GitHub/USTreeAtlas/shp/lirituli'  
##   using driver `ESRI Shapefile'  
## Simple feature collection with 61 features and 5 fields  
## Geometry type: POLYGON  
## Dimension:      XY  
## Bounding box:  xmin: -93.14224 ymin: 28.39825 xmax: -71.36444 ymax: 44.53041  
## CRS:           NA
```

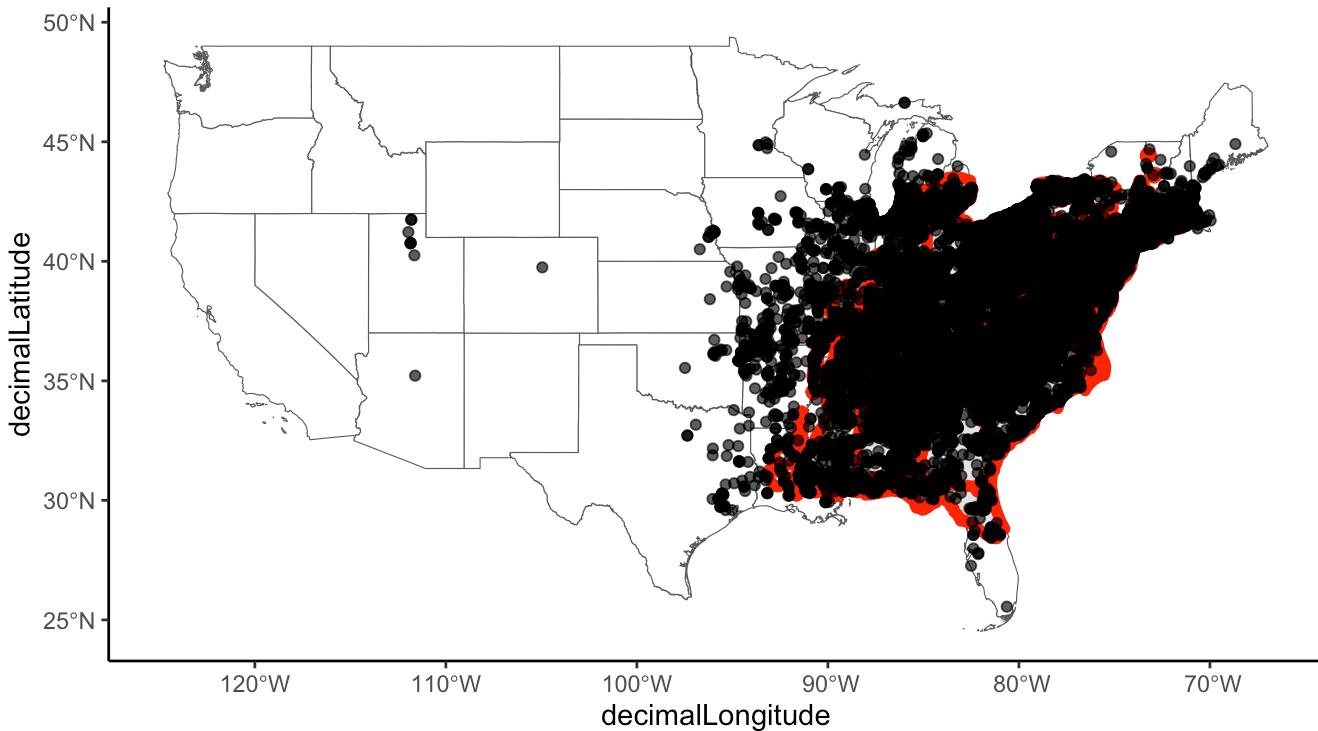
The projection is geographic with latitude and longitude. The datum is NAD27 which is EPSG:4267. The ellipsoid is Clarke 1866, and the transformation parameters

```
st_crs(LITU.range) <- 4267
```

```
LITU_clipped = st_intersection(LITU.range, states.map)
```

```
## Warning: attribute variables are assumed to be spatially constant throughout  
## all geometries
```

```
ggplot() +  
  geom_sf(data = states.map, fill = "white") +  
  geom_sf(data = LITU_clipped, col = "red", linewidth = 2) +  
  geom_point(data = LITU.occ, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7) +  
  theme_classic()
```



```
LITU_clipped$species = "Liriodendron tulipifera"
LITU_flag = cc_iucn(x = LITU.occ, range = LITU_clipped, lon = "decimalLongitude", lat =
"decimalLatitude",
value = "flagged", buffer = 50000)
```

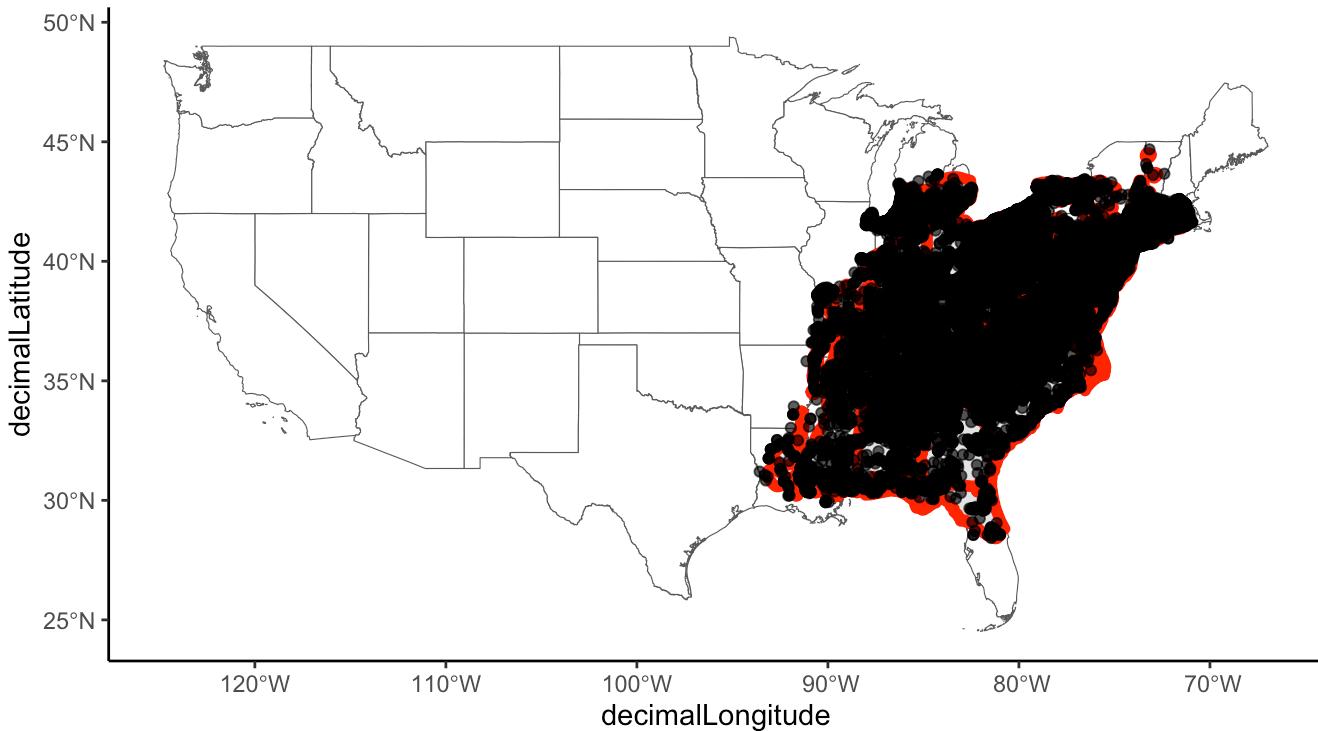
```
## Testing natural ranges
```

```
## Warning in cc_iucn(x = LITU.occ, range = LITU_clipped, lon =
## "decimalLongitude", : reprojecting reference to '+proj=longlat +datum=WGS84
## +no_defs'
```

```
## Flagged 1329 records.
```

```
LITU_occ_final = LITU.occ[LITU_flag, ]
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = LITU_clipped, col = "red", linewidth = 2)+
  geom_point(data = LITU_occ_final, aes(x = decimalLongitude, y = decimalLatitude), colo
r = "black", alpha = 0.7)+
  theme_classic()
```



```
ggsave("../Plots/LITU.range.pdf", width = 12, height = 8)
```

Subset for *Maclura pomifera*

```
MAP0.occ = gbif %>%
  filter(species == "Maclura pomifera") %>%
  select(species,decimalLatitude,decimalLongitude)
```

Read in range map

```
MAP0.range = st_read("../USTreeAtlas/shp/maclpomi/")
```

```
## Reading layer `maclpomi' from data source
##   `/Users/samanthaworthy/Documents/GitHub/USTreeAtlas/shp/maclpomi'
##   using driver `ESRI Shapefile'
## Simple feature collection with 2 features and 5 fields
## Geometry type: POLYGON
## Dimension:     XY
## Bounding box:  xmin: -103.3863 ymin: 29.07236 xmax: -93.57389 ymax: 34.64141
## CRS:           NA
```

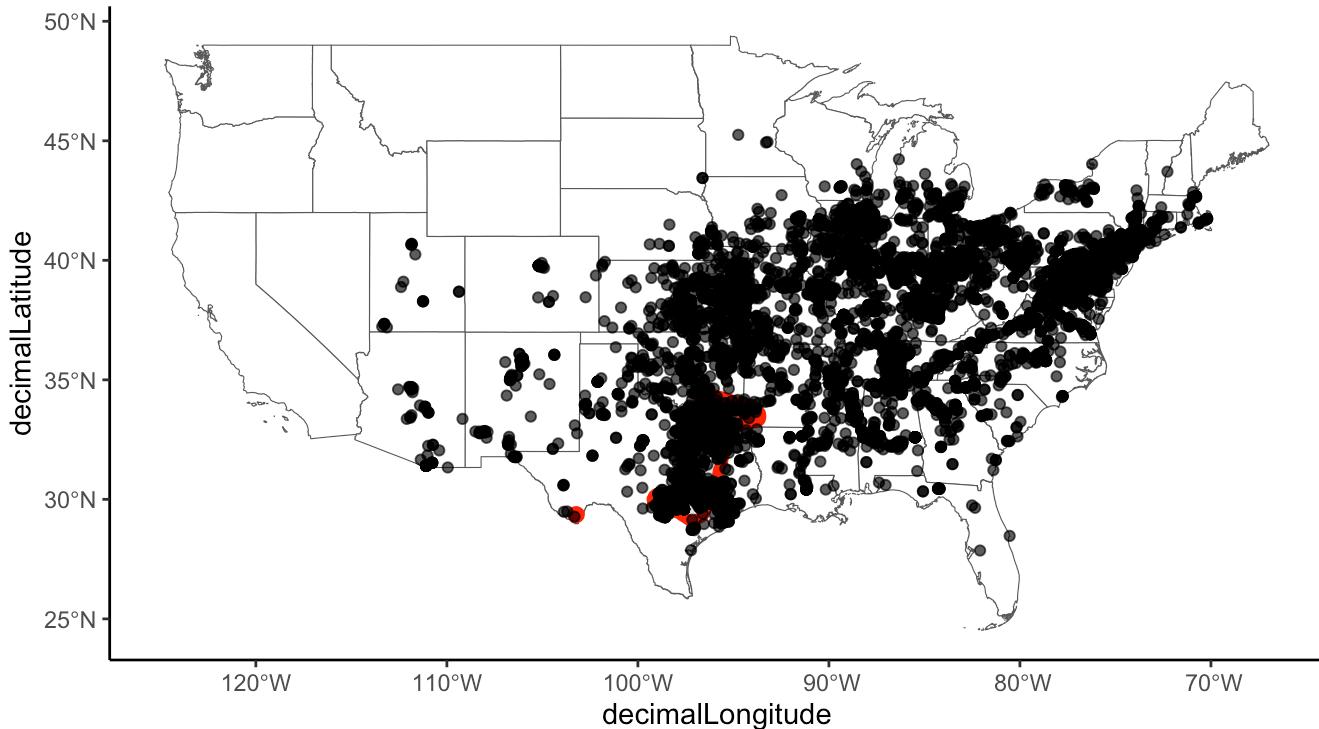
The projection is geographic with latitude and longitude. The datum is NAD27 which is EPSG:4267. The ellipsoid is Clarke 1866, and the transformation parameters

```
st_crs(MAP0.range) <- 4267
```

```
MAP0_clipped = st_intersection(MAP0.range, states.map)
```

```
## Warning: attribute variables are assumed to be spatially constant throughout
## all geometries
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = MAP0_clipped, col = "red", linewidth = 2)+
  geom_point(data = MAP0.occ, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
MAP0_clipped$species = "Mallotus pomifera"
MAP0_flag = cc_iucn(x = MAP0.occ, range = MAP0_clipped, lon = "decimalLongitude", lat =
"decimalLatitude",
                     value = "flagged", buffer = 50000)
```

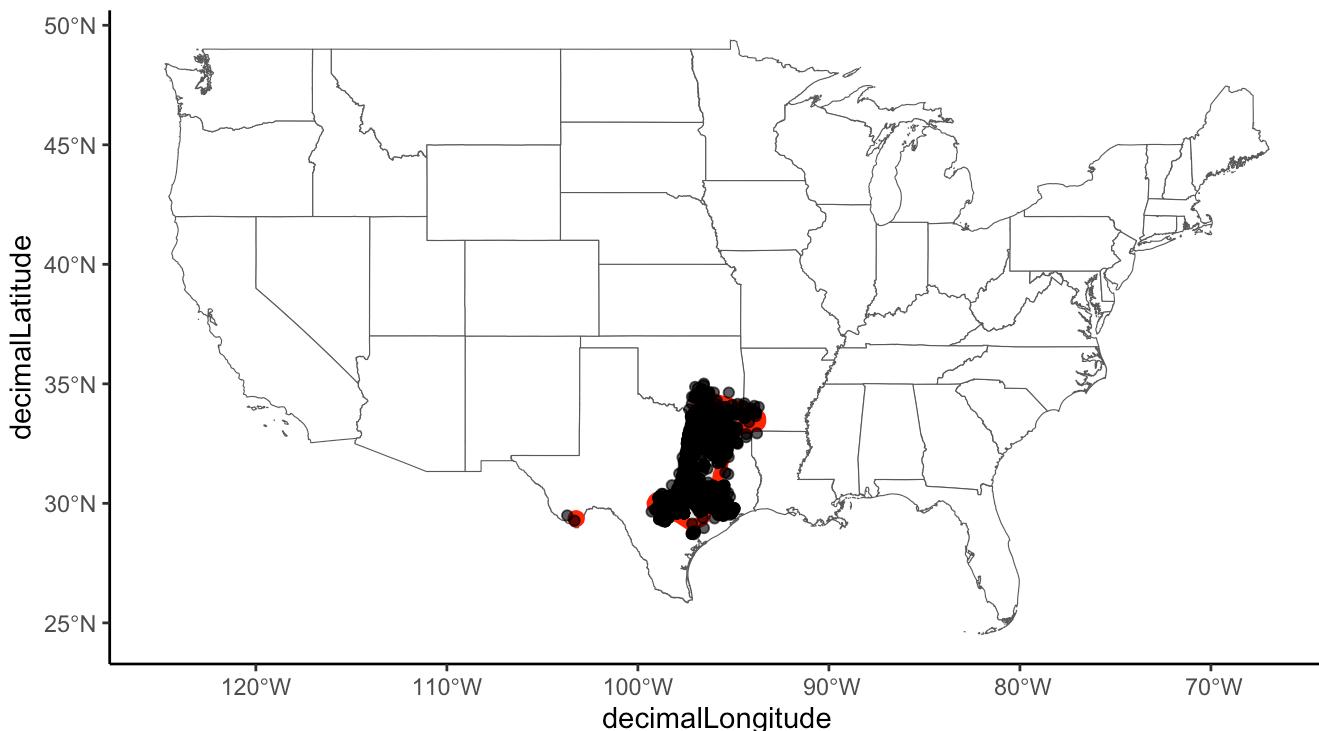
```
## Testing natural ranges
```

```
## Warning in cc_iucn(x = MAP0.occ, range = MAP0_clipped, lon =
## "decimalLongitude", : reprojecting reference to '+proj=longlat +datum=WGS84
## +no_defs'
```

```
## Flagged 10070 records.
```

```
MAP0_occ_final = MAP0.occ[MAP0_flag, ]
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = MAP0_clipped, col = "red", linewidth = 2)+
  geom_point(data = MAP0_occ_final, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
ggsave("../Plots/MAP0.range.pdf", width = 12, height = 8)
```

Subset for *Magnolia acuminata*

```
MAAC.occ = gbif %>%
  filter(species == "Magnolia acuminata") %>%
  select(species,decimalLatitude,decimalLongitude)
```

Read in range map

```
MAAC.range = st_read("../USTreeAtlas/shp/magnacum/")
```

```
## Reading layer `magnacum' from data source  
##   '/Users/samanthaworthy/Documents/GitHub/USTreeAtlas/shp/magnacum'  
##   using driver 'ESRI Shapefile'  
## Simple feature collection with 49 features and 5 fields  
## Geometry type: POLYGON  
## Dimension: XY  
## Bounding box: xmin: -94.6578 ymin: 30.68451 xmax: -75.45156 ymax: 43.38474  
## CRS: NA
```

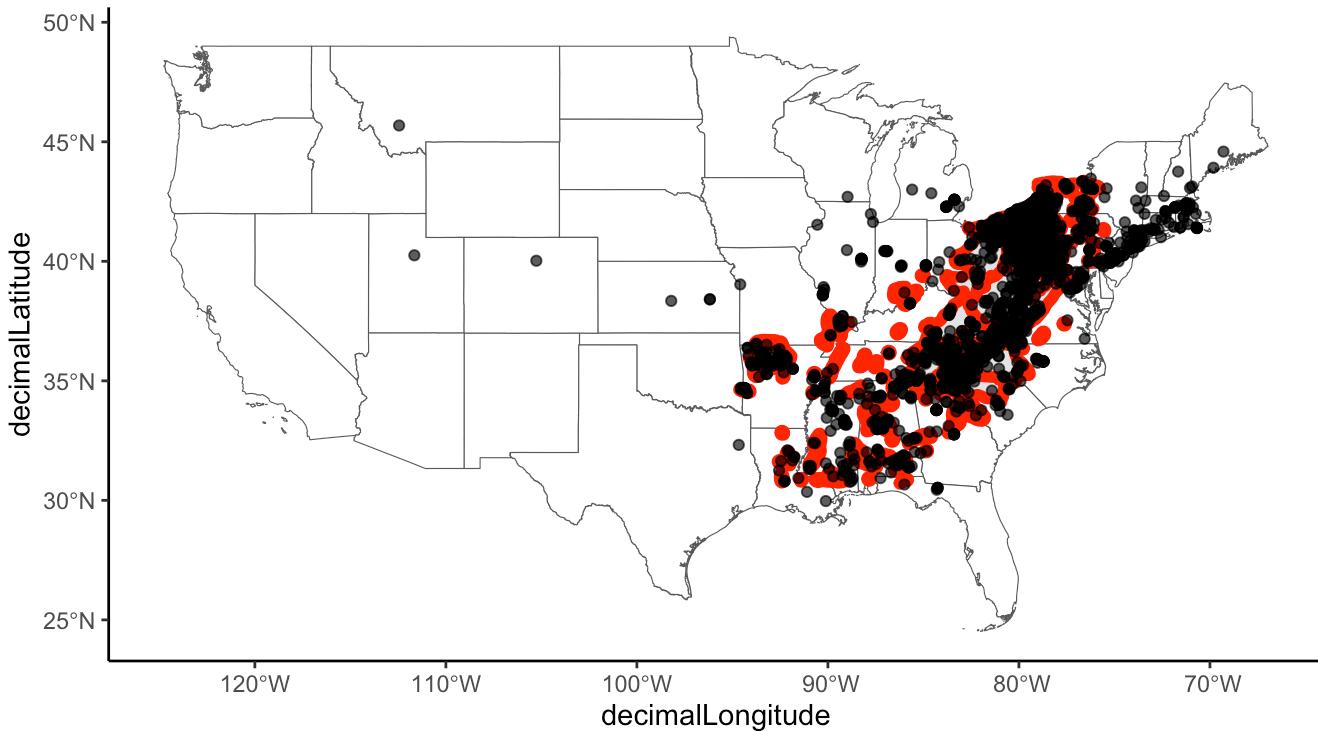
The projection is geographic with latitude and longitude. The datum is NAD27 which is EPSG:4267. The ellipsoid is Clarke 1866, and the transformation parameters

```
st_crs(MAAC.range) <- 4267
```

```
MAAC_clipped = st_intersection(MAAC.range, states.map)
```

```
## Warning: attribute variables are assumed to be spatially constant throughout  
## all geometries
```

```
ggplot() +  
  geom_sf(data = states.map, fill = "white") +  
  geom_sf(data = MAAC_clipped, col = "red", linewidth = 2) +  
  geom_point(data = MAAC.occ, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7) +  
  theme_classic()
```



```
MAAC_clipped$species = "Magnolia acuminata"
MAAC_flag = cc_iucn(x = MAAC.occ, range = MAAC_clipped, lon = "decimalLongitude", lat =
"decimalLatitude",
value = "flagged", buffer = 50000)
```

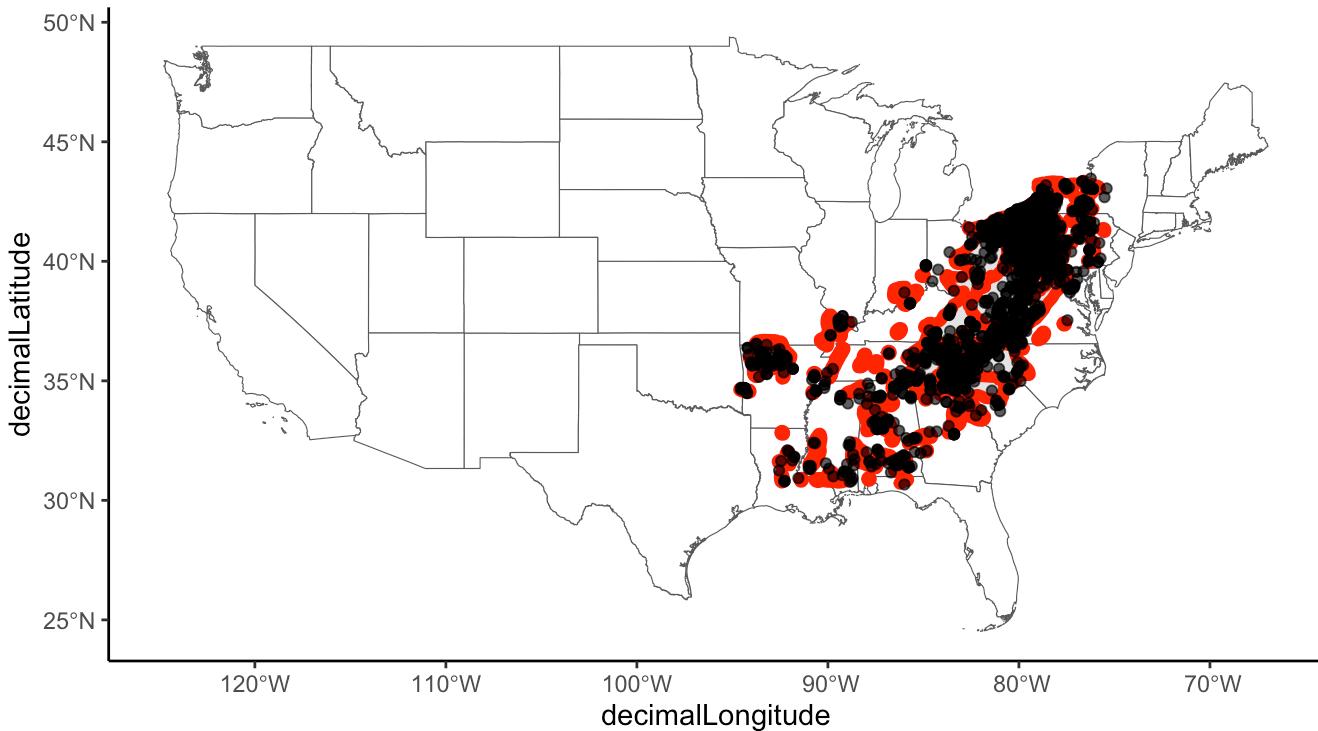
```
## Testing natural ranges
```

```
## Warning in cc_iucn(x = MAAC.occ, range = MAAC_clipped, lon =
## "decimalLongitude", : reprojecting reference to '+proj=longlat +datum=WGS84
## +no_defs'
```

```
## Flagged 404 records.
```

```
MAAC_occ_final = MAAC.occ[MAAC_flag, ]
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = MAAC_clipped, col = "red", linewidth = 2)+
  geom_point(data = MAAC_occ_final, aes(x = decimalLongitude, y = decimalLatitude), colo
r = "black", alpha = 0.7)+
  theme_classic()
```



```
ggsave("../Plots/MAAC.range.pdf", width = 12, height = 8)
```

Subset for *Magnolia fraseri*

```
MAFR.occ = gbif %>%
  filter(species == "Magnolia fraseri") %>%
  select(species,decimalLatitude,decimalLongitude)
```

Read in range map

```
MAFR.range = st_read("../USTreeAtlas/shp/magnfras/")
```

```
## Reading layer `magnfras' from data source
##   `/Users/samanthaworthy/Documents/GitHub/USTreeAtlas/shp/magnfras'
##   using driver `ESRI Shapefile'
## Simple feature collection with 4 features and 5 fields
## Geometry type: POLYGON
## Dimension:     XY
## Bounding box:  xmin: -84.82449 ymin: 34.46459 xmax: -77.81695 ymax: 39.62026
## CRS:           NA
```

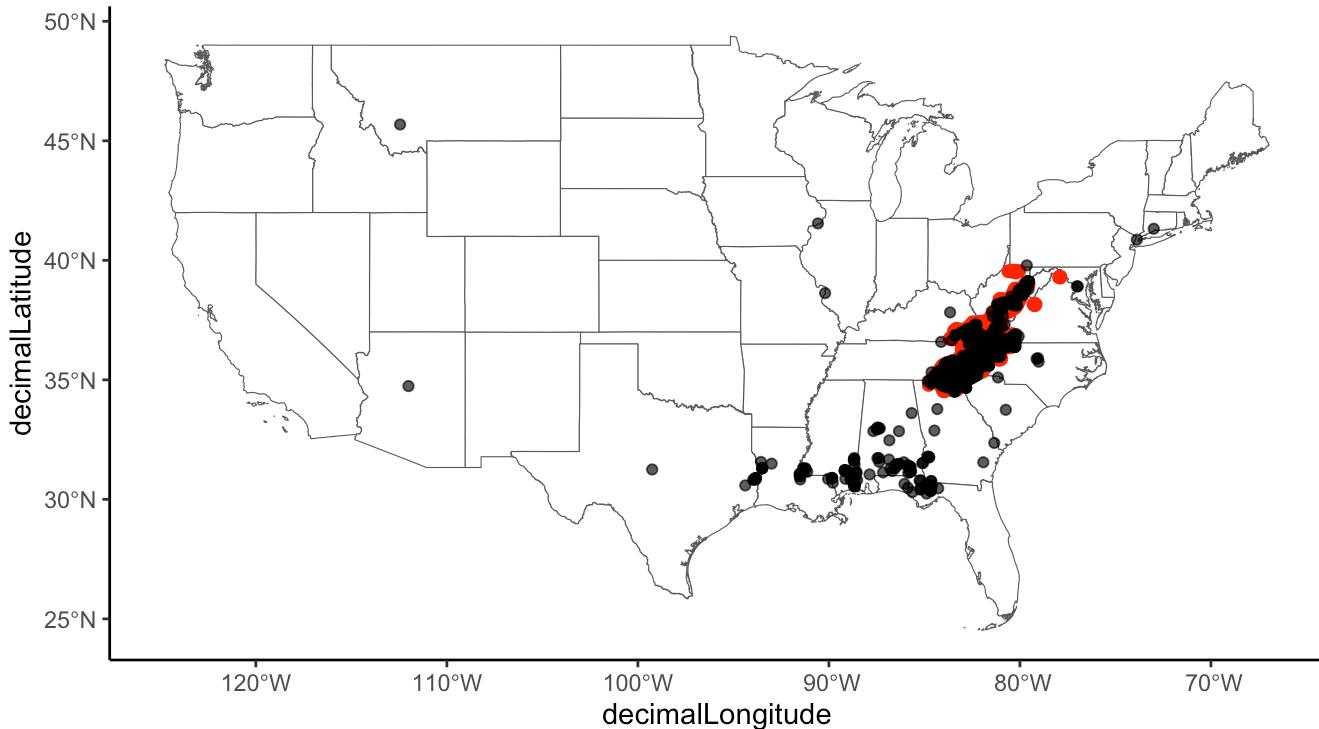
The projection is geographic with latitude and longitude. The datum is NAD27 which is EPSG:4267. The ellipsoid is Clarke 1866, and the transformation parameters

```
st_crs(MAFR.range) <- 4267
```

```
MAFR_clipped = st_intersection(MAFR.range, states.map)
```

```
## Warning: attribute variables are assumed to be spatially constant throughout
## all geometries
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = MAFR_clipped, col = "red", linewidth = 2)+
  geom_point(data = MAFR.occ, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
MAFR_clipped$species = "Magnolia fraseri"
MAFR_flag = cc_iucn(x = MAFR.occ, range = MAFR_clipped, lon = "decimalLongitude", lat =
"decimalLatitude",
                     value = "flagged", buffer = 50000)
```

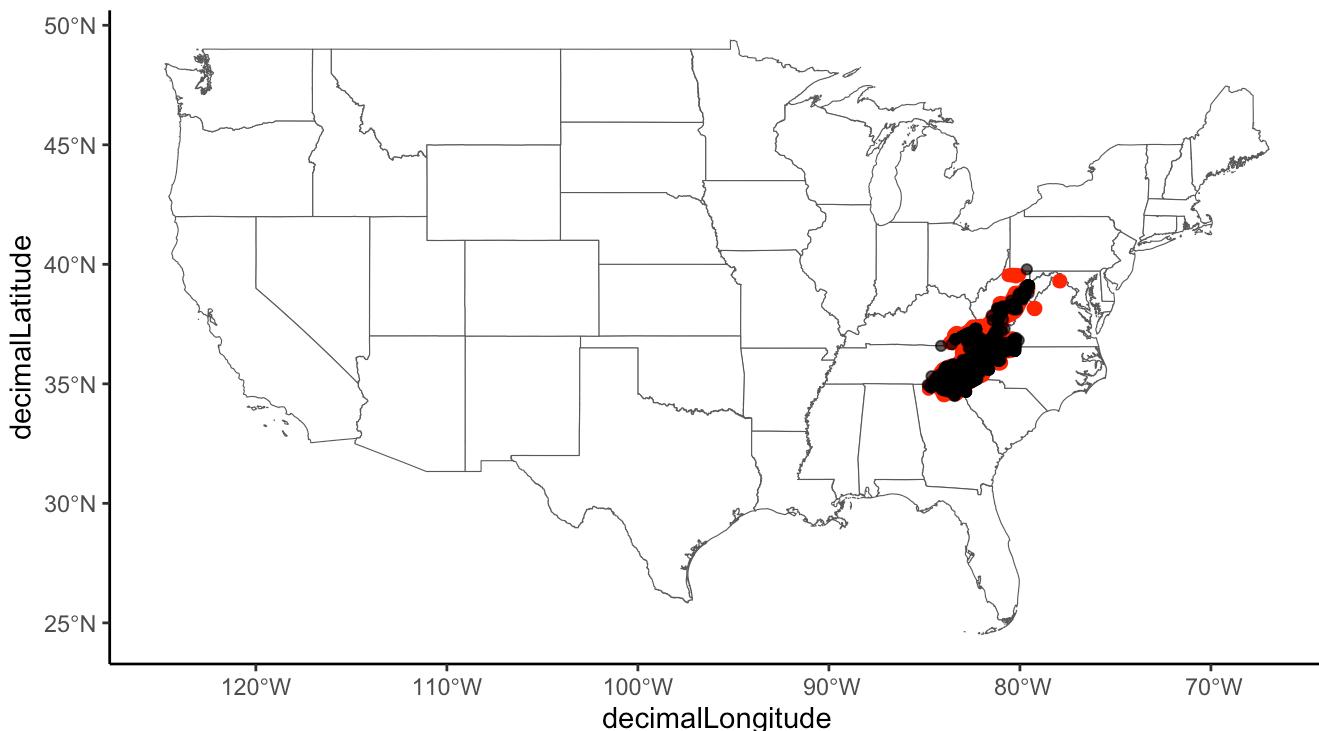
```
## Testing natural ranges
```

```
## Warning in cc_iucn(x = MAFR.occ, range = MAFR_clipped, lon =
## "decimalLongitude", : reprojecting reference to '+proj=longlat +datum=WGS84
## +no_defs'
```

```
## Flagged 139 records.
```

```
MAFR_occ_final = MAFR.occ[MAFR_flag, ]
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = MAFR_clipped, col = "red", linewidth = 2)+
  geom_point(data = MAFR_occ_final, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
ggsave("../Plots/MAFR.range.pdf", width = 12, height = 8)
```

Subset for Magnolia grandiflora

```
MAGR4.occ = gbif %>%
  filter(species == "Magnolia grandiflora") %>%
  select(species,decimalLatitude,decimalLongitude)
```

Read in range map

```
MAGR4.range = st_read("../USTreeAtlas/shp/magngran/")
```

```
## Reading layer `magngran' from data source
##   '/Users/samanthaworthy/Documents/GitHub/USTreeAtlas/shp/magngran'
##   using driver `ESRI Shapefile'
## Simple feature collection with 28 features and 5 fields
## Geometry type: POLYGON
## Dimension:      XY
## Bounding box:  xmin: -96.0386 ymin: 27.16424 xmax: -76.68305 ymax: 35.66163
## CRS:           NA
```

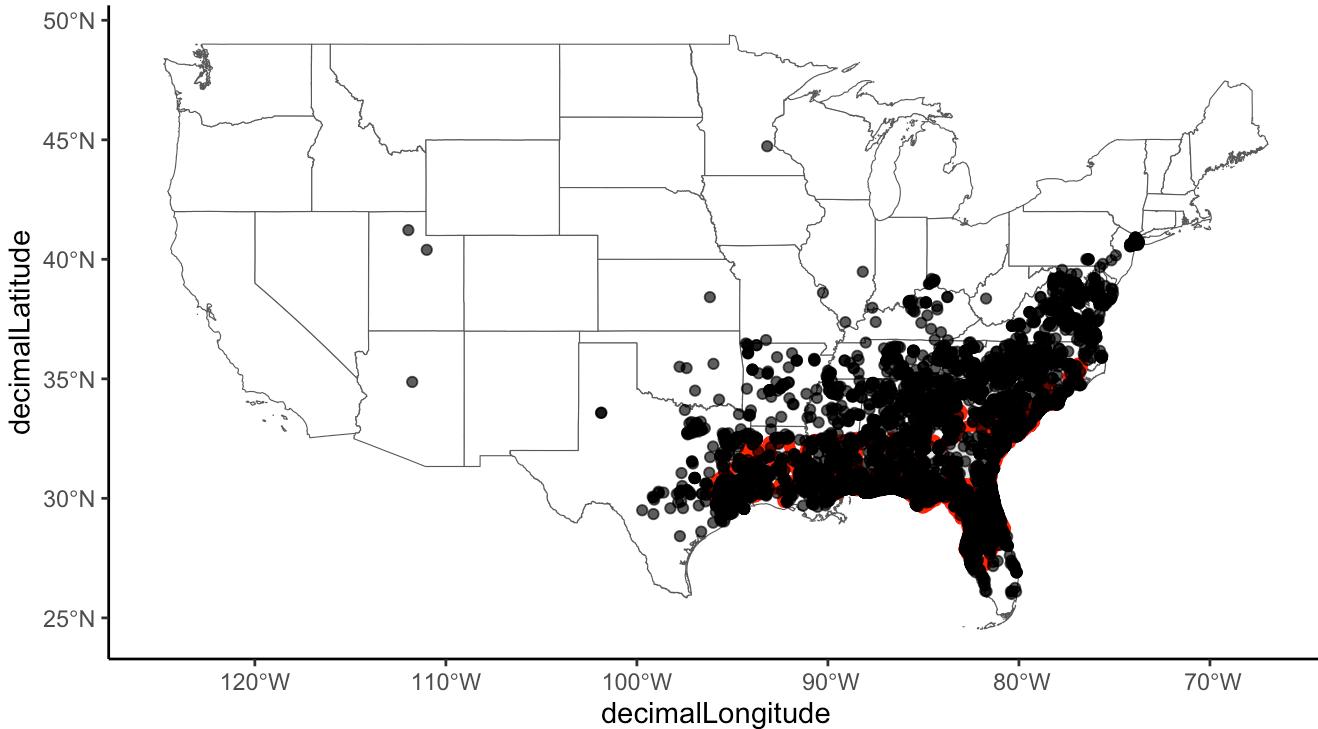
The projection is geographic with latitude and longitude. The datum is NAD27 which is EPSG:4267. The ellipsoid is Clarke 1866, and the transformation parameters

```
st_crs(MAGR4.range) <- 4267
```

```
MAGR4_clipped = st_intersection(MAGR4.range, states.map)
```

```
## Warning: attribute variables are assumed to be spatially constant throughout
## all geometries
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = MAGR4_clipped, col = "red", linewidth = 2)+
  geom_point(data = MAGR4.occ, aes(x = decimalLongitude, y = decimalLatitude), color =
"black", alpha = 0.7)+
  theme_classic()
```



```
MAGR4_clipped$species = "Magnolia grandiflora"
MAGR4_flag = cc_iucn(x = MAGR4.occ, range = MAGR4_clipped, lon = "decimalLongitude", lat = "decimalLatitude",
= "flagged", buffer = 50000)
```

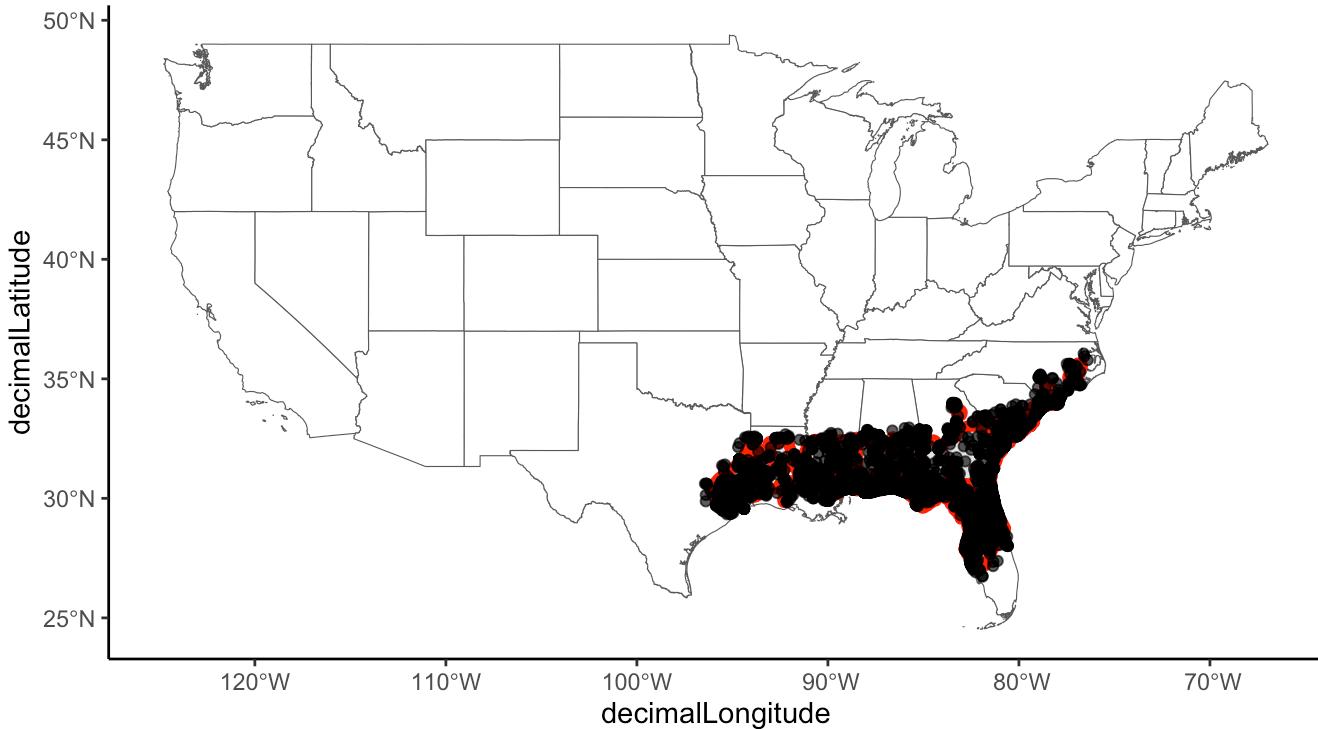
```
## Testing natural ranges
```

```
## Warning in cc_iucn(x = MAGR4.occ, range = MAGR4_clipped, lon =
## "decimalLongitude", : reprojecting reference to '+proj=longlat +datum=WGS84
## +no_defs'
```

```
## Flagged 4103 records.
```

```
MAGR4_occ_final = MAGR4.occ[MAGR4_flag, ]
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = MAGR4_clipped, col = "red", linewidth = 2)+
  geom_point(data = MAGR4_occ_final, aes(x = decimalLongitude, y = decimalLatitude), col = "black", alpha = 0.7)+
  theme_classic()
```



```
ggsave("../Plots/MAGR4.range.pdf", width = 12, height = 8)
```

Subset for Magnolia macrophylla

```
MAMA2.occ = gbif %>%
  filter(species == "Magnolia macrophylla") %>%
  select(species,decimalLatitude,decimalLongitude)
```

Read in range map

```
MAMA2.range = st_read("../USTreeAtlas/shp/magnmacr/")
```

```
## Reading layer `magnmacr` from data source
##   `/Users/samanthaworthy/Documents/GitHub/USTreeAtlas/shp/magnmacr'
##   using driver `ESRI Shapefile'
## Simple feature collection with 25 features and 5 fields
## Geometry type: POLYGON
## Dimension:     XY
## Bounding box:  xmin: -92.80724 ymin: 30.45176 xmax: -78.51603 ymax: 39.02176
## CRS:           NA
```

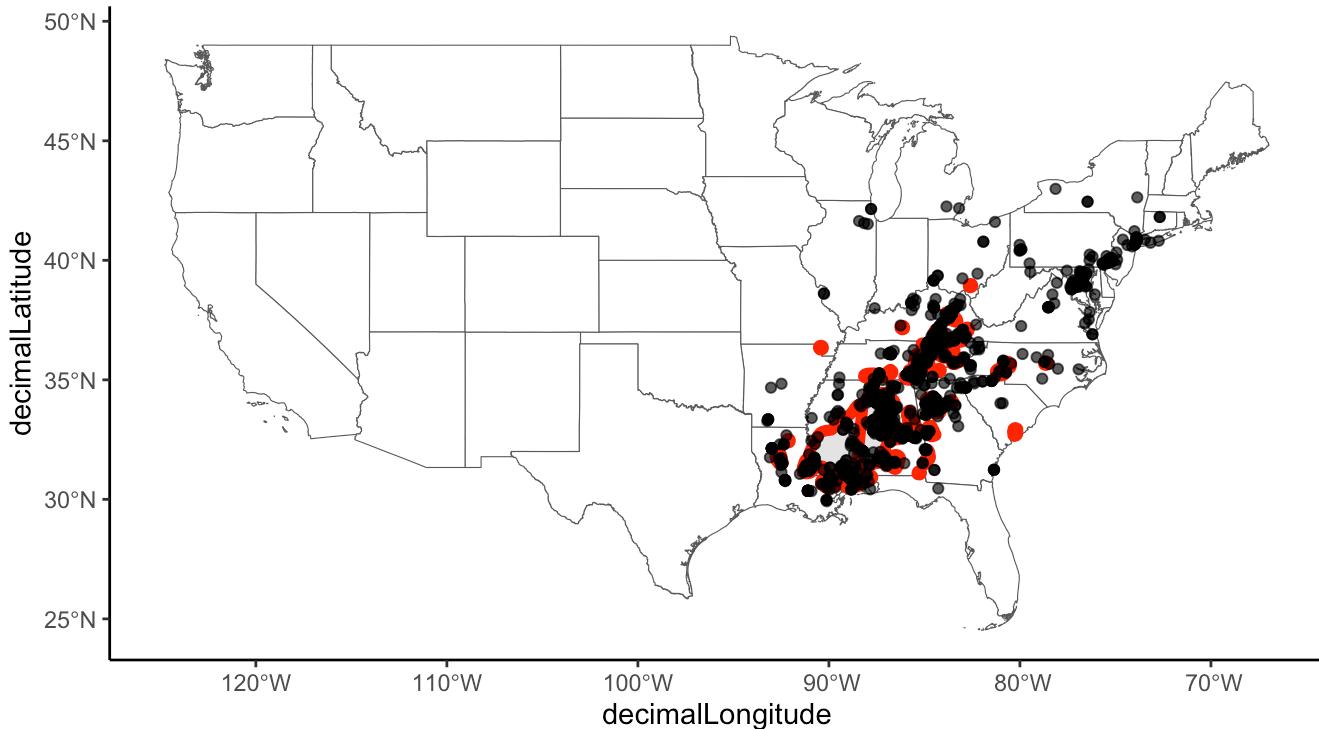
The projection is geographic with latitude and longitude. The datum is NAD27 which is EPSG:4267. The ellipsoid is Clarke 1866, and the transformation parameters

```
st_crs(MAMA2.range) <- 4267
```

```
MAMA2_clipped = st_intersection(MAMA2.range, states.map)
```

```
## Warning: attribute variables are assumed to be spatially constant throughout
## all geometries
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = MAMA2_clipped, col = "red", linewidth = 2)+
  geom_point(data = MAMA2.occ, aes(x = decimalLongitude, y = decimalLatitude), color =
"black", alpha = 0.7)+
  theme_classic()
```



```
MAMA2_clipped$species = "Magnolia macrophylla"
MAMA2_flag = cc_iucn(x = MAMA2.occ, range = MAMA2_clipped, lon = "decimalLongitude", lat =
= "decimalLatitude",
                      value = "flagged", buffer = 50000)
```

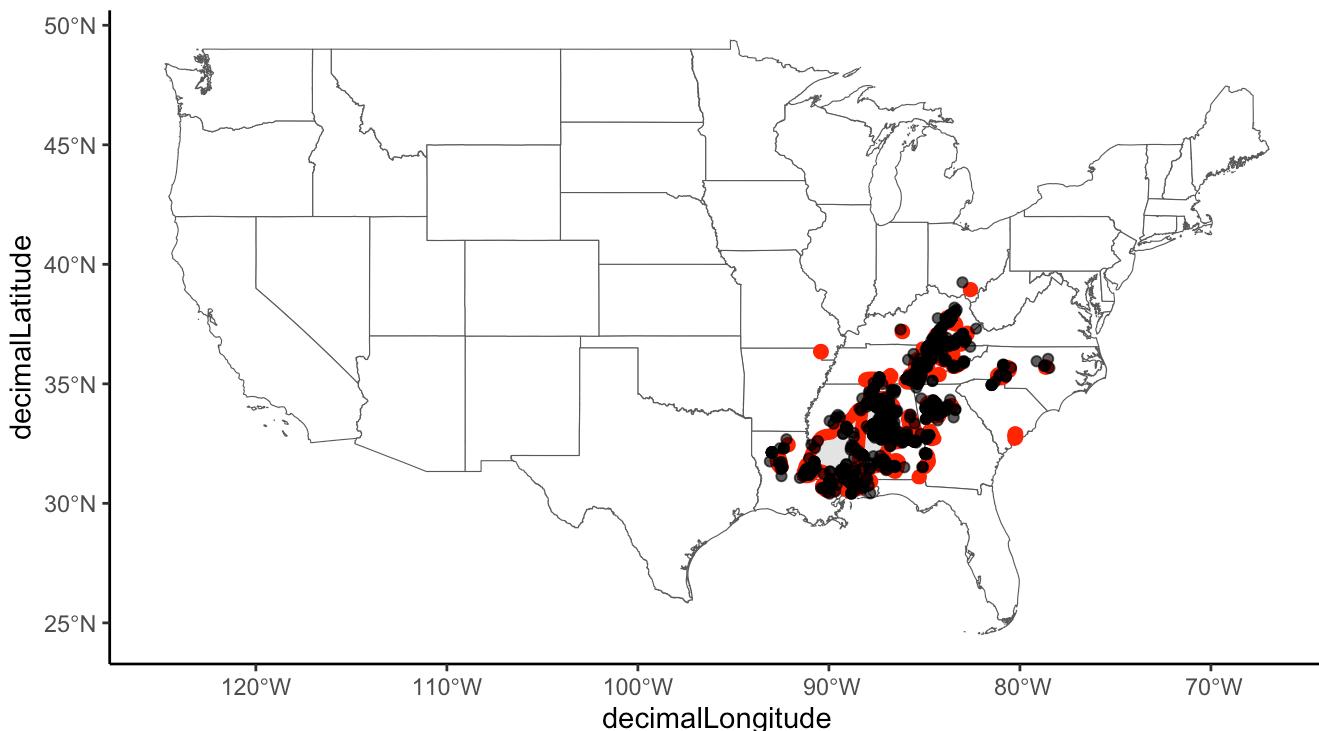
```
## Testing natural ranges
```

```
## Warning in cc_iucn(x = MAMA2.occ, range = MAMA2_clipped, lon =
## "decimalLongitude", : reprojecting reference to '+proj=longlat +datum=WGS84
## +no_defs'
```

```
## Flagged 378 records.
```

```
MAMA2_occ_final = MAMA2.occ[MAMA2_flag, ]
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = MAMA2_clipped, col = "red", linewidth = 2)+
  geom_point(data = MAMA2_occ_final, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
ggsave("../Plots/MAMA2.range.pdf", width = 12, height = 8)
```

Subset for Magnolia virginiana

```
MAVI2.occ = gbif %>%
  filter(species == "Magnolia virginiana") %>%
  select(species,decimalLatitude,decimalLongitude)
```

Read in range map

```
MAVI2.range = st_read("../USTreeAtlas/shp/magnvirg")
```

```
## Reading layer `magnvirg' from data source
##   `/Users/samanthaworthy/Documents/GitHub/USTreeAtlas/shp/magnvirg'
##   using driver `ESRI Shapefile'
## Simple feature collection with 82 features and 5 fields
## Geometry type: POLYGON
## Dimension:      XY
## Bounding box:  xmin: -95.6114 ymin: 25.71463 xmax: -72.75641 ymax: 40.91171
## CRS:           NA
```

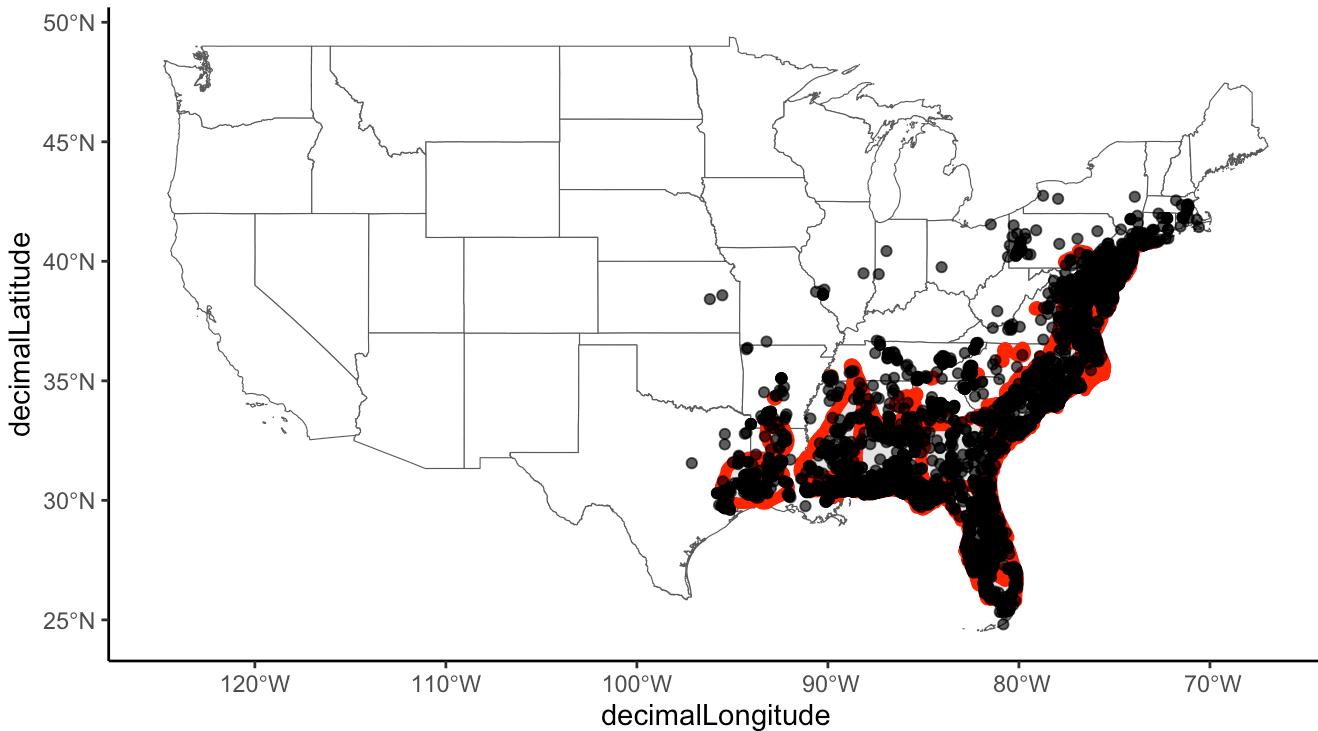
The projection is geographic with latitude and longitude. The datum is NAD27 which is EPSG:4267. The ellipsoid is Clarke 1866, and the transformation parameters

```
st_crs(MAVI2.range) <- 4267
```

```
MAVI2_clipped = st_intersection(MAVI2.range, states.map)
```

```
## Warning: attribute variables are assumed to be spatially constant throughout
## all geometries
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = MAVI2_clipped, col = "red", linewidth = 2)+
  geom_point(data = MAVI2.occ, aes(x = decimalLongitude, y = decimalLatitude), color =
"black", alpha = 0.7)+
  theme_classic()
```



```
MAVI2_clipped$species = "Magnolia virginiana"
MAVI2_flag = cc_iucn(x = MAVI2.occ, range = MAVI2_clipped, lon = "decimalLongitude", lat = "decimalLatitude",
                      value = "flagged", buffer = 50000)
```

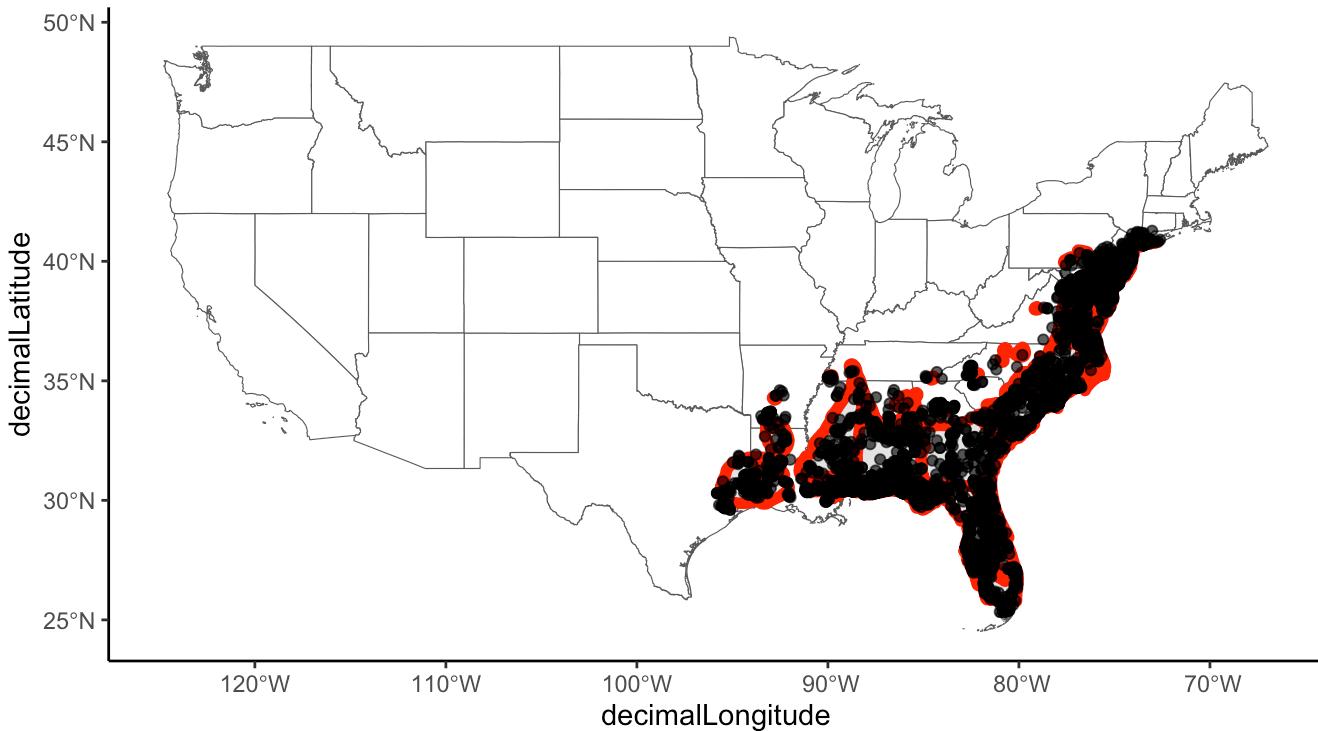
```
## Testing natural ranges
```

```
## Warning in cc_iucn(x = MAVI2.occ, range = MAVI2_clipped, lon =
## "decimalLongitude", : reprojecting reference to '+proj=longlat +datum=WGS84
## +no_defs'
```

```
## Flagged 240 records.
```

```
MAVI2_occ_final = MAVI2.occ[MAVI2_flag, ]
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = MAVI2_clipped, col = "red", linewidth = 2)+
  geom_point(data = MAVI2_occ_final, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
ggsave("../Plots/MAVI2.range.pdf", width = 12, height = 8)
```

Subset for *Morus rubra*

```
MORU2.occ = gbif %>%
  filter(species == "Morus rubra") %>%
  select(species,decimalLatitude,decimalLongitude)
```

Read in range map

```
MORU2.range = st_read("../USTreeAtlas/shp/morurubr/")
```

```
## Reading layer `morurubr' from data source
##   `/Users/samanthaworthy/Documents/GitHub/USTreeAtlas/shp/morurubr'
##   using driver `ESRI Shapefile'
## Simple feature collection with 96 features and 5 fields
## Geometry type: POLYGON
## Dimension:     XY
## Bounding box:  xmin: -101.9412 ymin: 25.71206 xmax: -70.92392 ymax: 44.91562
## CRS:           NA
```

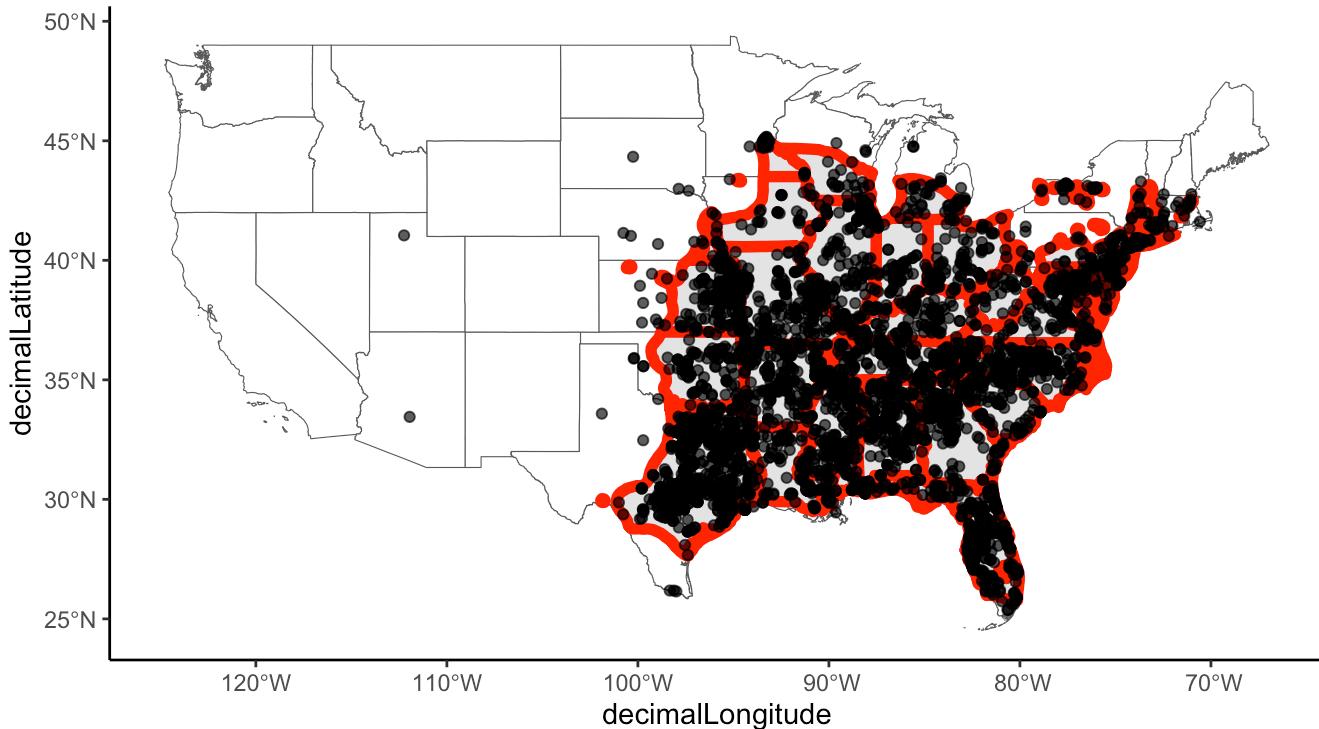
The projection is geographic with latitude and longitude. The datum is NAD27 which is EPSG:4267. The ellipsoid is Clarke 1866, and the transformation parameters

```
st_crs(MORU2.range) <- 4267
```

```
MORU2_clipped = st_intersection(MORU2.range, states.map)
```

```
## Warning: attribute variables are assumed to be spatially constant throughout
## all geometries
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = MORU2_clipped, col = "red", linewidth = 2)+
  geom_point(data = MORU2.occ, aes(x = decimalLongitude, y = decimalLatitude), color =
"black", alpha = 0.7)+
  theme_classic()
```



```
MORU2_clipped$species = "Morus rubra"
MORU2_flag = cc_iucn(x = MORU2.occ, range = MORU2_clipped, lon = "decimalLongitude", lat =
"decimalLatitude",
                      value = "flagged", buffer = 50000)
```

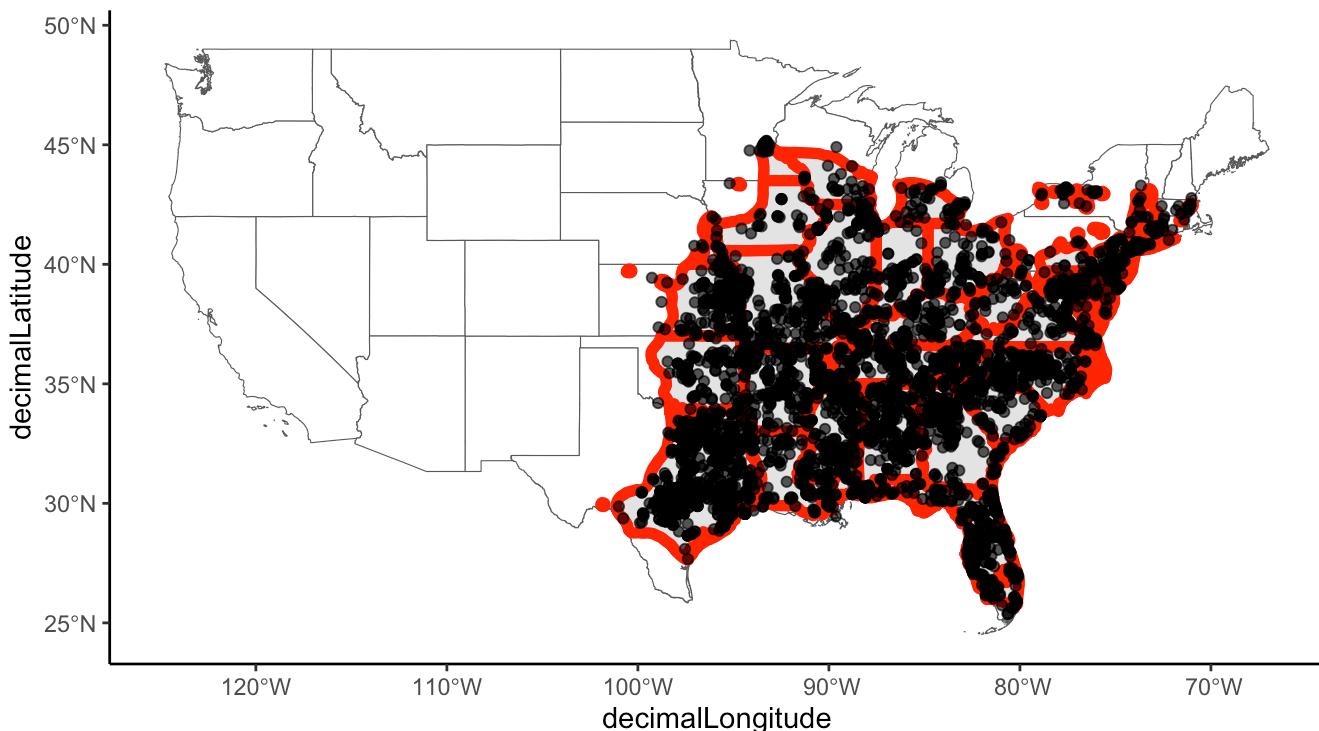
```
## Testing natural ranges
```

```
## Warning in cc_iucn(x = MORU2.occ, range = MORU2_clipped, lon =
## "decimalLongitude", : reprojecting reference to '+proj=longlat +datum=WGS84
## +no_defs'
```

```
## Flagged 30 records.
```

```
MORU2_occ_final = MORU2.occ[MORU2_flag, ]
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = MORU2_clipped, col = "red", linewidth = 2)+
  geom_point(data = MORU2_occ_final, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
ggsave("../Plots/MORU2.range.pdf", width = 12, height = 8)
```

Subset for *Nyssa aquatica*

```
NYAQ2.occ = gbif %>%
  filter(species == "Nyssa aquatica") %>%
  select(species,decimalLatitude,decimalLongitude)
```

Read in range map

```
NYAQ2.range = st_read("../USTreeAtlas/shp/nyssaqua/")

## Reading layer `nyssaqua' from data source
##   `/Users/samanthaworthy/Documents/GitHub/USTreeAtlas/shp/nyssaqua'
##   using driver `ESRI Shapefile'
## Simple feature collection with 48 features and 5 fields
## Geometry type: POLYGON
## Dimension:      XY
## Bounding box:  xmin: -95.18513 ymin: 29.33239 xmax: -75.44749 ymax: 39.09947
## CRS:           NA
```

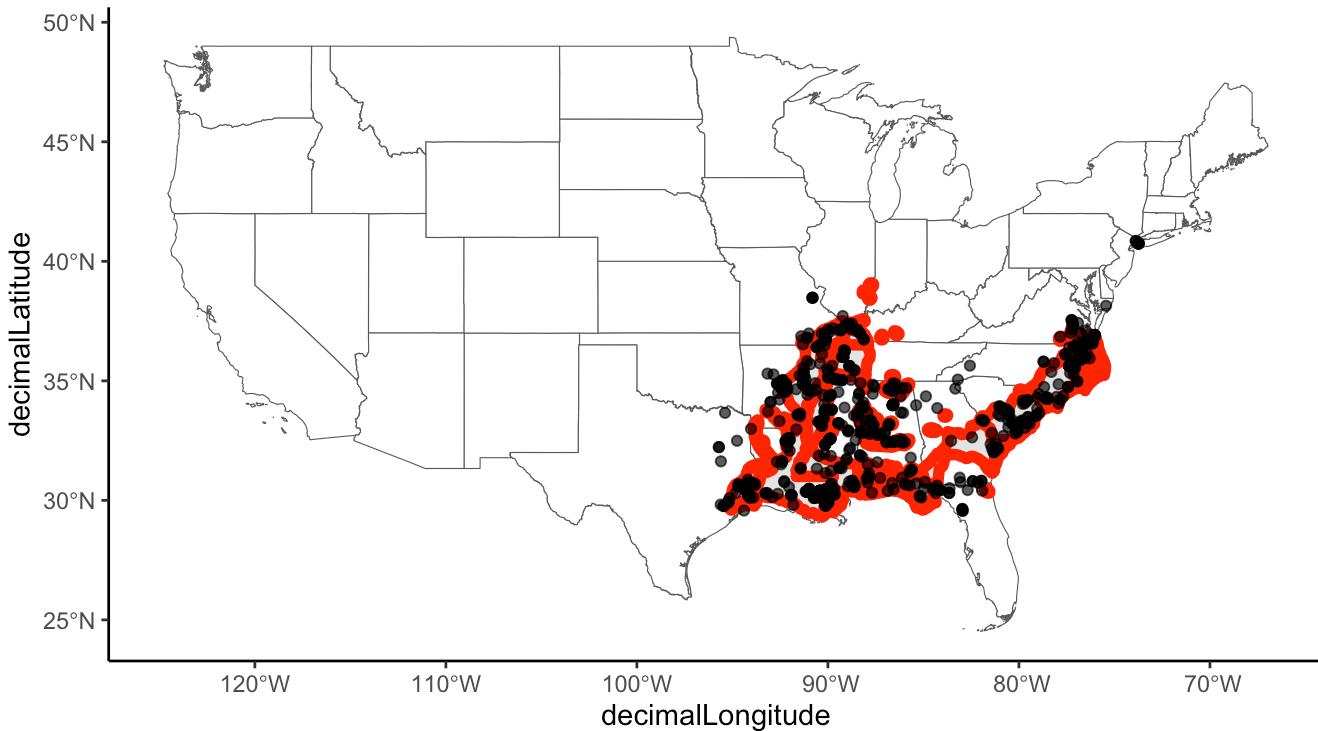
The projection is geographic with latitude and longitude. The datum is NAD27 which is EPSG:4267. The ellipsoid is Clarke 1866, and the transformation parameters

```
st_crs(NYAQ2.range) <- 4267
```

```
NYAQ2_clipped = st_intersection(NYAQ2.range, states.map)
```

```
## Warning: attribute variables are assumed to be spatially constant throughout
## all geometries
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = NYAQ2_clipped, col = "red", linewidth = 2)+
  geom_point(data = NYAQ2.occ, aes(x = decimalLongitude, y = decimalLatitude), color =
"black", alpha = 0.7)+
  theme_classic()
```



```
NYAQ2_clipped$species = "Nyssa aquatica"
NYAQ2_flag = cc_iucn(x = NYAQ2.occ, range = NYAQ2_clipped, lon = "decimalLongitude", lat = "decimalLatitude",
= "flagged", value = "flagged", buffer = 50000)
```

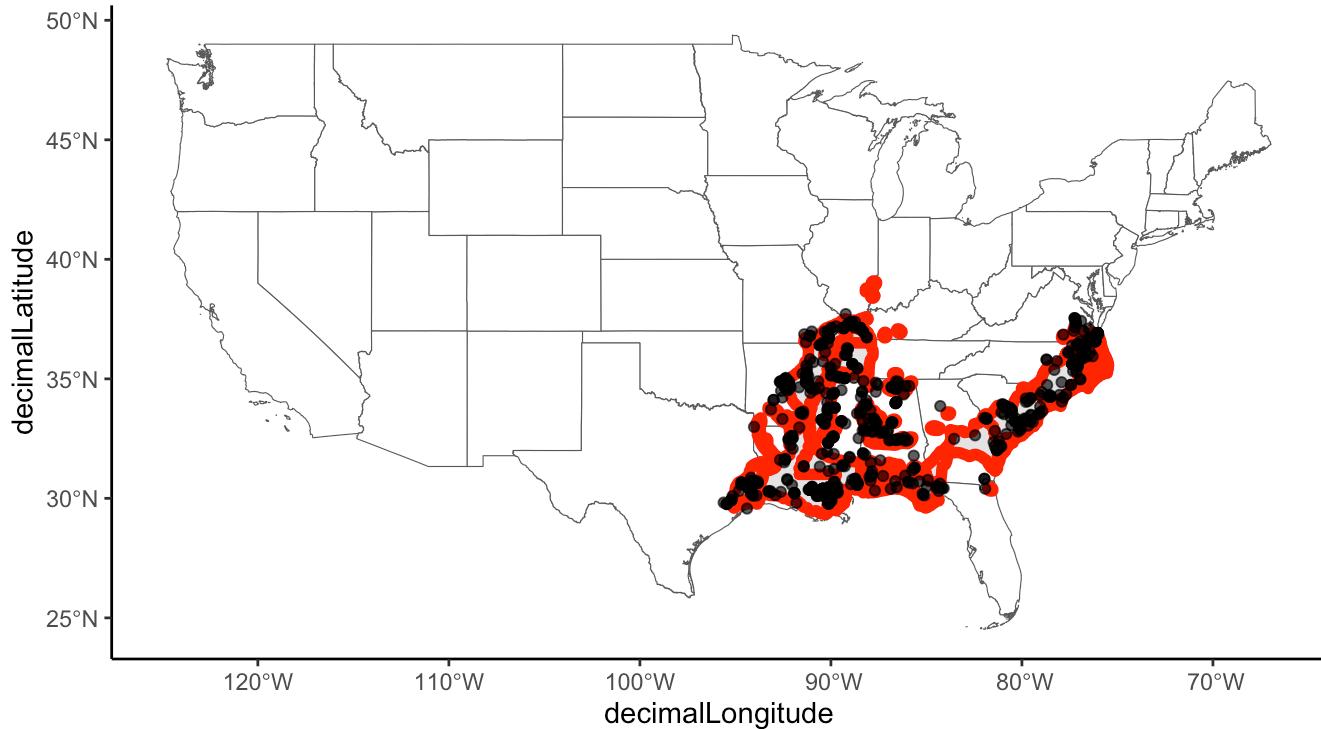
```
## Testing natural ranges
```

```
## Warning in cc_iucn(x = NYAQ2.occ, range = NYAQ2_clipped, lon =
## "decimalLongitude", : reprojecting reference to '+proj=longlat +datum=WGS84
## +no_defs'
```

```
## Flagged 45 records.
```

```
NYAQ2_occ_final = NYAQ2.occ[NYAQ2_flag, ]
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = NYAQ2_clipped, col = "red", linewidth = 2)+
  geom_point(data = NYAQ2_occ_final, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```

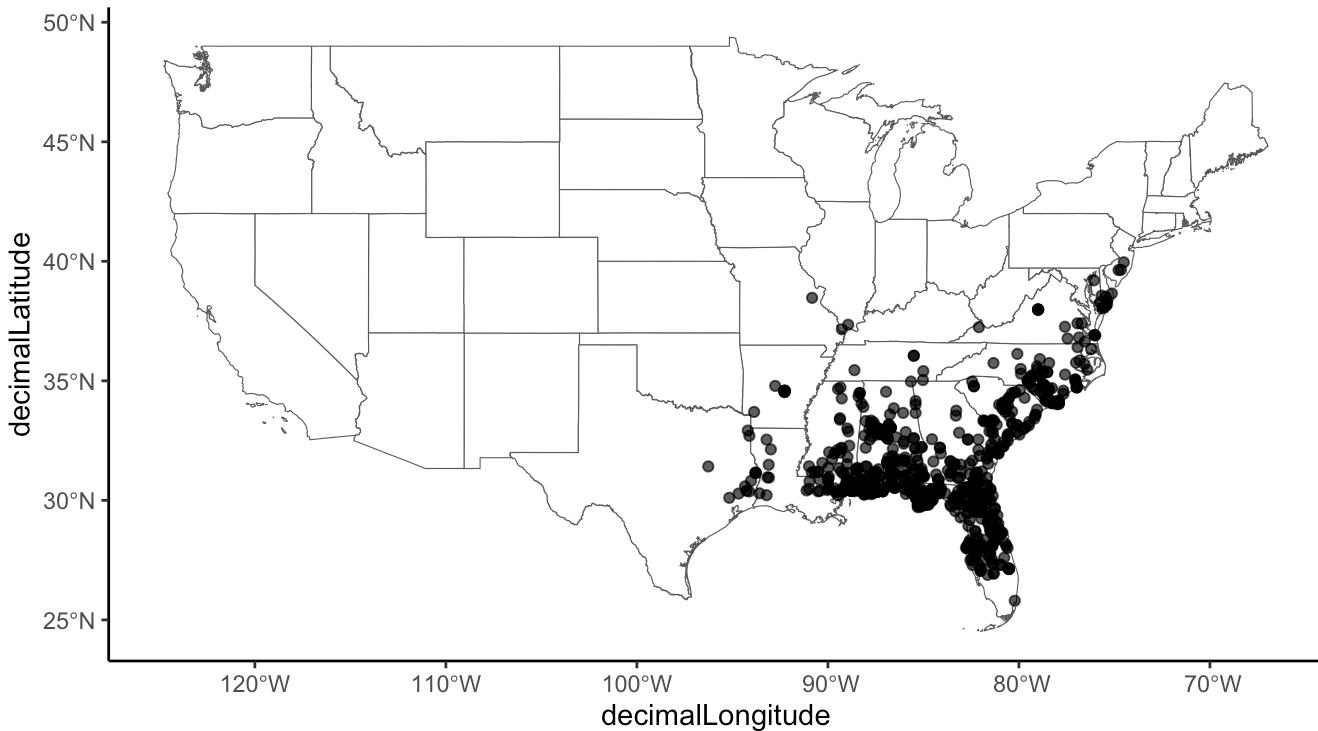


```
ggsave("../Plots/NYAQ2.range.pdf", width = 12, height = 8)
```

Subset for *Nyssa biflora*. Little range map not available. BIEN range map not available.

```
NYBI.occ = gbif %>%
  filter(species == "Nyssa biflora") %>%
  select(species,decimalLatitude,decimalLongitude)
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_point(data = NYBI.occ, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
ggsave("../Plots/NYBI.range.pdf", width = 12, height = 8)
```

Subset for *Nyssa ogeche*

```
NYOG.occ = gbif %>%
  filter(species == "Nyssa ogeche") %>%
  select(species,decimalLatitude,decimalLongitude)
```

Read in range map

```
NYOG.range = st_read("../USTreeAtlas/shp/nyssogec/")
```

```
## Reading layer `nyssogec' from data source
##   `/Users/samanthaworthy/Documents/GitHub/USTreeAtlas/shp/nyssogec'
##   using driver `ESRI Shapefile'
## Simple feature collection with 8 features and 5 fields
## Geometry type: POLYGON
## Dimension:     XY
## Bounding box:  xmin: -86.51112 ymin: 29.52137 xmax: -80.47782 ymax: 32.7832
## CRS:           NA
```

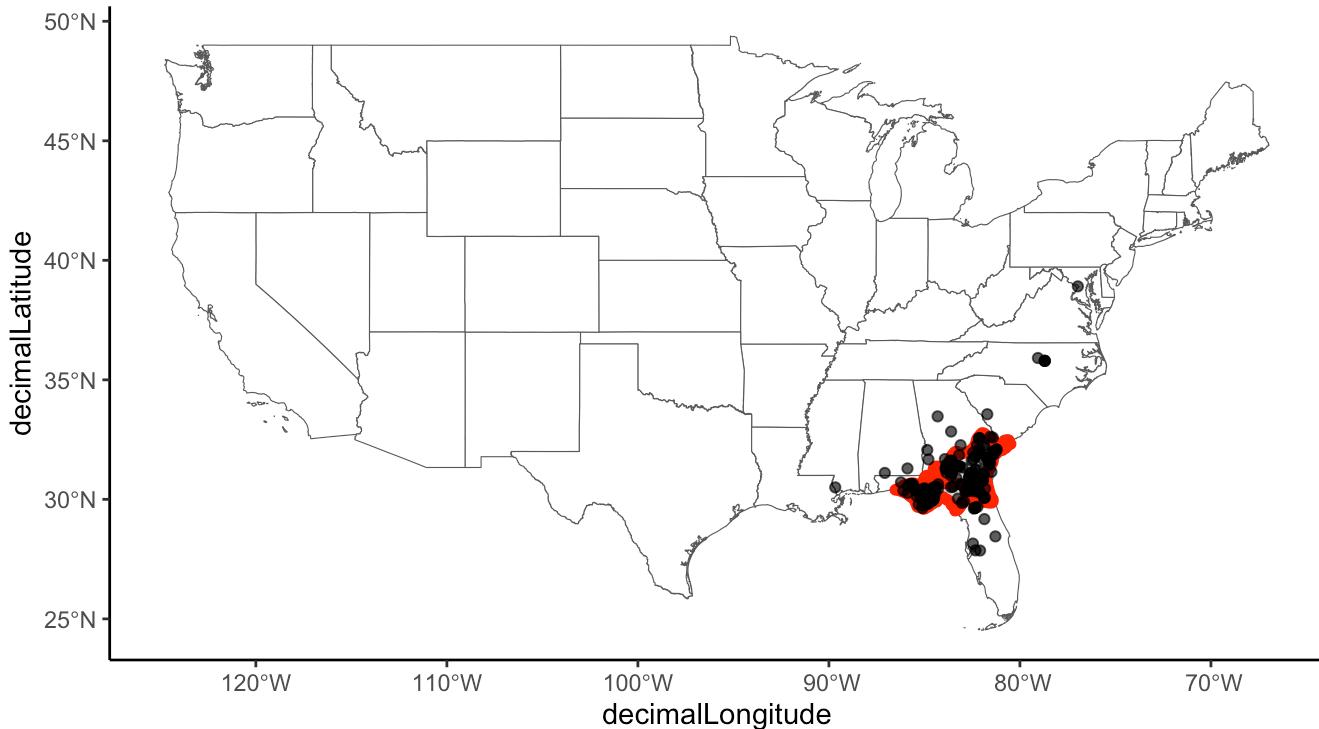
The projection is geographic with latitude and longitude. The datum is NAD27 which is EPSG:4267. The ellipsoid is Clarke 1866, and the transformation parameters

```
st_crs(NYOG.range) <- 4267
```

```
NYOG_clipped = st_intersection(NYOG.range, states.map)
```

```
## Warning: attribute variables are assumed to be spatially constant throughout
## all geometries
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = NYOG_clipped, col = "red", linewidth = 2)+
  geom_point(data = NYOG.occ, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
NYOG_clipped$species = "Nyssa ogeche"
NYOG_flag = cc_iucn(x = NYOG.occ, range = NYOG_clipped, lon = "decimalLongitude", lat =
"decimalLatitude",
                     value = "flagged", buffer = 50000)
```

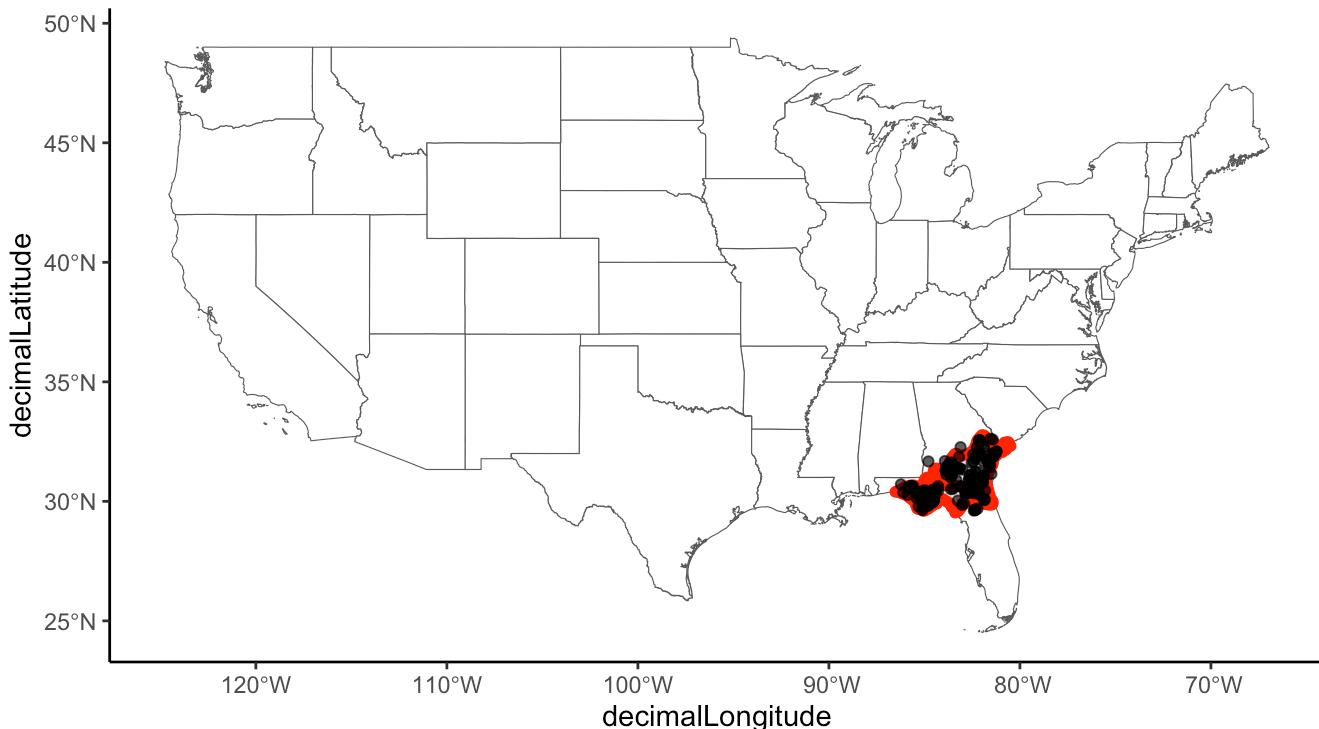
```
## Testing natural ranges
```

```
## Warning in cc_iucn(x = NYOG.occ, range = NYOG_clipped, lon =
## "decimalLongitude", : reprojecting reference to '+proj=longlat +datum=WGS84
## +no_defs'
```

```
## Flagged 17 records.
```

```
NYOG_occ_final = NYOG.occ[NYOG_flag, ]
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = NYOG_clipped, col = "red", linewidth = 2)+
  geom_point(data = NYOG_occ_final, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
ggsave("../Plots/NYOG.range.pdf", width = 12, height = 8)
```

Subset for *Nyssa sylvatica*

```
NYSY.occ = gbif %>%
  filter(species == "Nyssa sylvatica") %>%
  select(species,decimalLatitude,decimalLongitude)
```

Read in range map

```
NYSY.range = st_read("../USTreeAtlas/shp/nyssylyv/")
```

```
## Reading layer `nyssylyv` from data source
##   `/Users/samanthaworthy/Documents/GitHub/USTreeAtlas/shp/nyssylyv'
##   using driver `ESRI Shapefile'
## Simple feature collection with 98 features and 5 fields
## Geometry type: POLYGON
## Dimension:      XY
## Bounding box:  xmin: -98.92374 ymin: 16.64896 xmax: -69.58422 ymax: 44.80475
## CRS:           NA
```

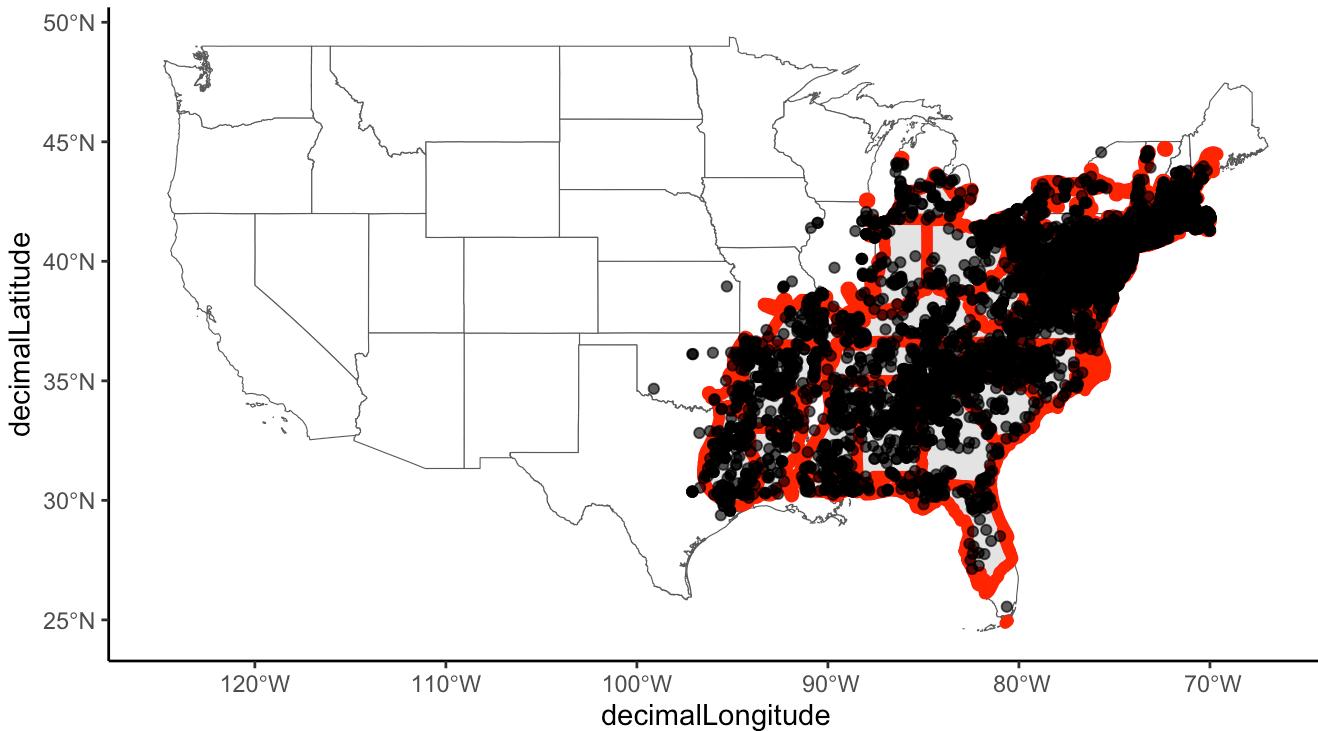
The projection is geographic with latitude and longitude. The datum is NAD27 which is EPSG:4267. The ellipsoid is Clarke 1866, and the transformation parameters

```
st_crs(NYSY.range) <- 4267
```

```
NYSY_clipped = st_intersection(NYSY.range, states.map)
```

```
## Warning: attribute variables are assumed to be spatially constant throughout
## all geometries
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = NYSY_clipped, col = "red", linewidth = 2)+
  geom_point(data = NYSY.occ, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
NYSY_clipped$species = "Nyssa sylvatica"
NYSY_flag = cc_iucn(x = NYSY.occ, range = NYSY_clipped, lon = "decimalLongitude", lat =
"decimalLatitude",
value = "flagged", buffer = 50000)
```

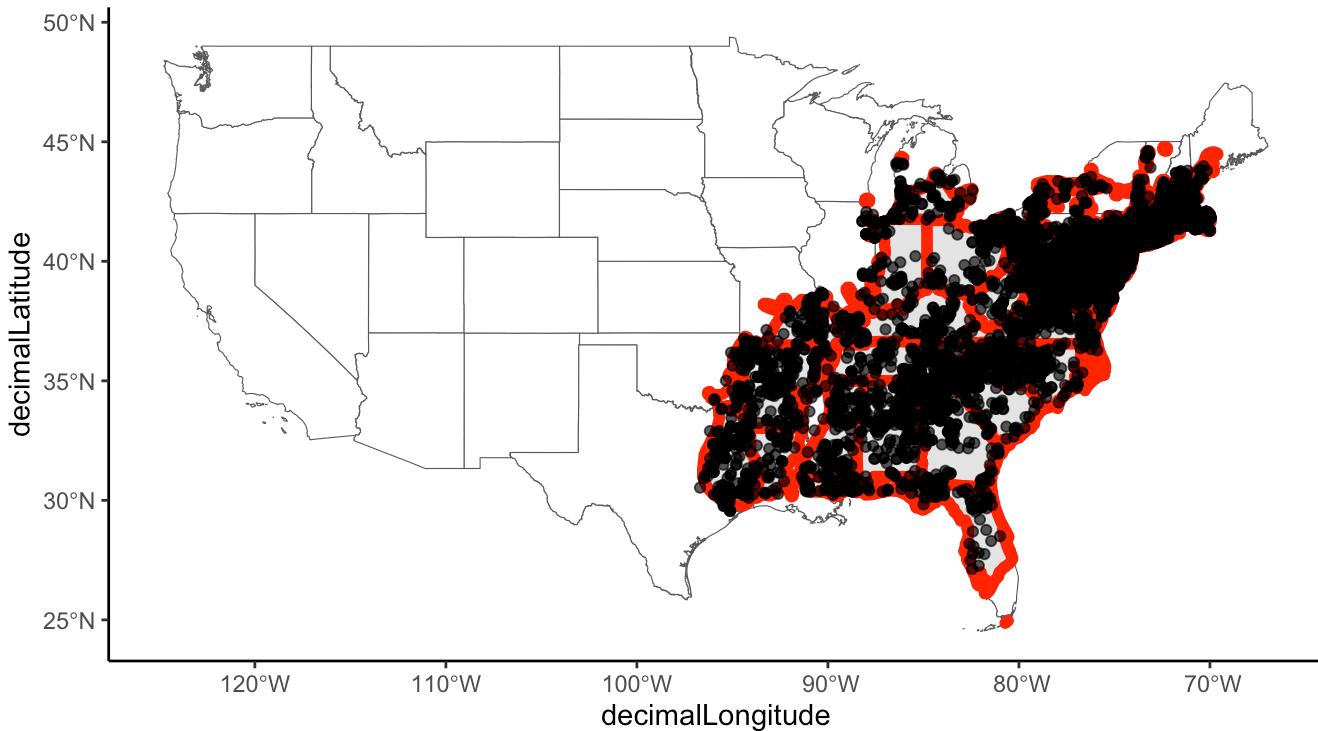
```
## Testing natural ranges
```

```
## Warning in cc_iucn(x = NYSY.occ, range = NYSY_clipped, lon =
## "decimalLongitude", : reprojecting reference to '+proj=longlat +datum=WGS84
## +no_defs'
```

```
## Flagged 48 records.
```

```
NYSY_occ_final = NYSY.occ[NYSY_flag, ]
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = NYSY_clipped, col = "red", linewidth = 2)+
  geom_point(data = NYSY_occ_final, aes(x = decimalLongitude, y = decimalLatitude), colo
r = "black", alpha = 0.7)+
  theme_classic()
```



```
ggsave("../Plots/NYSY.range.pdf", width = 12, height = 8)
```

Subset for *Ostrya virginiana*

```
OSVI.occ = gbif %>%
  filter(species == "Ostrya virginiana") %>%
  select(species,decimalLatitude,decimalLongitude)
```

Read in range map

```
OSVI.range = st_read("../USTreeAtlas/shp/ostrviro/")
```

```
## Reading layer `ostrviro` from data source
##   `/Users/samanthaworthy/Documents/GitHub/USTreeAtlas/shp/ostrviro'
##   using driver `ESRI Shapefile'
## Simple feature collection with 145 features and 5 fields
## Geometry type: POLYGON
## Dimension:     XY
## Bounding box:  xmin: -109.4911 ymin: 13.70159 xmax: -59.68972 ymax: 50.35658
## CRS:           NA
```

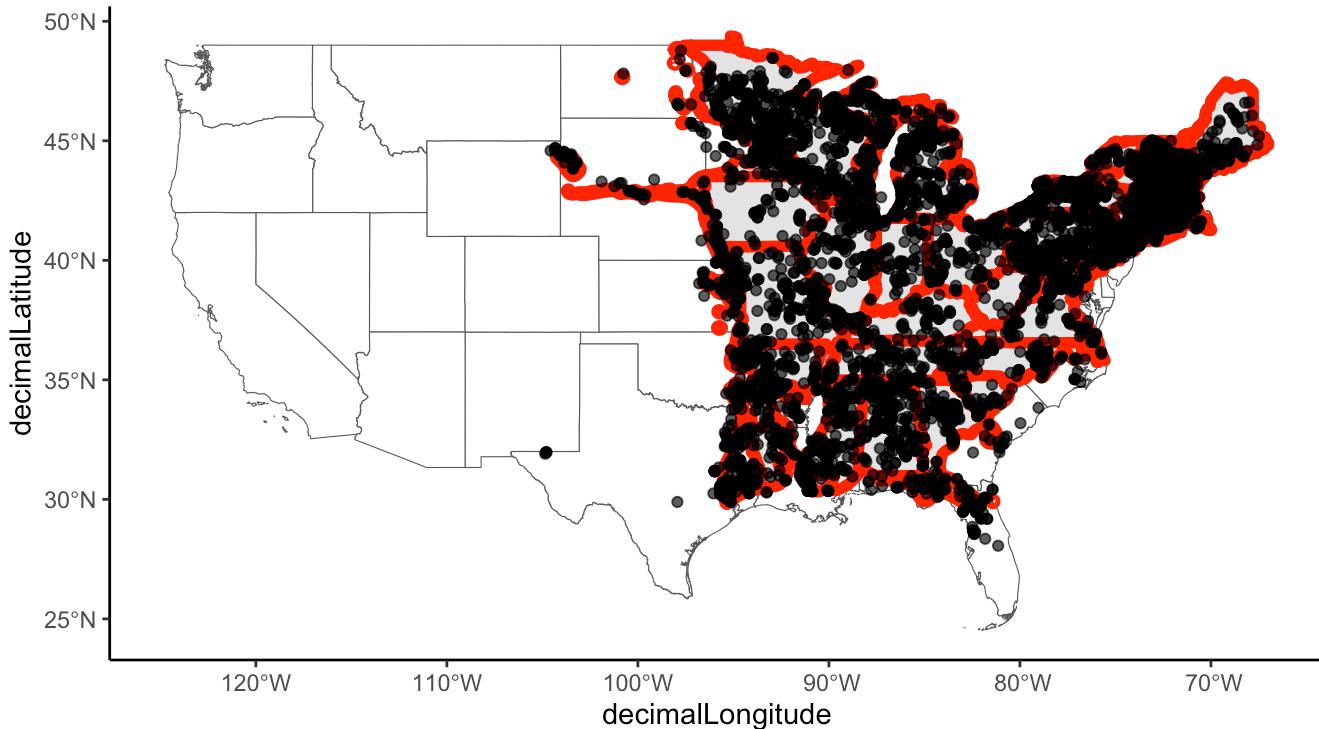
The projection is geographic with latitude and longitude. The datum is NAD27 which is EPSG:4267. The ellipsoid is Clarke 1866, and the transformation parameters

```
st_crs(OSVI.range) <- 4267
```

```
OSVI_clipped = st_intersection(OSVI.range, states.map)
```

```
## Warning: attribute variables are assumed to be spatially constant throughout
## all geometries
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = OSVI_clipped, col = "red", linewidth = 2)+
  geom_point(data = OSVI.occ, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
OSVI_clipped$species = "Ostrya virginiana"
OSVI_flag = cc_iucn(x = OSVI.occ, range = OSVI_clipped, lon = "decimalLongitude", lat =
"decimalLatitude",
                     value = "flagged", buffer = 50000)
```

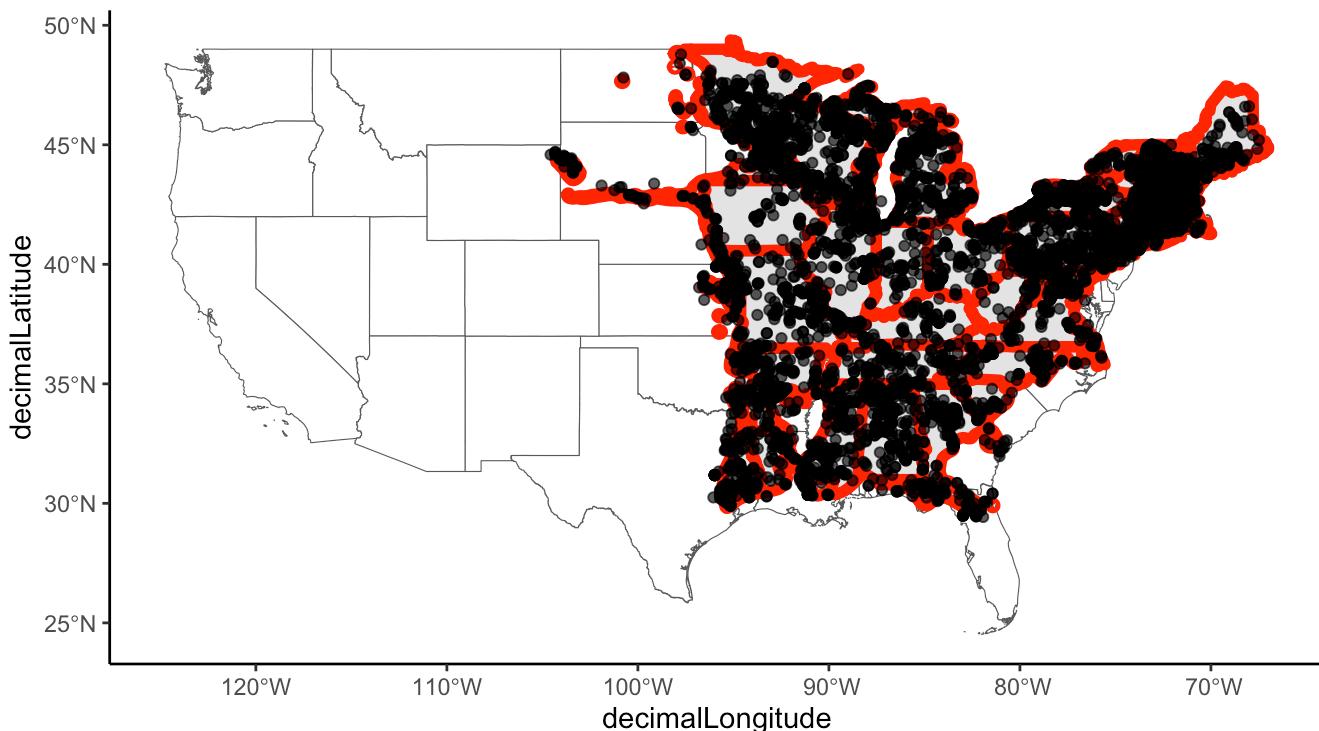
```
## Testing natural ranges
```

```
## Warning in cc_iucn(x = OSVI.occ, range = OSVI_clipped, lon =
## "decimalLongitude", : reprojecting reference to '+proj=longlat +datum=WGS84
## +no_defs'
```

```
## Flagged 54 records.
```

```
OSVI_occ_final = OSVI.occ[OSVI_flag, ]
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = OSVI_clipped, col = "red", linewidth = 2)+
  geom_point(data = OSVI_occ_final, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
ggsave("../Plots/OSVI.range.pdf", width = 12, height = 8)
```

Subset for Oxydendrum arboreum

```
OXAR.occ = gbif %>%
  filter(species == "Oxydendrum arboreum") %>%
  select(species,decimalLatitude,decimalLongitude)
```

Read in range map

```
OXAR.range = st_read("../USTreeAtlas/shp/oxydarbo/")
```

```
## Reading layer `oxydarbo' from data source
##   `/Users/samanthaworthy/Documents/GitHub/USTreeAtlas/shp/oxydarbo'
##   using driver `ESRI Shapefile'
## Simple feature collection with 34 features and 5 fields
## Geometry type: POLYGON
## Dimension:      XY
## Bounding box:  xmin: -94.92362 ymin: 29.90913 xmax: -75.31862 ymax: 40.52448
## CRS:           NA
```

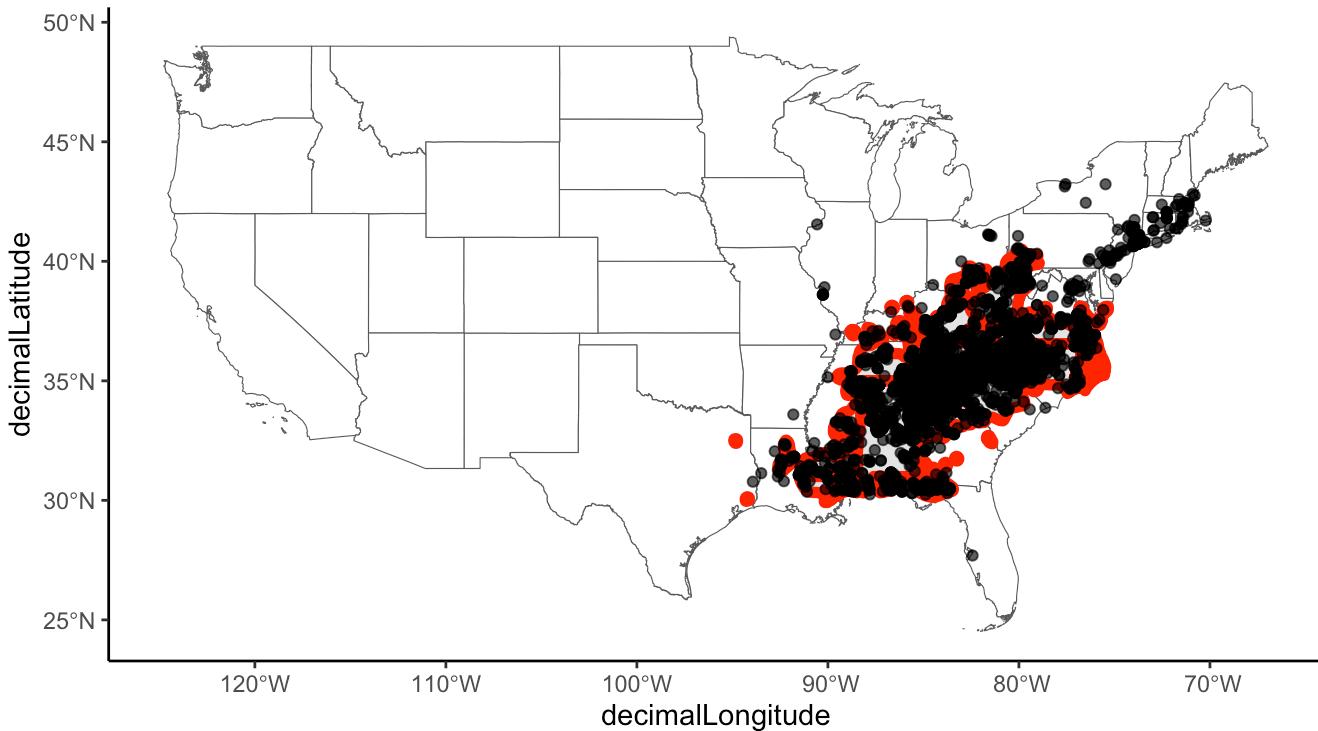
The projection is geographic with latitude and longitude. The datum is NAD27 which is EPSG:4267. The ellipsoid is Clarke 1866, and the transformation parameters

```
st_crs(OXAR.range) <- 4267
```

```
OXAR_clipped = st_intersection(OXAR.range, states.map)
```

```
## Warning: attribute variables are assumed to be spatially constant throughout
## all geometries
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = OXAR_clipped, col = "red", linewidth = 2)+
  geom_point(data = OXAR.occ, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
OXAR_clipped$species = "Oxydendrum arboreum"
OXAR_flag = cc_iucn(x = OXAR.occ, range = OXAR_clipped, lon = "decimalLongitude", lat =
"decimalLatitude",
value = "flagged", buffer = 50000)
```

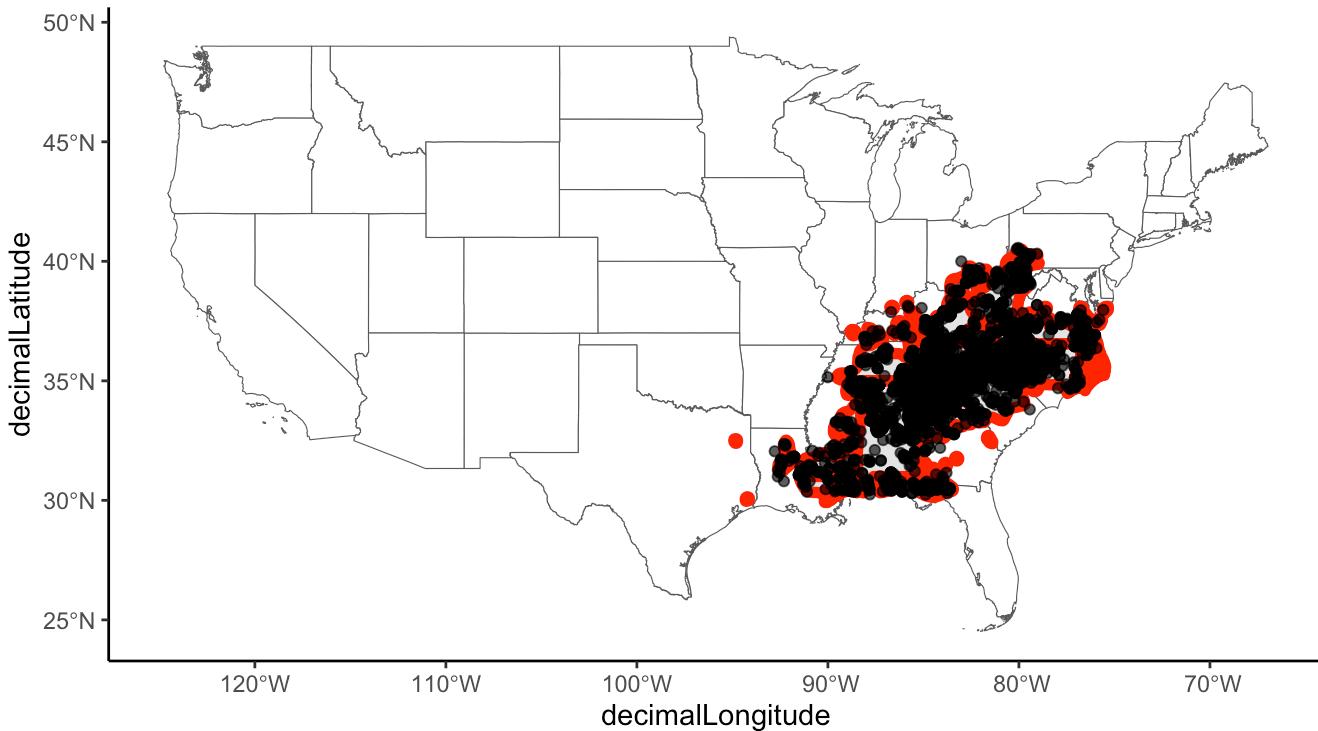
```
## Testing natural ranges
```

```
## Warning in cc_iucn(x = OXAR.occ, range = OXAR_clipped, lon =
## "decimalLongitude", : reprojecting reference to '+proj=longlat +datum=WGS84
## +no_defs'
```

```
## Flagged 170 records.
```

```
OXAR_occ_final = OXAR.occ[OXAR_flag, ]
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = OXAR_clipped, col = "red", linewidth = 2)+
  geom_point(data = OXAR_occ_final, aes(x = decimalLongitude, y = decimalLatitude), colo
r = "black", alpha = 0.7)+
  theme_classic()
```



```
ggsave("../Plots/0XAR.range.pdf", width = 12, height = 8)
```

Subset for *Paulownia tomentosa*. Little range map not available.

```
PAT02.occ = gbif %>%
  filter(species == "Paulownia tomentosa") %>%
  select(species,decimalLatitude,decimalLongitude)
```

Get range map from BIEN

```
(PAT02.range.sf <- BIEN_ranges_load_species('Paulownia tomentosa'))
```

```
## Simple feature collection with 1 feature and 2 fields
## Geometry type: MULTIPOLYGON
## Dimension: XY
## Bounding box: xmin: -107.129 ymin: -50.24668 xmax: -41.68269 ymax: 48.70595
## Geodetic CRS: WGS 84
##           species      gid      geometry
## 1 Paulownia_tomentosa 65044 MULTIPOLYGON (((-51.90394 -...
```

The projection is geographic with latitude and longitude. The datum is NAD27 which is EPSG:4267. The BIEN ranges are WG84.

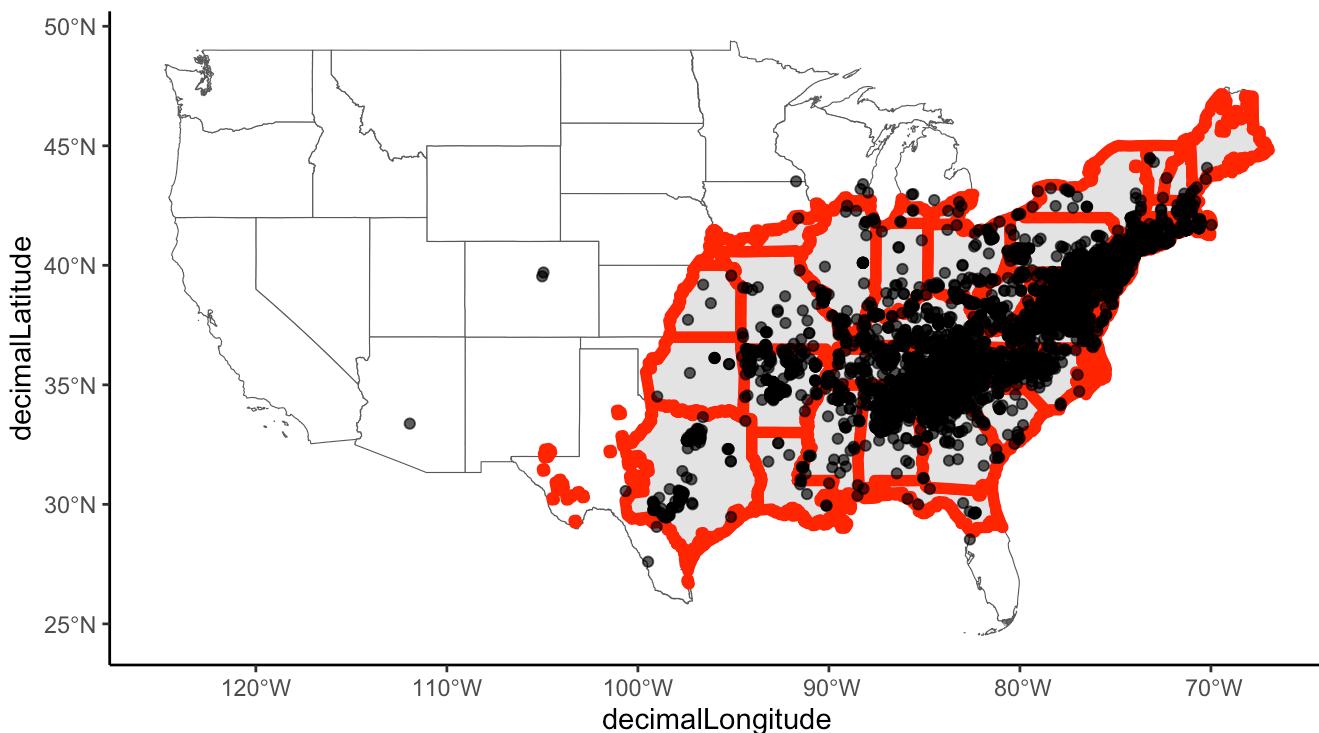
```
PAT02.range.2 = PAT02.range.sf %>%
  st_transform(st_crs(states.map))
```

```
PAT02.range.3 = terra::vect(PAT02.range.2)
states.map.2 = terra::vect(states.map)
```

```
PAT02.range.4 = terra::intersect(PAT02.range.3, states.map.2)
```

```
PAT02.range.5 = st_as_sf(PAT02.range.4)
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(dat = PAT02.range.5, col = "red", linewidth = 2)+
  geom_point(data = PAT02.occ, aes(x = decimalLongitude, y = decimalLatitude), color =
"black", alpha = 0.7)+
  theme_classic()
```



```
PAT02.range.5$species = "Paulownia tomentosa"
PAT02_flag = cc_iucn(x = PAT02.occ, range = PAT02.range.5, lon = "decimalLongitude", lat =
"decimalLatitude",
                      value = "flagged", buffer = 50000)
```

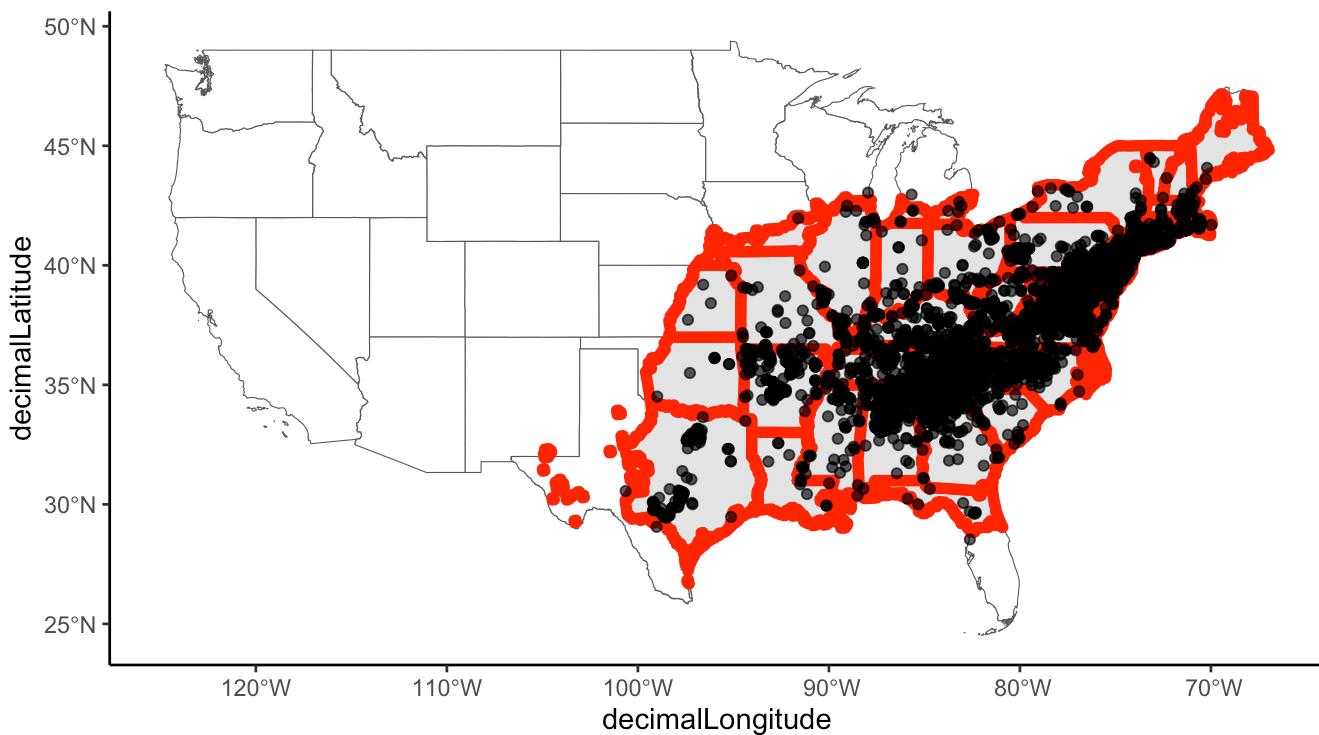
```
## Testing natural ranges
```

```
## Warning in cc_iucn(x = PAT02.occ, range = PAT02.range.5, lon =
## "decimalLongitude", : reprojecting reference to '+proj=longlat +datum=WGS84
## +no_defs'
```

```
## Flagged 9 records.
```

```
PAT02_occ_final = PAT02.occ[PAT02_flag, ]
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = PAT02.range.5, col = "red", linewidth = 2)+
  geom_point(data = PAT02_occ_final, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
ggsave("../Plots/PAT02.range.pdf", width = 12, height = 8)
```

Subset for *Persea borbonia*

```
PEB0.occ = gbif %>%
  filter(species == "Persea borbonia") %>%
  select(species,decimalLatitude,decimalLongitude)
```

Read in range map

```
PEB0.range = st_read("../USTreeAtlas/shp/persborb/")
```

```
## Reading layer `persborb' from data source
##   '/Users/samanthaworthy/Documents/GitHub/USTreeAtlas/shp/persborb'
##   using driver `ESRI Shapefile'
## Simple feature collection with 94 features and 5 fields
## Geometry type: POLYGON
## Dimension:     XY
## Bounding box:  xmin: -97.96335 ymin: 24.6522 xmax: -75.1954 ymax: 38.55726
## CRS:           NA
```

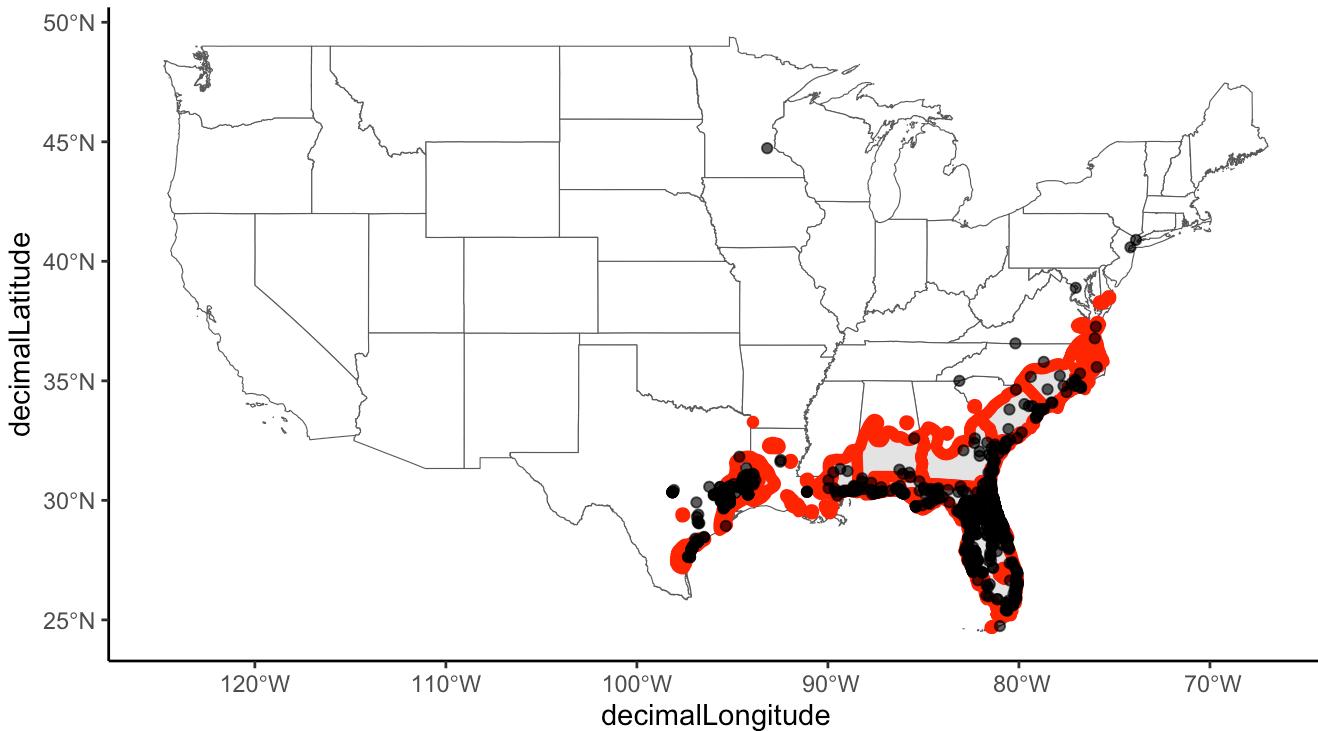
The projection is geographic with latitude and longitude. The datum is NAD27 which is EPSG:4267. The ellipsoid is Clarke 1866, and the transformation parameters

```
st_crs(PEB0.range) <- 4267
```

```
PEB0_clipped = st_intersection(PEB0.range, states.map)
```

```
## Warning: attribute variables are assumed to be spatially constant throughout
## all geometries
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = PEB0_clipped, col = "red", linewidth = 2)+
  geom_point(data = PEB0.occ, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
PEB0_clipped$species = "Persea borbonia"
PEB0_flag = cc_iucn(x = PEB0.occ, range = PEB0_clipped, lon = "decimalLongitude", lat =
"decimalLatitude",
                     value = "flagged", buffer = 50000)
```

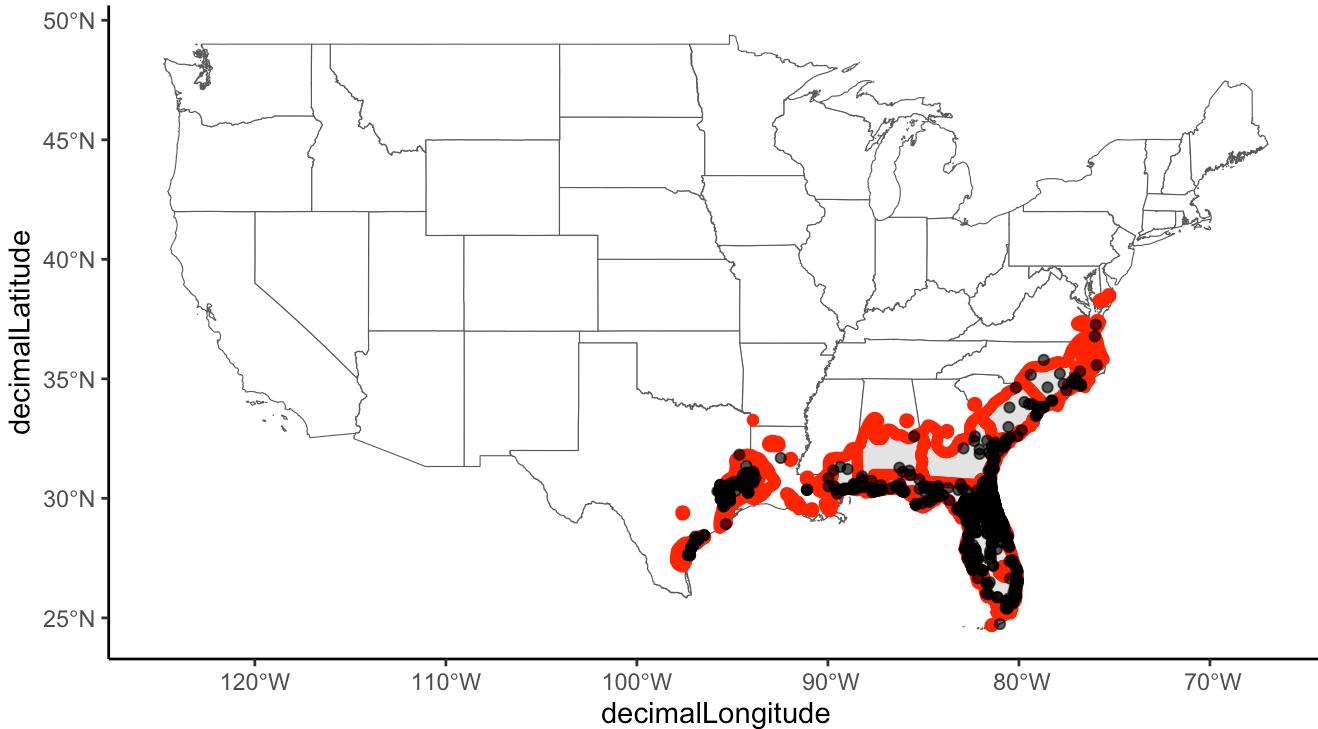
```
## Testing natural ranges
```

```
## Warning in cc_iucn(x = PEB0.occ, range = PEB0_clipped, lon =
## "decimalLongitude", : reprojecting reference to '+proj=longlat +datum=WGS84
## +no_defs'
```

```
## Flagged 26 records.
```

```
PEB0_occ_final = PEB0.occ[PEB0_flag, ]
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = PEB0_clipped, col = "red", linewidth = 2)+
  geom_point(data = PEB0_occ_final, aes(x = decimalLongitude, y = decimalLatitude), colo
r = "black", alpha = 0.7)+
  theme_classic()
```



```
ggsave("../Plots/PEB0.range.pdf", width = 12, height = 8)
```

Subset for *Picea glauca*

```
PIGL.occ = gbif %>%
  filter(species == "Picea glauca") %>%
  select(species,decimalLatitude,decimalLongitude)
```

Read in range map

```
PIGL.range = st_read("../USTreeAtlas/shp/piceglau/")
```

```
## Reading layer `piceglau' from data source
##   `/Users/samanthaworthy/Documents/GitHub/USTreeAtlas/shp/piceglau'
##   using driver `ESRI Shapefile'
## Simple feature collection with 1449 features and 5 fields
## Geometry type: POLYGON
## Dimension:     XY
## Bounding box:  xmin: -163.9861 ymin: 42.71046 xmax: -52.63629 ymax: 69.57938
## CRS:           NA
```

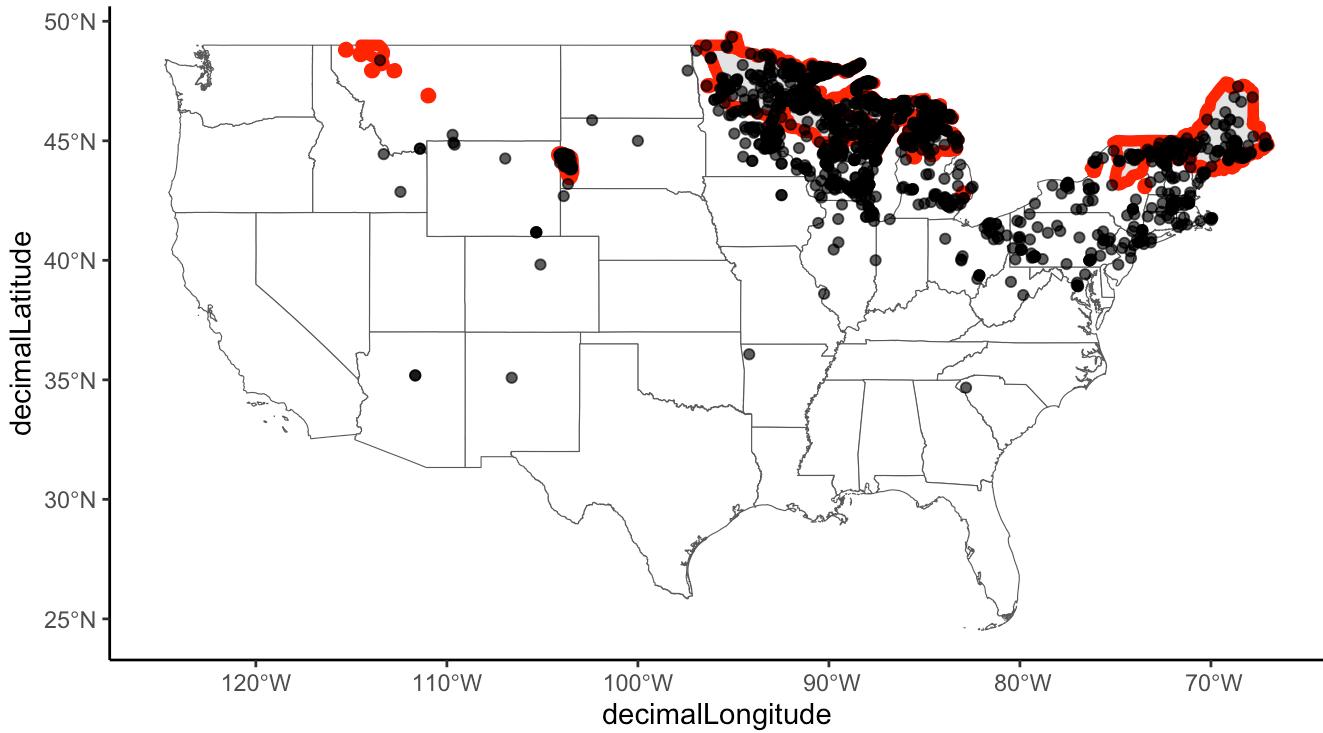
The projection is geographic with latitude and longitude. The datum is NAD27 which is EPSG:4267. The ellipsoid is Clarke 1866, and the transformation parameters

```
st_crs(PIGL.range) <- 4267
```

```
PIGL_clipped = st_intersection(PIGL.range, states.map)
```

```
## Warning: attribute variables are assumed to be spatially constant throughout
## all geometries
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = PIGL_clipped, col = "red", linewidth = 2)+
  geom_point(data = PIGL.occ, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
PIGL_clipped$species = "Picea glauca"
PIGL_flag = cc_iucn(x = PIGL.occ, range = PIGL_clipped, lon = "decimalLongitude", lat =
"decimalLatitude",
                     value = "flagged", buffer = 50000)
```

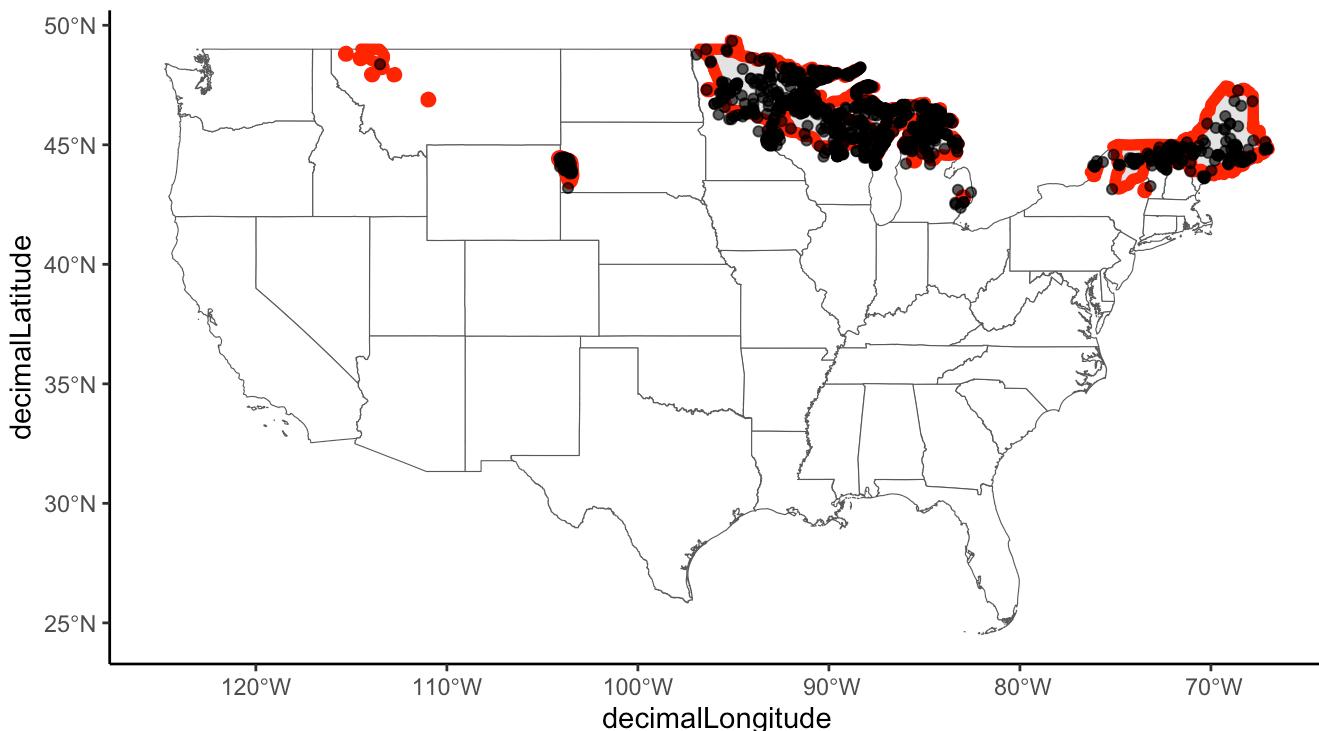
```
## Testing natural ranges
```

```
## Warning in cc_iucn(x = PIGL.occ, range = PIGL_clipped, lon =
## "decimalLongitude", : reprojecting reference to '+proj=longlat +datum=WGS84
## +no_defs'
```

```
## Flagged 422 records.
```

```
PIGL_occ_final = PIGL.occ[PIGL_flag, ]
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = PIGL_clipped, col = "red", linewidth = 2)+
  geom_point(data = PIGL_occ_final, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
ggsave("../Plots/PIGL.range.pdf", width = 12, height = 8)
```

Subset for *Picea mariana*

```
PIMA.occ = gbif %>%
  filter(species == "Picea mariana") %>%
  select(species,decimalLatitude,decimalLongitude)
```

Read in range map

```
PIMA.range = st_read("../USTreeAtlas/shp/picemari/")

## Reading layer `picemari' from data source
##   `/Users/samanthaworthy/Documents/GitHub/USTreeAtlas/shp/picemari'
##   using driver `ESRI Shapefile'
## Simple feature collection with 1585 features and 5 fields
## Geometry type: POLYGON
## Dimension:      XY
## Bounding box:  xmin: -161.9129 ymin: 40.52763 xmax: -52.63629 ymax: 69.51231
## CRS:           NA
```

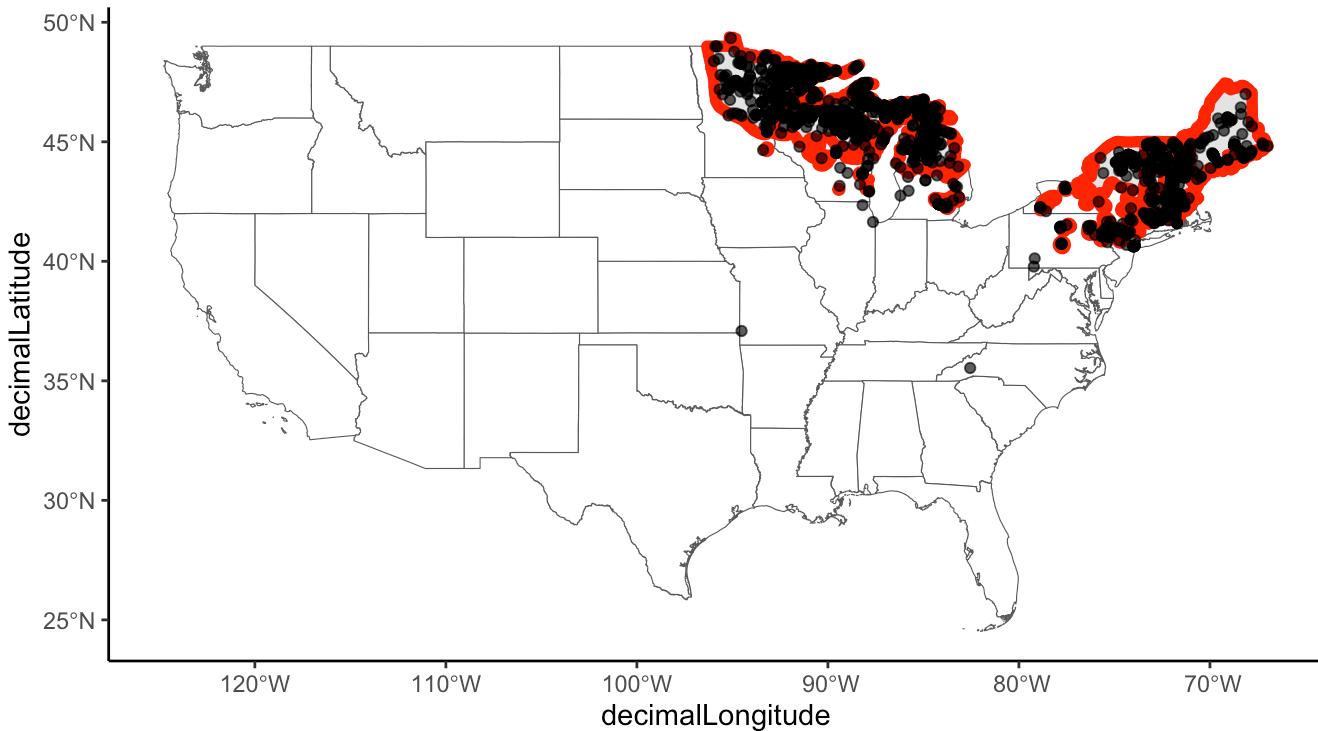
The projection is geographic with latitude and longitude. The datum is NAD27 which is EPSG:4267. The ellipsoid is Clarke 1866, and the transformation parameters

```
st_crs(PIMA.range) <- 4267
```

```
PIMA_clipped = st_intersection(PIMA.range, states.map)
```

```
## Warning: attribute variables are assumed to be spatially constant throughout
## all geometries
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = PIMA_clipped, col = "red", linewidth = 2)+
  geom_point(data = PIMA.occ, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
PIMA_clipped$species = "Picea mariana"
PIMA_flag = cc_iucn(x = PIMA.occ, range = PIMA_clipped, lon = "decimalLongitude", lat =
"decimalLatitude",
                     value = "flagged", buffer = 50000)
```

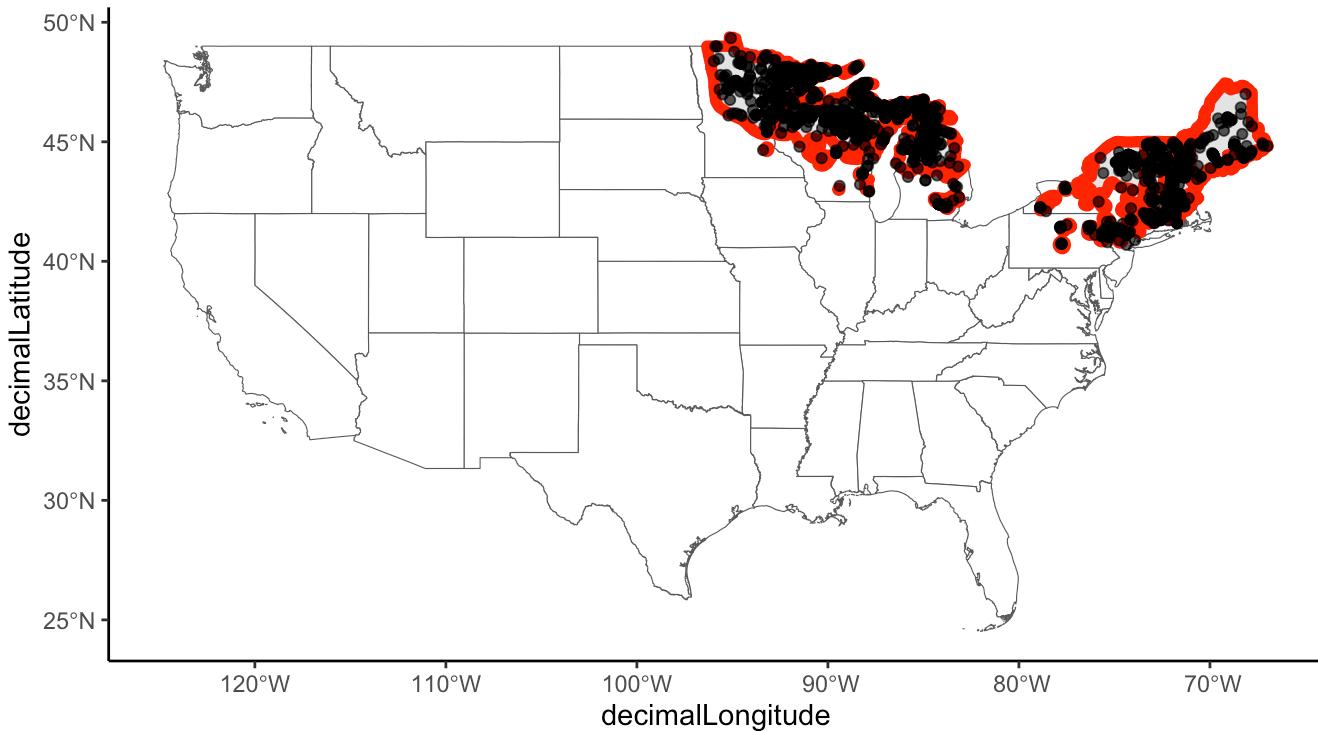
```
## Testing natural ranges
```

```
## Warning in cc_iucn(x = PIMA.occ, range = PIMA_clipped, lon =
## "decimalLongitude", : reprojecting reference to '+proj=longlat +datum=WGS84
## +no_defs'
```

```
## Flagged 19 records.
```

```
PIMA_occ_final = PIMA.occ[PIMA_flag, ]
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = PIMA_clipped, col = "red", linewidth = 2)+
  geom_point(data = PIMA_occ_final, aes(x = decimalLongitude, y = decimalLatitude), colo
r = "black", alpha = 0.7)+
  theme_classic()
```



```
ggsave("../Plots/PIMA.range.pdf", width = 12, height = 8)
```

Subset for *Picea rubens*

```
PIRU.occ = gbif %>%
  filter(species == "Picea rubens") %>%
  select(species,decimalLatitude,decimalLongitude)
```

Read in range map

```
PIRU.range = st_read("../USTreeAtlas/shp/picerube/")
```

```
## Reading layer `picerube' from data source
##   `/Users/samanthaworthy/Documents/GitHub/USTreeAtlas/shp/picerube'
##   using driver `ESRI Shapefile'
## Simple feature collection with 326 features and 5 fields
## Geometry type: POLYGON
## Dimension:     XY
## Bounding box:  xmin: -83.7767 ymin: 35.23503 xmax: -59.69256 ymax: 48.01405
## CRS:           NA
```

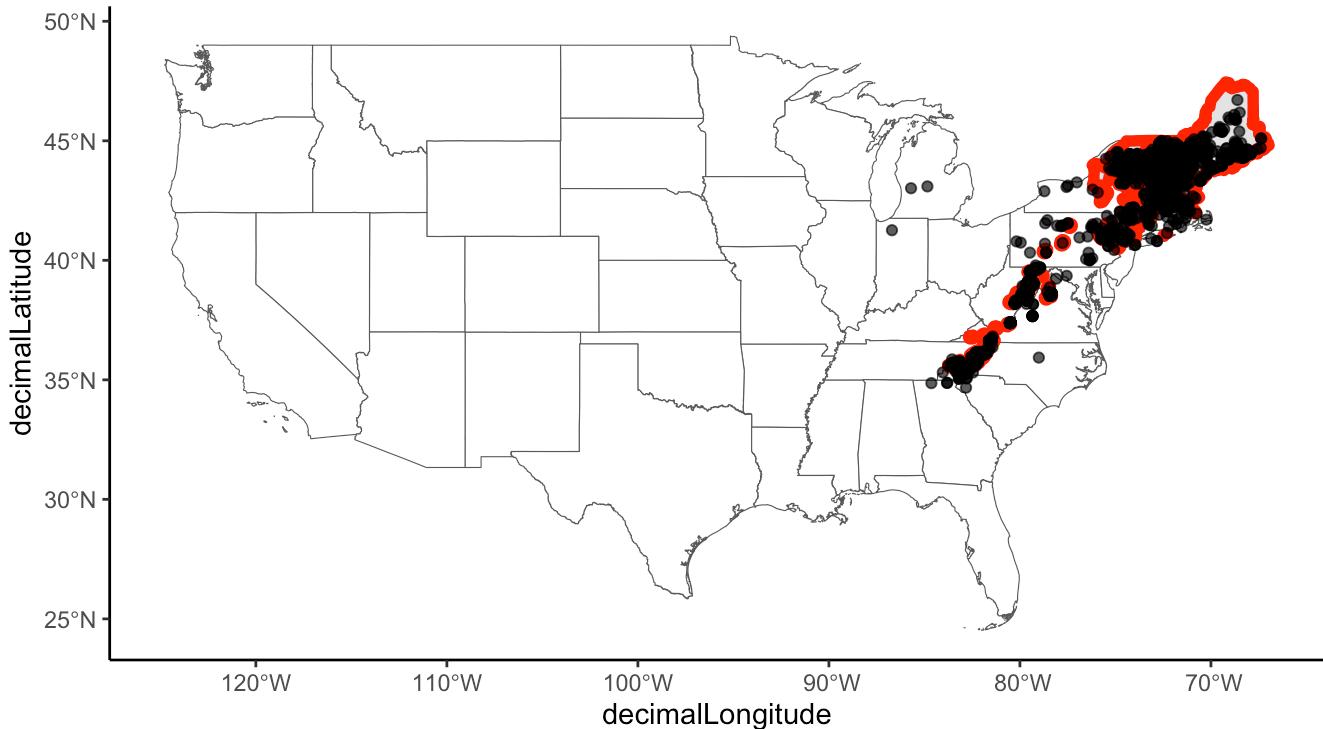
The projection is geographic with latitude and longitude. The datum is NAD27 which is EPSG:4267. The ellipsoid is Clarke 1866, and the transformation parameters

```
st_crs(PIRU.range) <- 4267
```

```
PIRU_clipped = st_intersection(PIRU.range, states.map)
```

```
## Warning: attribute variables are assumed to be spatially constant throughout
## all geometries
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = PIRU_clipped, col = "red", linewidth = 2)+
  geom_point(data = PIRU.occ, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
PIRU_clipped$species = "Picea rubens"
PIRU_flag = cc_iucn(x = PIRU.occ, range = PIRU_clipped, lon = "decimalLongitude", lat =
"decimalLatitude",
                     value = "flagged", buffer = 50000)
```

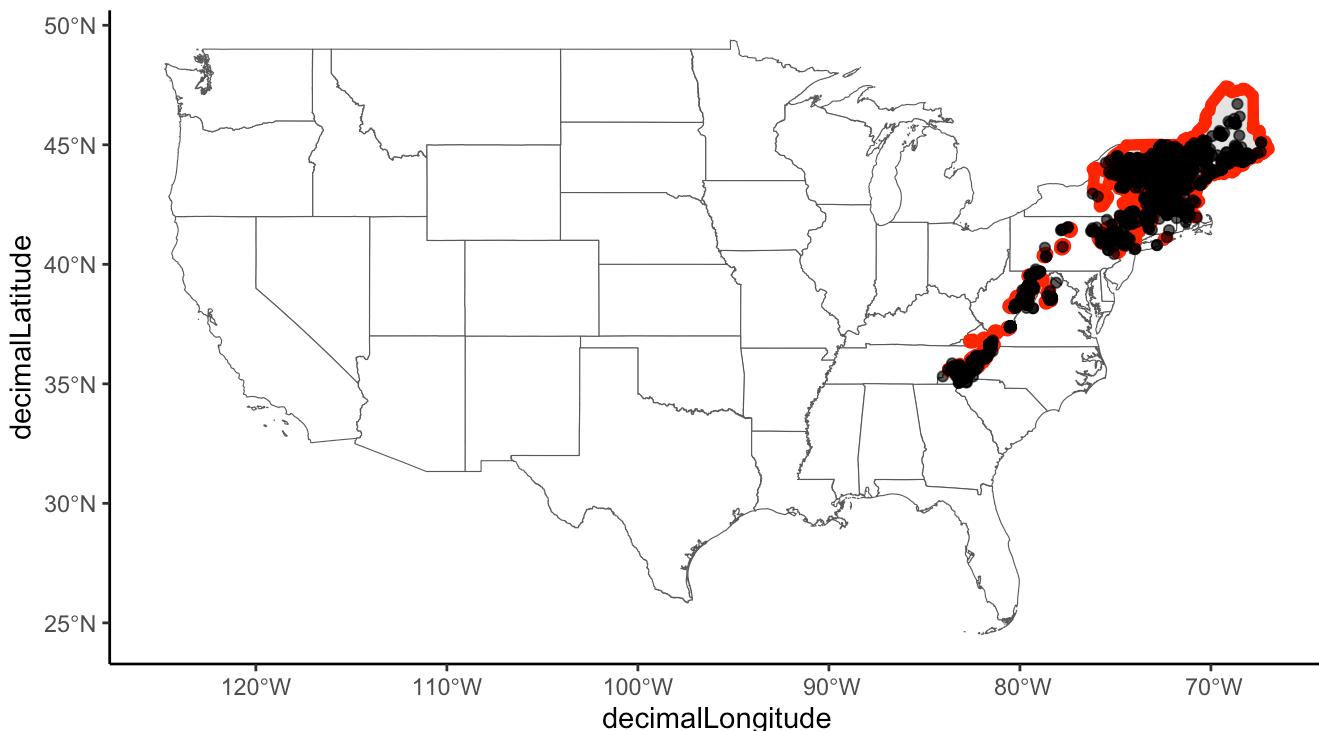
```
## Testing natural ranges
```

```
## Warning in cc_iucn(x = PIRU.occ, range = PIRU_clipped, lon =
## "decimalLongitude", : reprojecting reference to '+proj=longlat +datum=WGS84
## +no_defs'
```

```
## Flagged 41 records.
```

```
PIRU_occ_final = PIRU.occ[PIRU_flag, ]
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = PIRU_clipped, col = "red", linewidth = 2)+
  geom_point(data = PIRU_occ_final, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
ggsave("../Plots/PIRU.range.pdf", width = 12, height = 8)
```

Subset for *Pinus banksiana*

```
PIBA2.occ = gbif %>%
  filter(species == "Pinus banksiana") %>%
  select(species,decimalLatitude,decimalLongitude)
```

Read in range map

```
PIBA2.range = st_read("../USTreeAtlas/shp/pinubank/")
```

```
## Reading layer `pinubank' from data source
##   `/Users/samanthaworthy/Documents/GitHub/USTreeAtlas/shp/pinubank'
##   using driver `ESRI Shapefile'
## Simple feature collection with 395 features and 5 fields
## Geometry type: POLYGON
## Dimension:      XY
## Bounding box:  xmin: -127.2683 ymin: 41.47121 xmax: -60.3597 ymax: 65.29585
## CRS:           NA
```

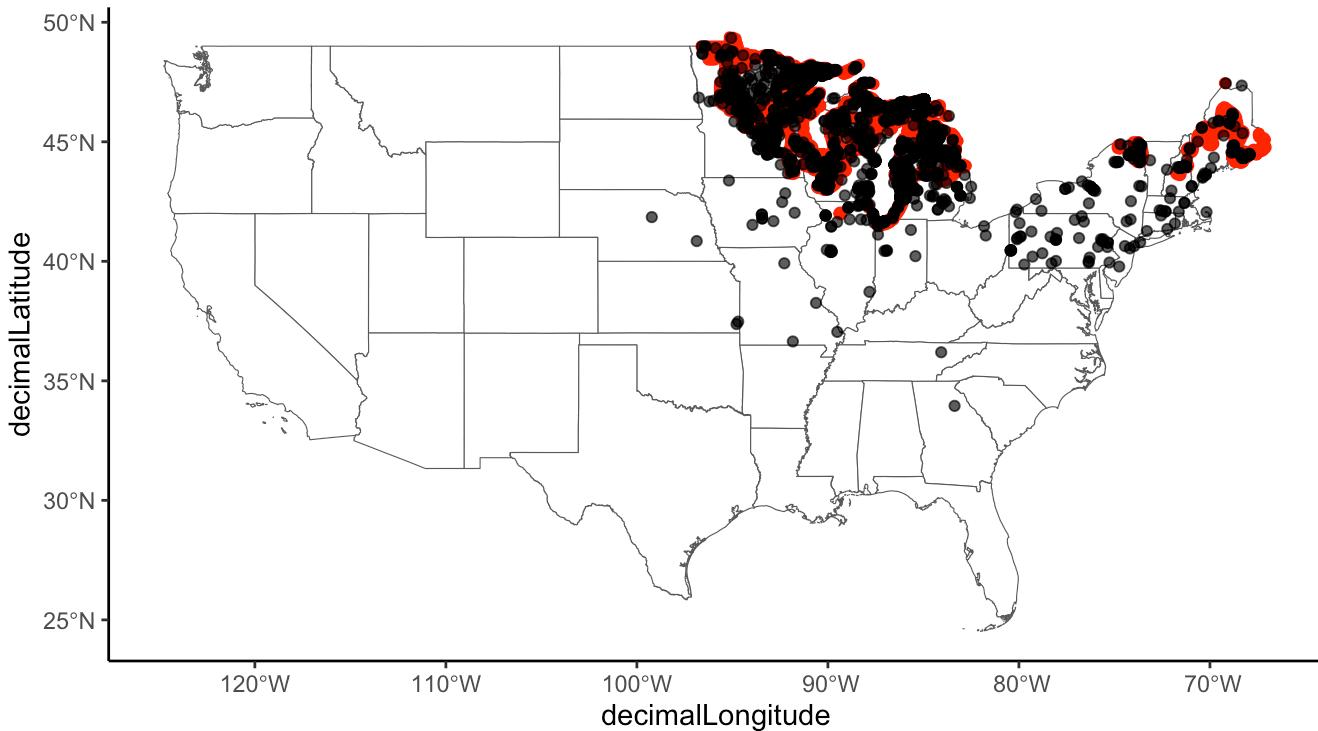
The projection is geographic with latitude and longitude. The datum is NAD27 which is EPSG:4267. The ellipsoid is Clarke 1866, and the transformation parameters

```
st_crs(PIBA2.range) <- 4267
```

```
PIBA2_clipped = st_intersection(PIBA2.range, states.map)
```

```
## Warning: attribute variables are assumed to be spatially constant throughout
## all geometries
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = PIBA2_clipped, col = "red", linewidth = 2)+
  geom_point(data = PIBA2.occ, aes(x = decimalLongitude, y = decimalLatitude), color =
"black", alpha = 0.7)+
  theme_classic()
```



```
PIBA2_clipped$species = "Pinus banksiana"
PIBA2_flag = cc_iucn(x = PIBA2.occ, range = PIBA2_clipped, lon = "decimalLongitude", lat = "decimalLatitude",
                      value = "flagged", buffer = 50000)
```

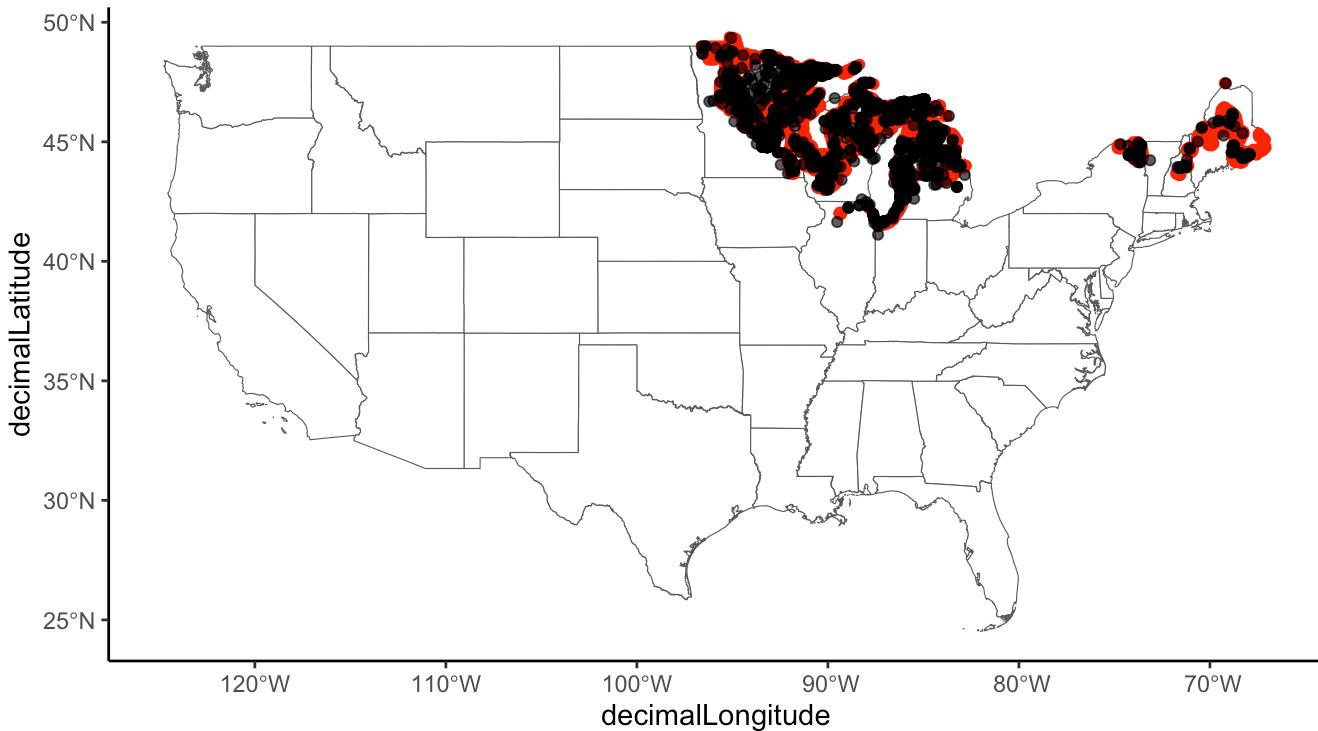
```
## Testing natural ranges
```

```
## Warning in cc_iucn(x = PIBA2.occ, range = PIBA2_clipped, lon =
## "decimalLongitude", : reprojecting reference to '+proj=longlat +datum=WGS84
## +no_defs'
```

```
## Flagged 229 records.
```

```
PIBA2_occ_final = PIBA2.occ[PIBA2_flag, ]
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = PIBA2_clipped, col = "red", linewidth = 2)+
  geom_point(data = PIBA2_occ_final, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
ggsave("../Plots/PIBA2.range.pdf", width = 12, height = 8)
```

Subset for *Pinus clausa*

```
PICL.occ = gbif %>%
  filter(species == "Pinus clausa") %>%
  select(species,decimalLatitude,decimalLongitude)
```

Read in range map

```
PICL.range = st_read("../USTreeAtlas/shp/pinuclau/")
```

```
## Reading layer `pinuclau' from data source
##   `/Users/samanthaworthy/Documents/GitHub/USTreeAtlas/shp/pinuclau'
##   using driver `ESRI Shapefile'
## Simple feature collection with 52 features and 5 fields
## Geometry type: POLYGON
## Dimension:     XY
## Bounding box:  xmin: -87.70842 ymin: 25.84471 xmax: -80.03255 ymax: 30.66881
## CRS:           NA
```

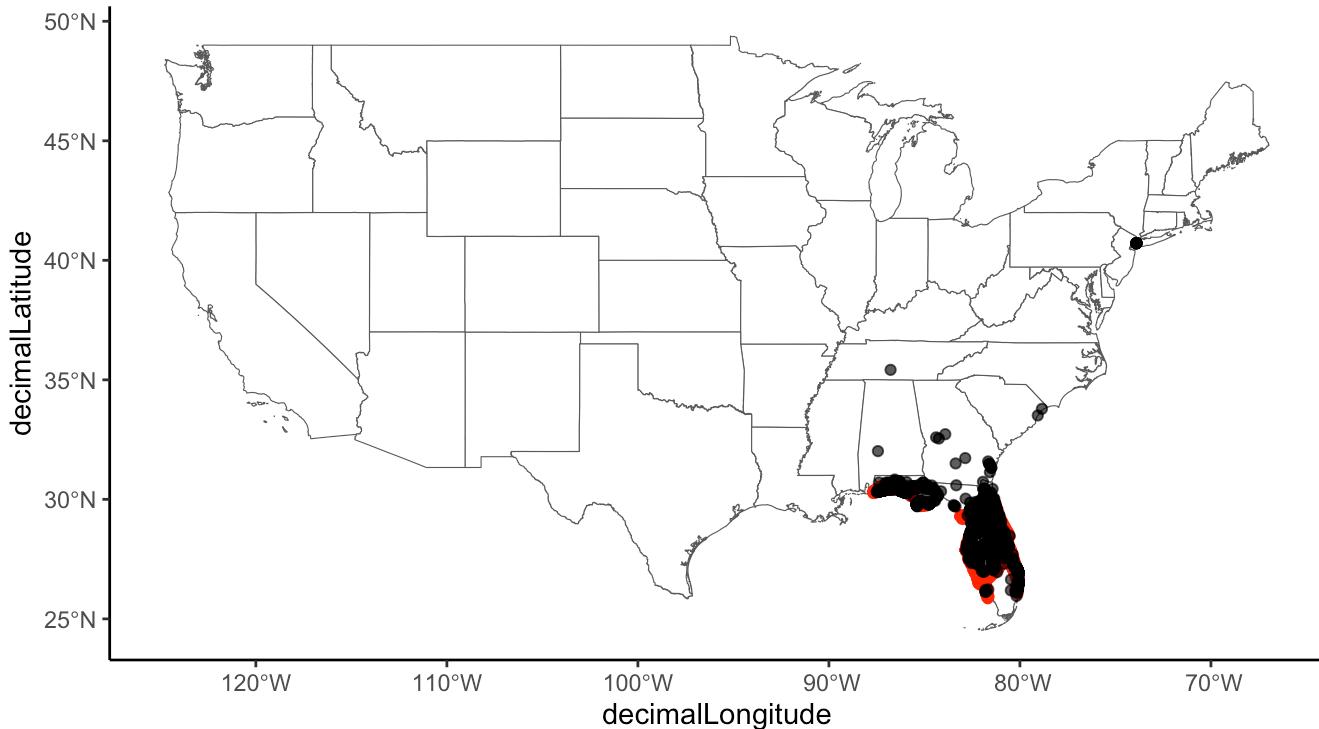
The projection is geographic with latitude and longitude. The datum is NAD27 which is EPSG:4267. The ellipsoid is Clarke 1866, and the transformation parameters

```
st_crs(PICL.range) <- 4267
```

```
PICL_clipped = st_intersection(PICL.range, states.map)
```

```
## Warning: attribute variables are assumed to be spatially constant throughout
## all geometries
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = PICL_clipped, col = "red", linewidth = 2)+
  geom_point(data = PICL.occ, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
PICL_clipped$species = "Pinus clausa"
PICL_flag = cc_iucn(x = PICL.occ, range = PICL_clipped, lon = "decimalLongitude", lat =
"decimalLatitude",
                     value = "flagged", buffer = 50000)
```

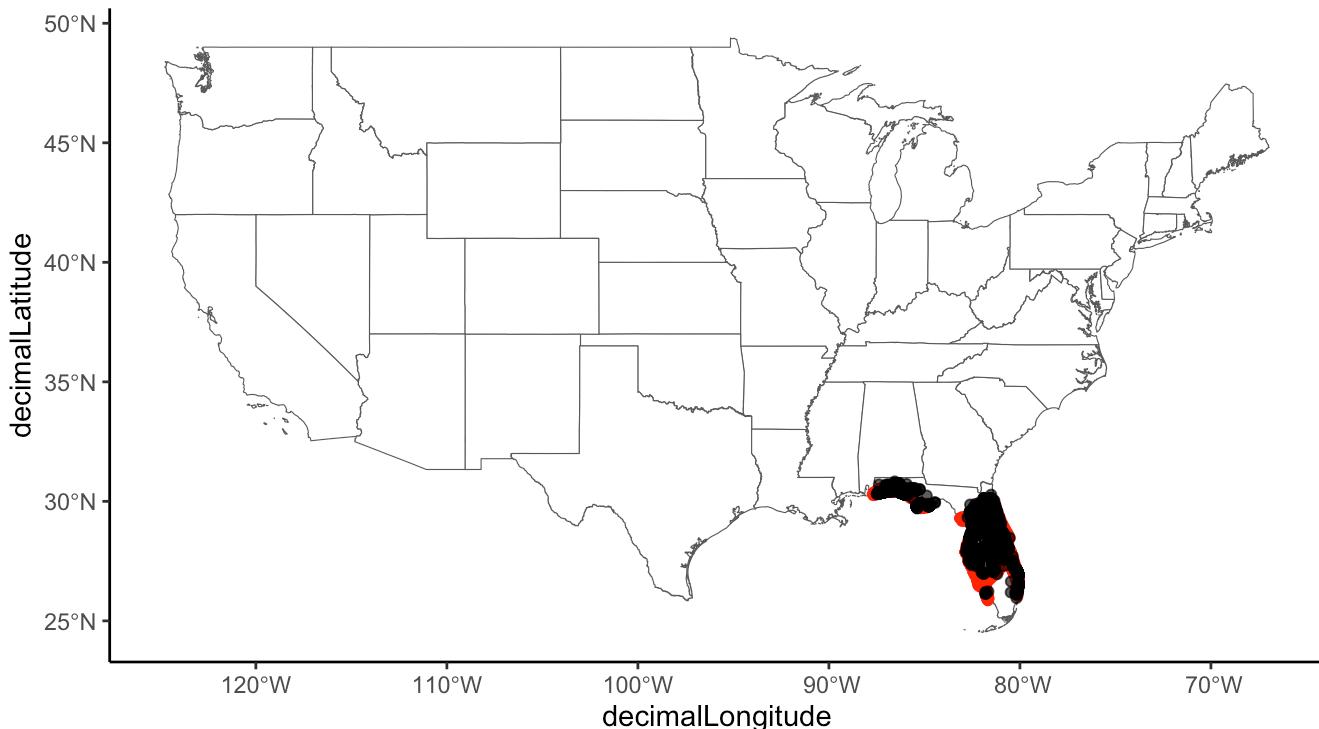
```
## Testing natural ranges
```

```
## Warning in cc_iucn(x = PICL.occ, range = PICL_clipped, lon =
## "decimalLongitude", : reprojecting reference to '+proj=longlat +datum=WGS84
## +no_defs'
```

```
## Flagged 54 records.
```

```
PICL_occ_final = PICL.occ[PICL_flag, ]
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = PICL_clipped, col = "red", linewidth = 2)+
  geom_point(data = PICL_occ_final, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
ggsave("../Plots/PICL.range.pdf", width = 12, height = 8)
```

Subset for *Pinus echinata*

```
PIEC2.occ = gbif %>%
  filter(species == "Pinus echinata") %>%
  select(species,decimalLatitude,decimalLongitude)
```

Read in range map

```
PIEC2.range = st_read("../USTreeAtlas/shp/pinuechi/")
```

```
## Reading layer `pinuechi' from data source
##   `/Users/samanthaworthy/Documents/GitHub/USTreeAtlas/shp/pinuechi'
##   using driver `ESRI Shapefile'
## Simple feature collection with 68 features and 5 fields
## Geometry type: POLYGON
## Dimension:      XY
## Bounding box:  xmin: -96.62461 ymin: 29.79749 xmax: -73.2604 ymax: 41.11497
## CRS:           NA
```

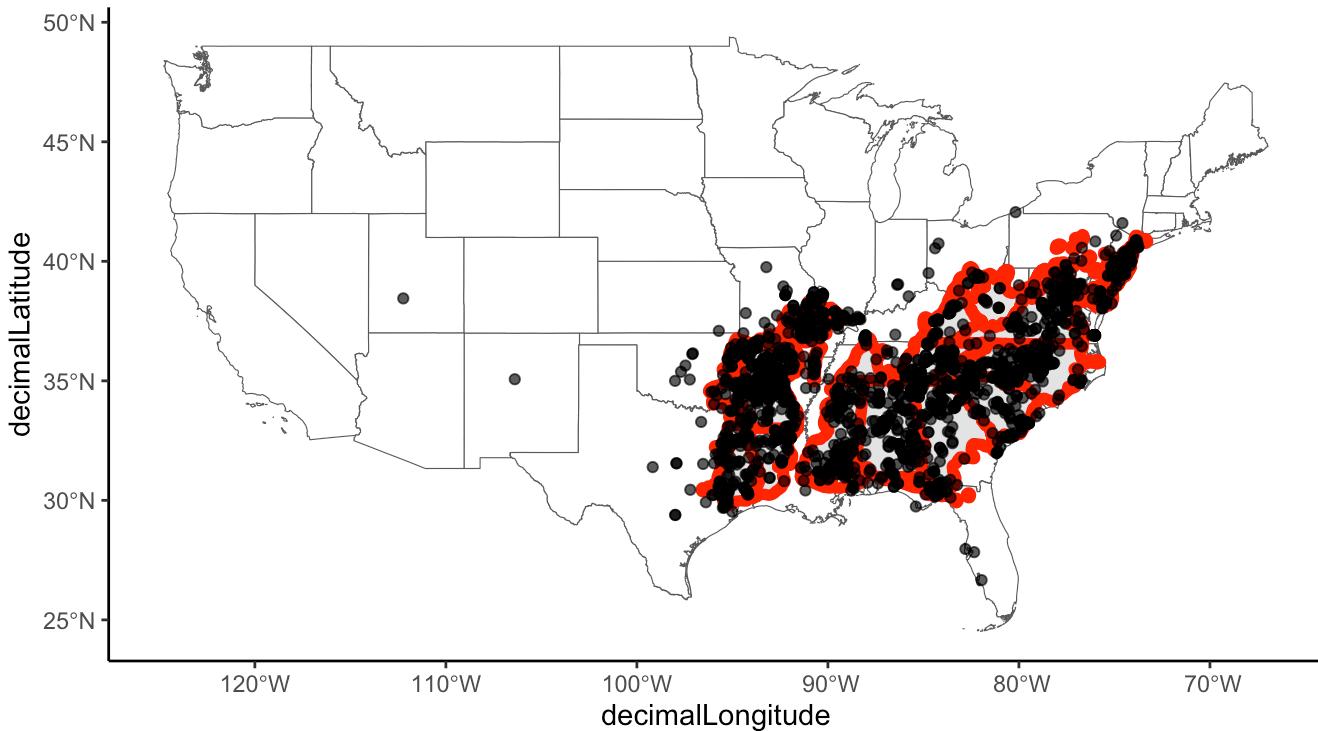
The projection is geographic with latitude and longitude. The datum is NAD27 which is EPSG:4267. The ellipsoid is Clarke 1866, and the transformation parameters

```
st_crs(PIEC2.range) <- 4267
```

```
PIEC2_clipped = st_intersection(PIEC2.range, states.map)
```

```
## Warning: attribute variables are assumed to be spatially constant throughout
## all geometries
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = PIEC2_clipped, col = "red", linewidth = 2)+
  geom_point(data = PIEC2.occ, aes(x = decimalLongitude, y = decimalLatitude), color =
"black", alpha = 0.7)+
  theme_classic()
```



```
PIEC2_clipped$species = "Pinus echinata"
PIEC2_flag = cc_iucn(x = PIEC2.occ, range = PIEC2_clipped, lon = "decimalLongitude", lat = "decimalLatitude",
                      value = "flagged", buffer = 50000)
```

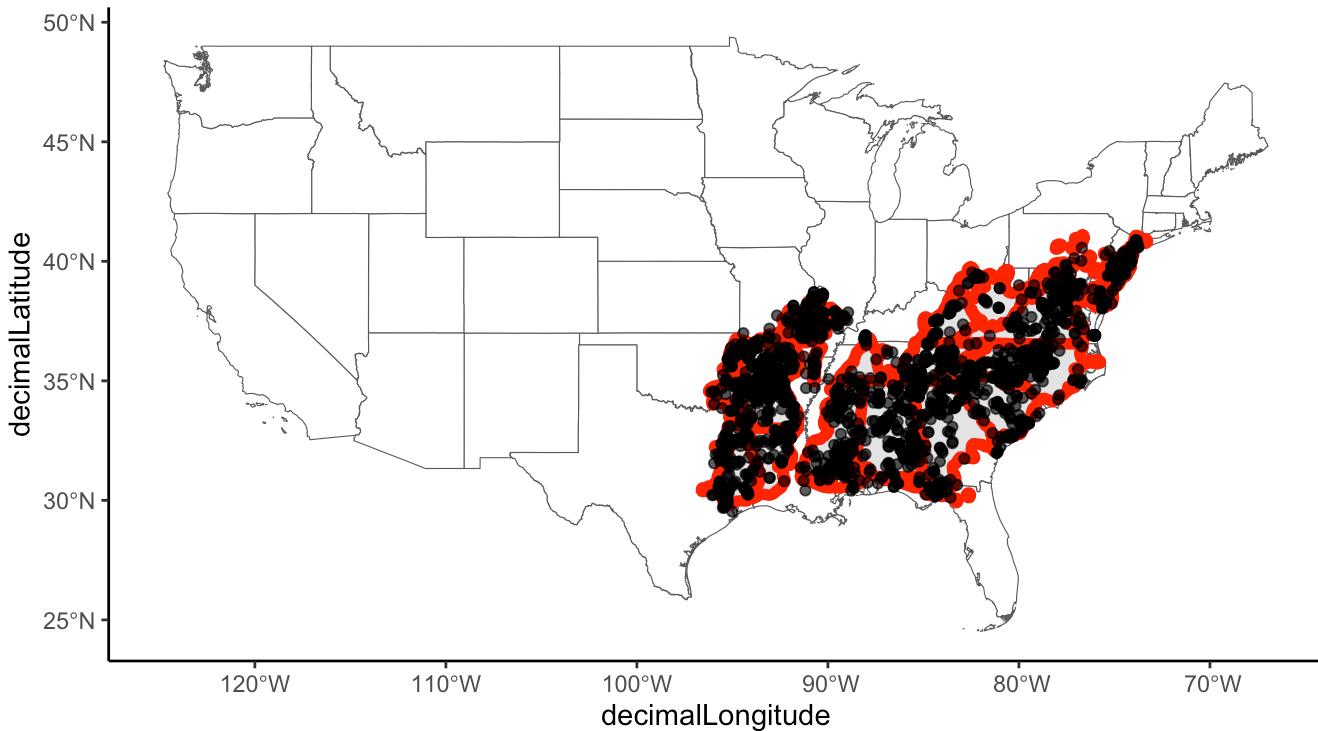
```
## Testing natural ranges
```

```
## Warning in cc_iucn(x = PIEC2.occ, range = PIEC2_clipped, lon =
## "decimalLongitude", : reprojecting reference to '+proj=longlat +datum=WGS84
## +no_defs'
```

```
## Flagged 48 records.
```

```
PIEC2_occ_final = PIEC2.occ[PIEC2_flag, ]
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = PIEC2_clipped, col = "red", linewidth = 2)+
  geom_point(data = PIEC2_occ_final, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
ggsave("../Plots/PIEC2.range.pdf", width = 12, height = 8)
```

Subset for *Pinus elliottii*

```
PIEL.occ = gbif %>%
  filter(species == "Pinus elliottii") %>%
  select(species,decimalLatitude,decimalLongitude)
```

Read in range map

```
PIEL.range = st_read("../USTreeAtlas/shp/pinuelli/")
```

```
## Reading layer `pinuelli' from data source
##   `/Users/samanthaworthy/Documents/GitHub/USTreeAtlas/shp/pinuelli'
##   using driver `ESRI Shapefile'
## Simple feature collection with 129 features and 5 fields
## Geometry type: POLYGON
## Dimension:     XY
## Bounding box:  xmin: -90.77222 ymin: 24.58278 xmax: -79.60842 ymax: 33.28711
## CRS:           NA
```

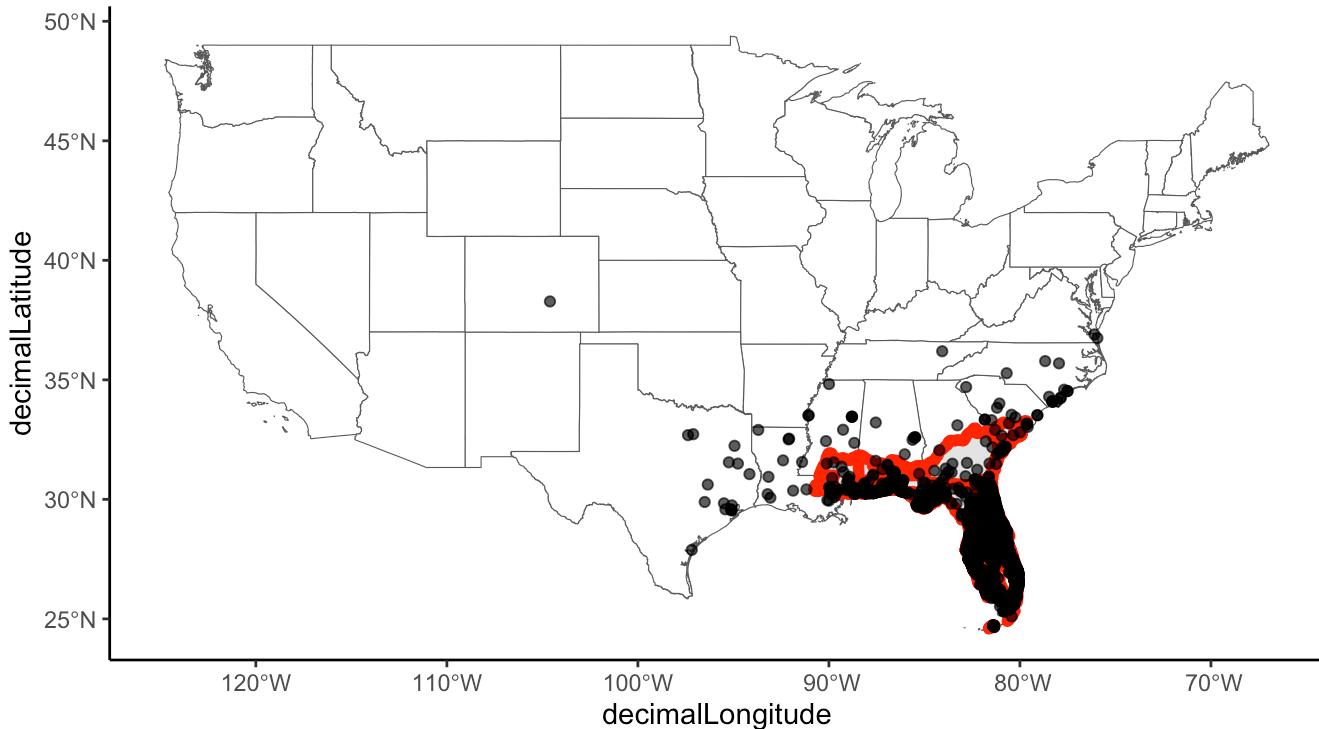
The projection is geographic with latitude and longitude. The datum is NAD27 which is EPSG:4267. The ellipsoid is Clarke 1866, and the transformation parameters

```
st_crs(PIEL.range) <- 4267
```

```
PIEL_clipped = st_intersection(PIEL.range, states.map)
```

```
## Warning: attribute variables are assumed to be spatially constant throughout
## all geometries
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = PIEL_clipped, col = "red", linewidth = 2)+
  geom_point(data = PIEL.occ, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
PIEL_clipped$species = "Pinus elliottii"
PIEL_flag = cc_iucn(x = PIEL.occ, range = PIEL_clipped, lon = "decimalLongitude", lat =
"decimalLatitude",
                     value = "flagged", buffer = 50000)
```

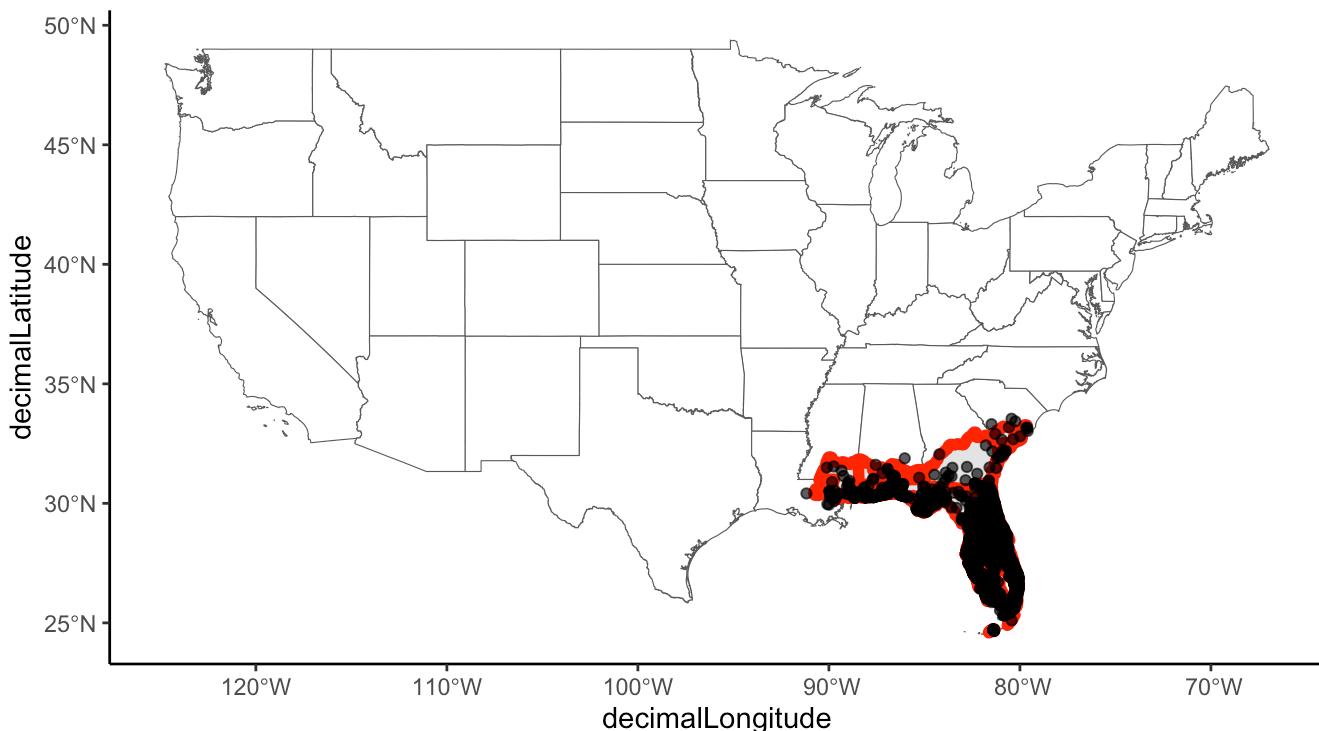
```
## Testing natural ranges
```

```
## Warning in cc_iucn(x = PIEL.occ, range = PIEL_clipped, lon =
## "decimalLongitude", : reprojecting reference to '+proj=longlat +datum=WGS84
## +no_defs'
```

```
## Flagged 64 records.
```

```
PIEL_occ_final = PIEL.occ[PIEL_flag, ]
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = PIEL_clipped, col = "red", linewidth = 2)+
  geom_point(data = PIEL_occ_final, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
ggsave("../Plots/PIEL.range.pdf", width = 12, height = 8)
```

Subset for *Pinus glabra*

```
PIGL2.occ = gbif %>%
  filter(species == "Pinus glabra") %>%
  select(species,decimalLatitude,decimalLongitude)
```

Read in range map

```
PIGL2.range = st_read("../USTreeAtlas/shp/pinuglab/")
```

```
## Reading layer `pinuglab' from data source
##   `/Users/samanthaworthy/Documents/GitHub/USTreeAtlas/shp/pinuglab'
##   using driver `ESRI Shapefile'
## Simple feature collection with 9 features and 5 fields
## Geometry type: POLYGON
## Dimension:      XY
## Bounding box:  xmin: -91.29132 ymin: 29.58212 xmax: -79.20943 ymax: 34.05908
## CRS:           NA
```

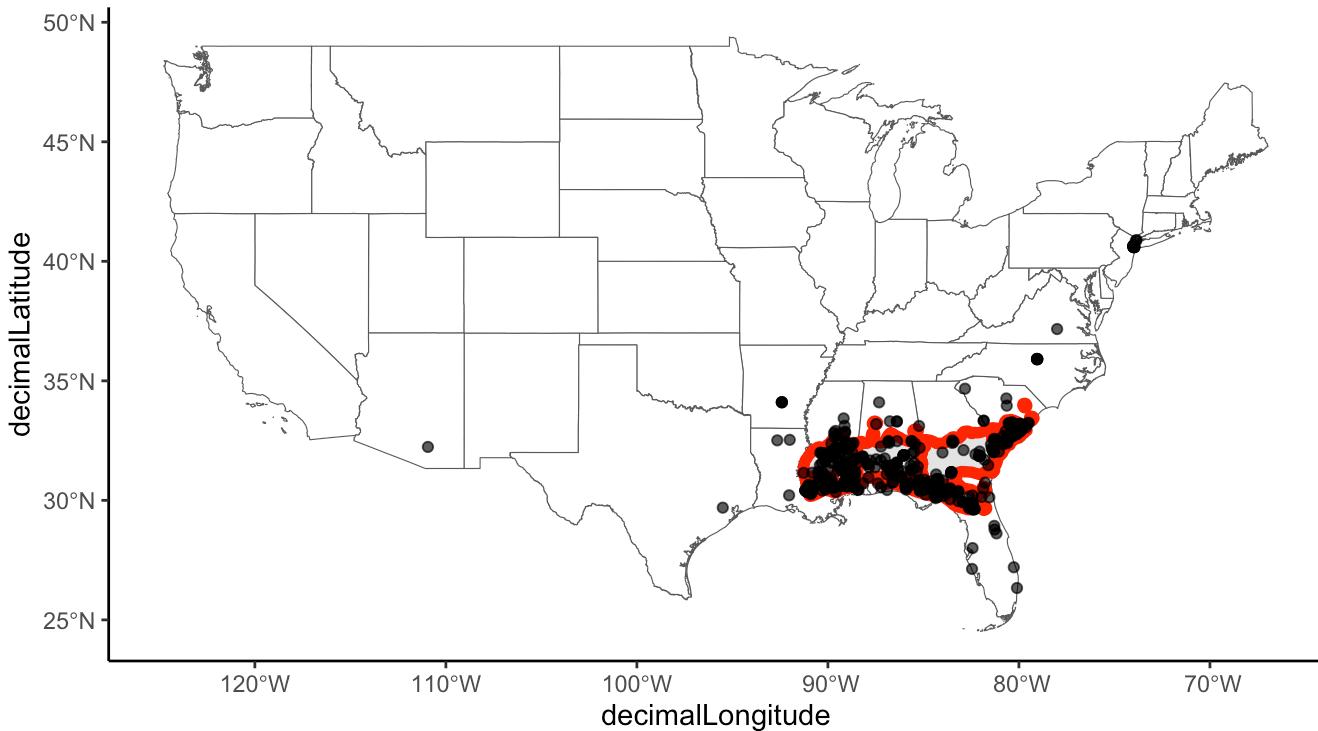
The projection is geographic with latitude and longitude. The datum is NAD27 which is EPSG:4267. The ellipsoid is Clarke 1866, and the transformation parameters

```
st_crs(PIGL2.range) <- 4267
```

```
PIGL2_clipped = st_intersection(PIGL2.range, states.map)
```

```
## Warning: attribute variables are assumed to be spatially constant throughout
## all geometries
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = PIGL2_clipped, col = "red", linewidth = 2)+
  geom_point(data = PIGL2.occ, aes(x = decimalLongitude, y = decimalLatitude), color =
"black", alpha = 0.7)+
  theme_classic()
```



```
PIGL2_clipped$species = "Pinus glabra"
PIGL2_flag = cc_iucn(x = PIGL2.occ, range = PIGL2_clipped, lon = "decimalLongitude", lat = "decimalLatitude",
                      value = "flagged", buffer = 50000)
```

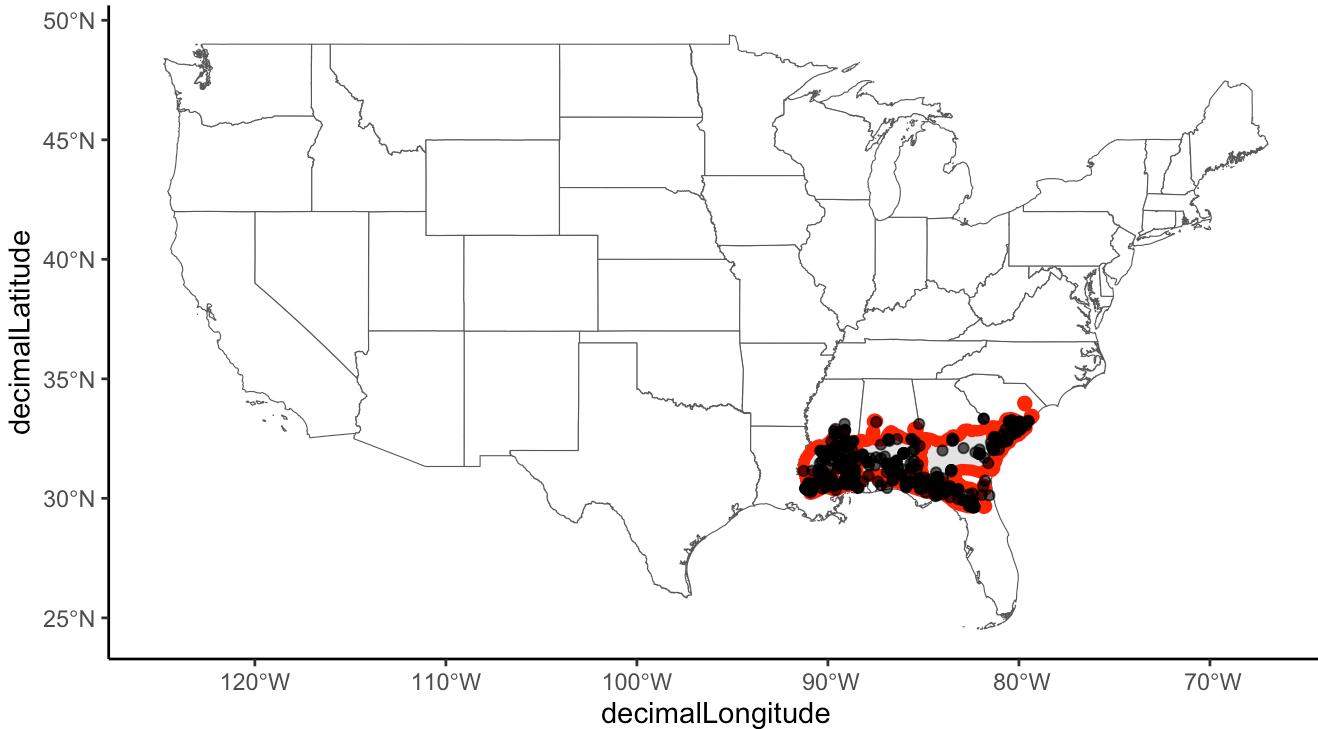
```
## Testing natural ranges
```

```
## Warning in cc_iucn(x = PIGL2.occ, range = PIGL2_clipped, lon =
## "decimalLongitude", : reprojecting reference to '+proj=longlat +datum=WGS84
## +no_defs'
```

```
## Flagged 54 records.
```

```
PIGL2_occ_final = PIGL2.occ[PIGL2_flag, ]
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = PIGL2_clipped, col = "red", linewidth = 2)+
  geom_point(data = PIGL2_occ_final, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
ggsave("../Plots/PIGL2.range.pdf", width = 12, height = 8)
```

Subset for *Pinus palustris*

```
PIPA2.occ = gbif %>%
  filter(species == "Pinus palustris") %>%
  select(species,decimalLatitude,decimalLongitude)
```

Read in range map

```
PIPA2.range = st_read("../USTreeAtlas/shp/pinupalu/")
```

```
## Reading layer `pinupalu' from data source
##   `/Users/samanthaworthy/Documents/GitHub/USTreeAtlas/shp/pinupalu'
##   using driver `ESRI Shapefile'
## Simple feature collection with 38 features and 5 fields
## Geometry type: POLYGON
## Dimension:     XY
## Bounding box:  xmin: -95.21806 ymin: 26.61921 xmax: -75.79999 ymax: 36.84856
## CRS:           NA
```

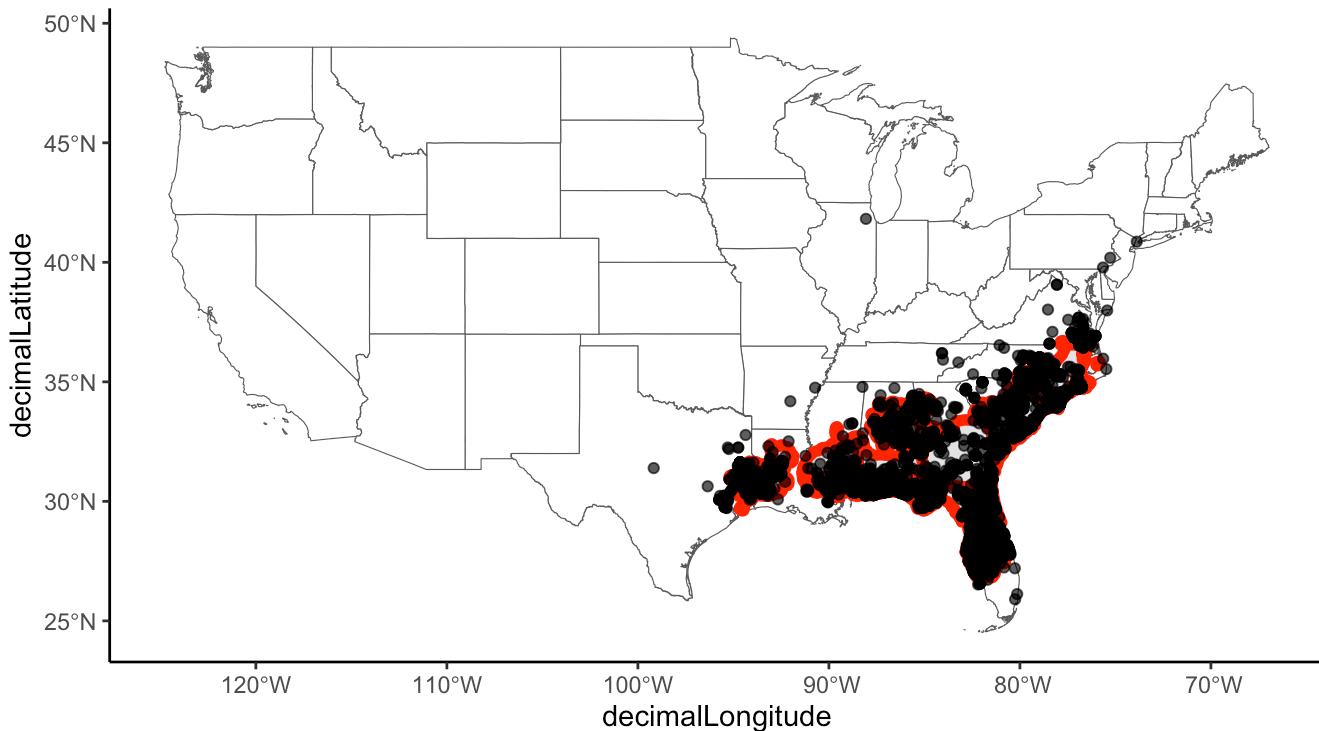
The projection is geographic with latitude and longitude. The datum is NAD27 which is EPSG:4267. The ellipsoid is Clarke 1866, and the transformation parameters

```
st_crs(PIPA2.range) <- 4267
```

```
PIPA2_clipped = st_intersection(PIPA2.range, states.map)
```

```
## Warning: attribute variables are assumed to be spatially constant throughout
## all geometries
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = PIPA2_clipped, col = "red", linewidth = 2)+
  geom_point(data = PIPA2.occ, aes(x = decimalLongitude, y = decimalLatitude), color =
"black", alpha = 0.7)+
  theme_classic()
```



```
PIPA2_clipped$species = "Pinus palustris"
PIPA2_flag = cc_iucn(x = PIPA2.occ, range = PIPA2_clipped, lon = "decimalLongitude", lat =
"decimalLatitude",
                      value = "flagged", buffer = 50000)
```

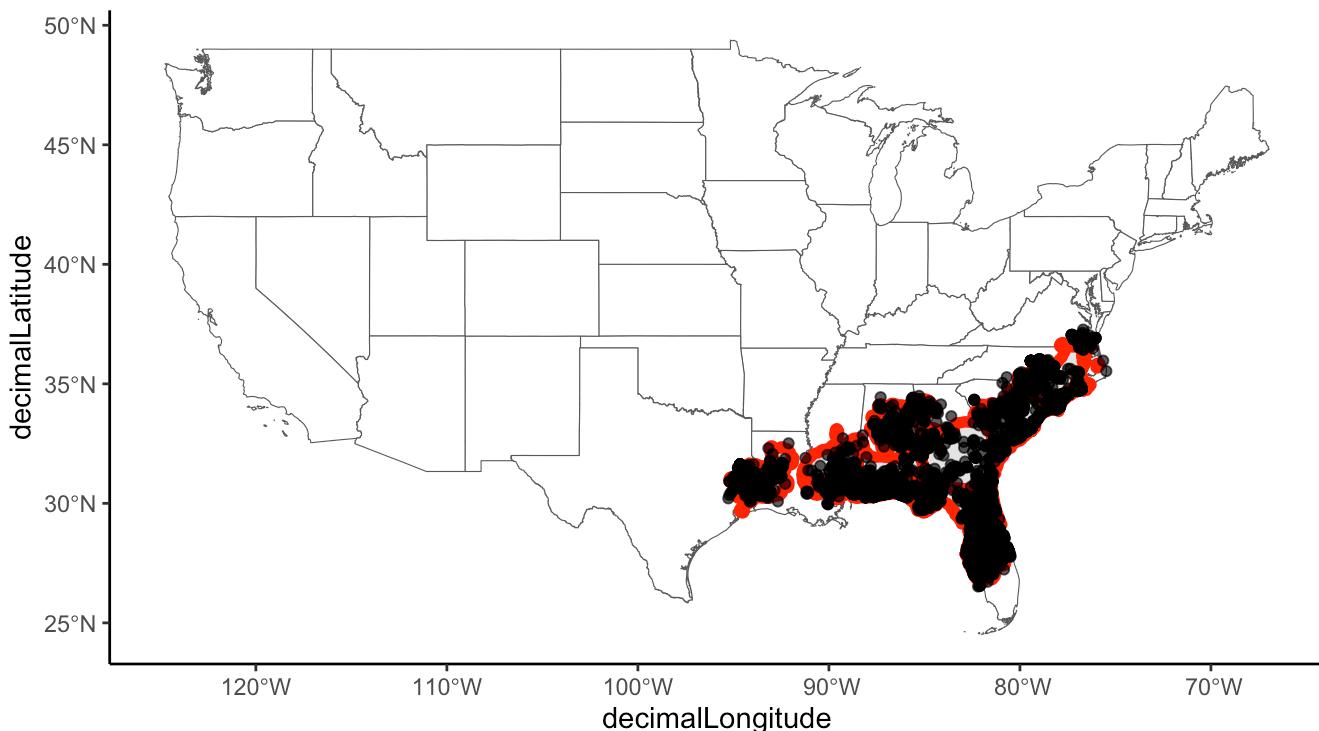
```
## Testing natural ranges
```

```
## Warning in cc_iucn(x = PIPA2.occ, range = PIPA2_clipped, lon =
## "decimalLongitude", : reprojecting reference to '+proj=longlat +datum=WGS84
## +no_defs'
```

```
## Flagged 127 records.
```

```
PIPA2_occ_final = PIPA2.occ[PIPA2_flag, ]
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = PIPA2_clipped, col = "red", linewidth = 2)+
  geom_point(data = PIPA2_occ_final, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
ggsave("../Plots/PIPA2.range.pdf", width = 12, height = 8)
```

Subset for *Pinus pungens*

```
PIPUS.occ = gbif %>%
  filter(species == "Pinus pungens") %>%
  select(species,decimalLatitude,decimalLongitude)
```

Read in range map

```
PIPUS.range = st_read("../USTreeAtlas/shp/pinupung")  
  
## Reading layer `pinupung' from data source  
##   `/Users/samanthaworthy/Documents/GitHub/USTreeAtlas/shp/pinupung'  
##   using driver `ESRI Shapefile'  
## Simple feature collection with 26 features and 5 fields  
## Geometry type: POLYGON  
## Dimension:      XY  
## Bounding box:  xmin: -84.29883 ymin: 34.56113 xmax: -74.77565 ymax: 41.06224  
## CRS:           NA
```

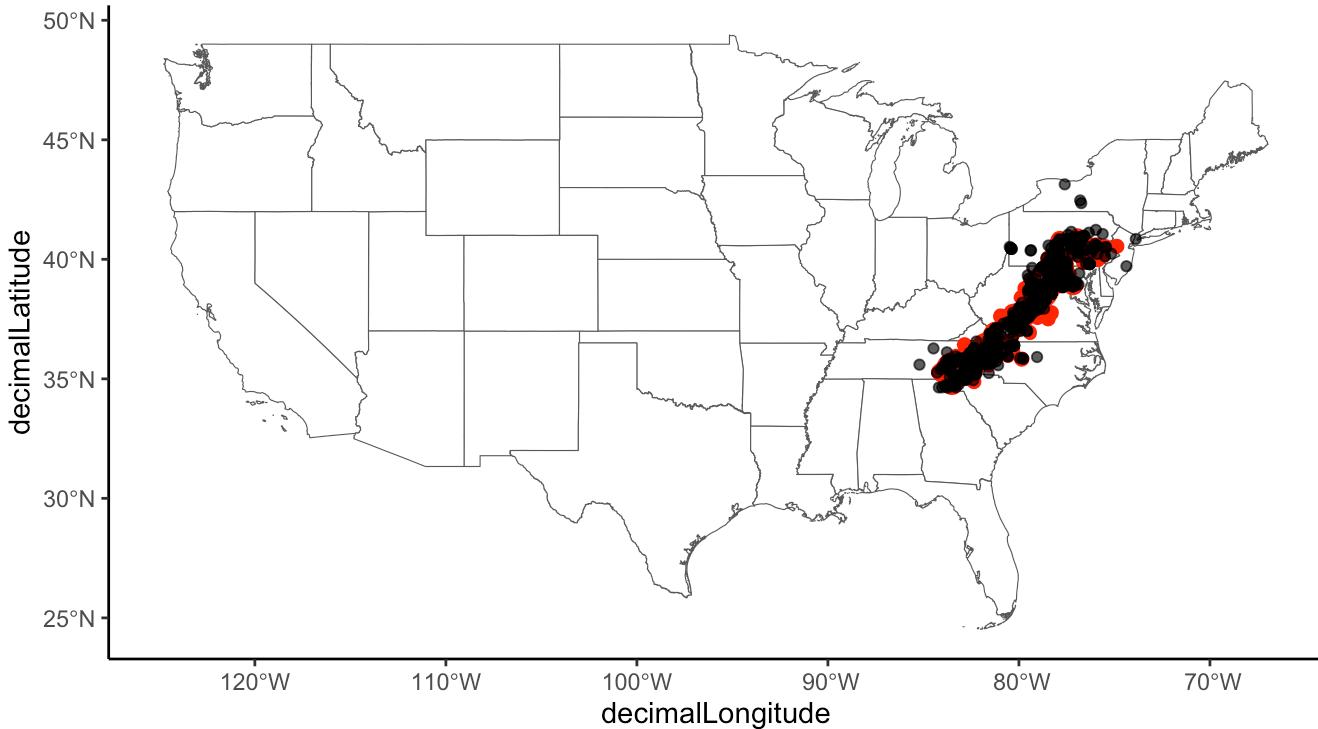
The projection is geographic with latitude and longitude. The datum is NAD27 which is EPSG:4267. The ellipsoid is Clarke 1866, and the transformation parameters

```
st_crs(PIPUS.range) <- 4267
```

```
PIPUS_clipped = st_intersection(PIPUS.range, states.map)
```

```
## Warning: attribute variables are assumed to be spatially constant throughout  
## all geometries
```

```
ggplot() +  
  geom_sf(data = states.map, fill = "white") +  
  geom_sf(data = PIPUS_clipped, col = "red", linewidth = 2) +  
  geom_point(data = PIPUS.occ, aes(x = decimalLongitude, y = decimalLatitude), color =  
  "black", alpha = 0.7) +  
  theme_classic()
```



```
PIPUS_clipped$species = "Pinus pungens"
PIPUS_flag = cc_iucn(x = PIPUS.occ, range = PIPUS_clipped, lon = "decimalLongitude", lat = "decimalLatitude",
value = "flagged", buffer = 50000)
```

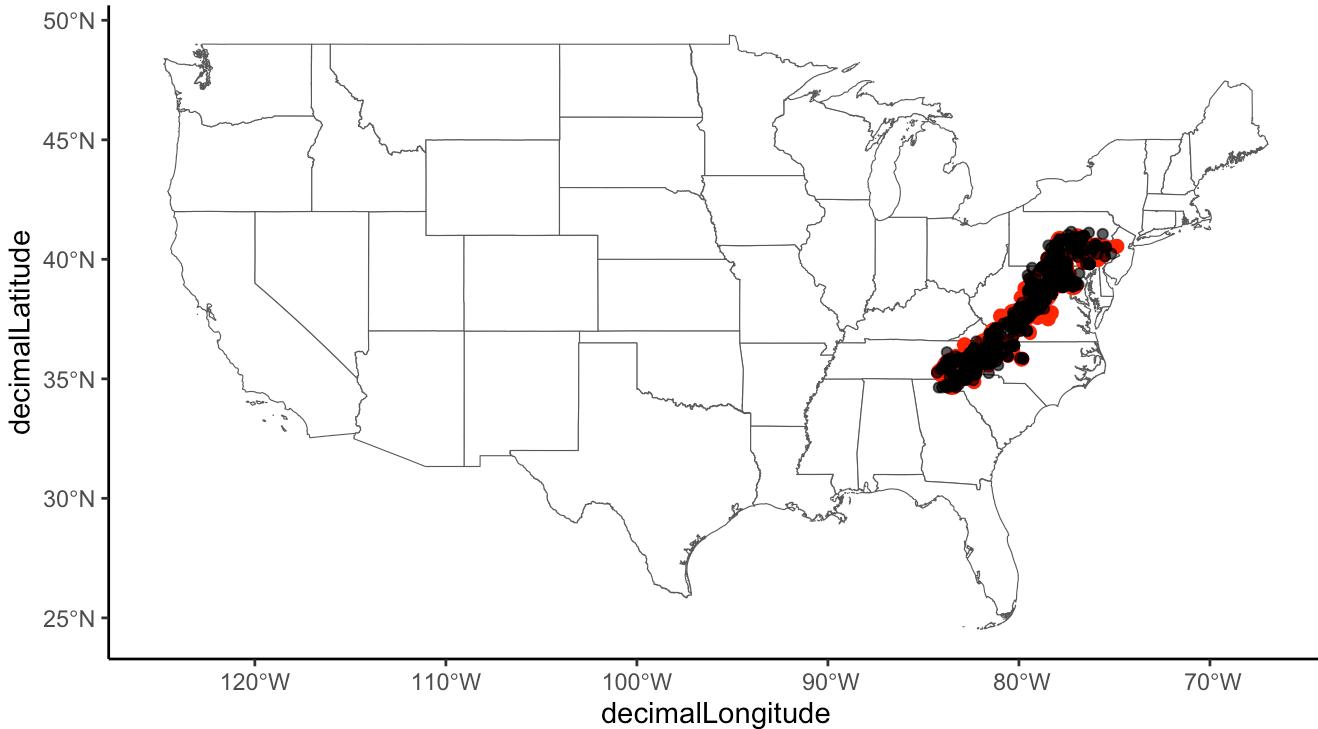
```
## Testing natural ranges
```

```
## Warning in cc_iucn(x = PIPUS.occ, range = PIPUS_clipped, lon =
## "decimalLongitude", : reprojecting reference to '+proj=longlat +datum=WGS84
## +no_defs'
```

```
## Flagged 18 records.
```

```
PIPUS_occ_final = PIPUS.occ[PIPUS_flag, ]
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = PIPUS_clipped, col = "red", linewidth = 2)+
  geom_point(data = PIPUS_occ_final, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
ggsave("../Plots/PIPUS.range.pdf", width = 12, height = 8)
```

Subset for *Pinus resinosa*

```
PIRE.occ = gbif %>%
  filter(species == "Pinus resinosa") %>%
  select(species,decimalLatitude,decimalLongitude)
```

Read in range map

```
PIRE.range = st_read("../USTreeAtlas/shp/pinuresi/")
```

```
## Reading layer `pinuresi' from data source
##   `/Users/samanthaworthy/Documents/GitHub/USTreeAtlas/shp/pinuresi'
##   using driver `ESRI Shapefile'
## Simple feature collection with 485 features and 5 fields
## Geometry type: POLYGON
## Dimension:     XY
## Bounding box:  xmin: -96.63834 ymin: 38.64299 xmax: -54.26736 ymax: 51.25153
## CRS:           NA
```

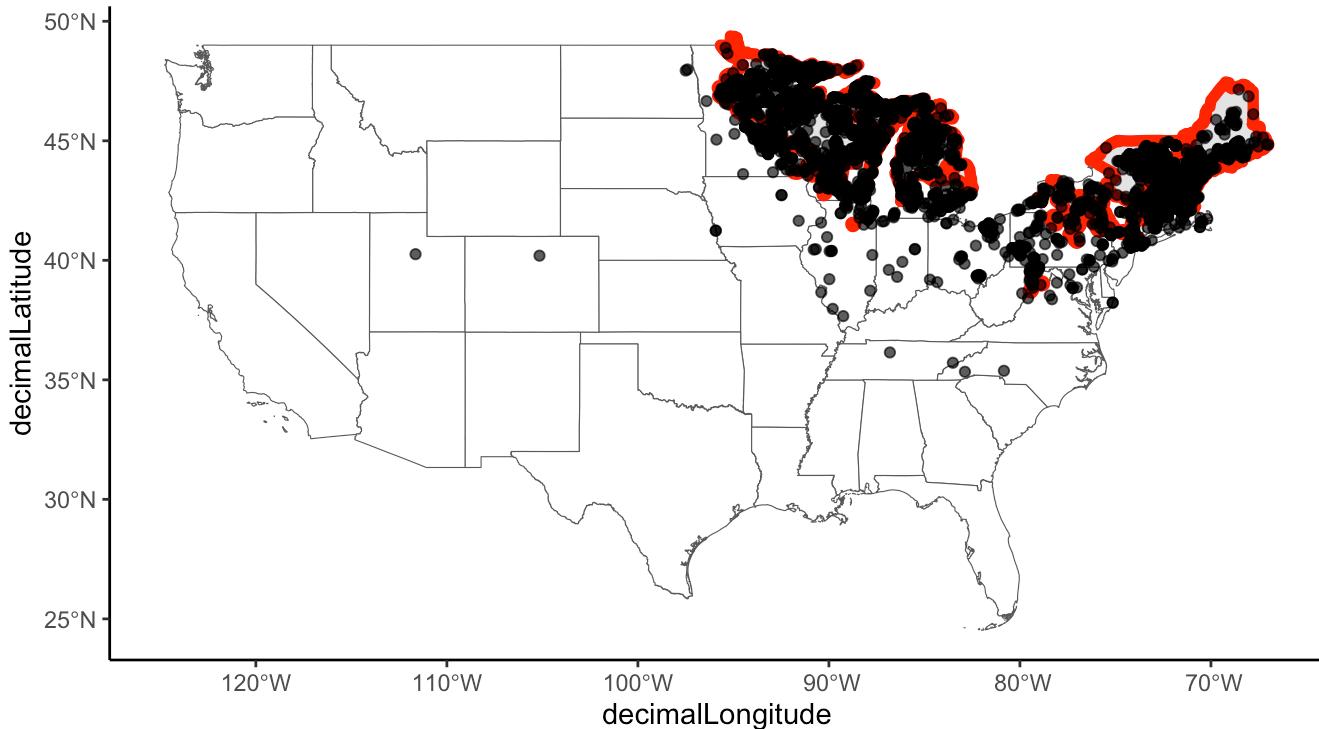
The projection is geographic with latitude and longitude. The datum is NAD27 which is EPSG:4267. The ellipsoid is Clarke 1866, and the transformation parameters

```
st_crs(PIRE.range) <- 4267
```

```
PIRE_clipped = st_intersection(PIRE.range, states.map)
```

```
## Warning: attribute variables are assumed to be spatially constant throughout
## all geometries
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = PIRE_clipped, col = "red", linewidth = 2)+
  geom_point(data = PIRE.occ, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
PIRE_clipped$species = "Pinus resinosa"
PIRE_flag = cc_iucn(x = PIRE.occ, range = PIRE_clipped, lon = "decimalLongitude", lat =
"decimalLatitude",
                     value = "flagged", buffer = 50000)
```

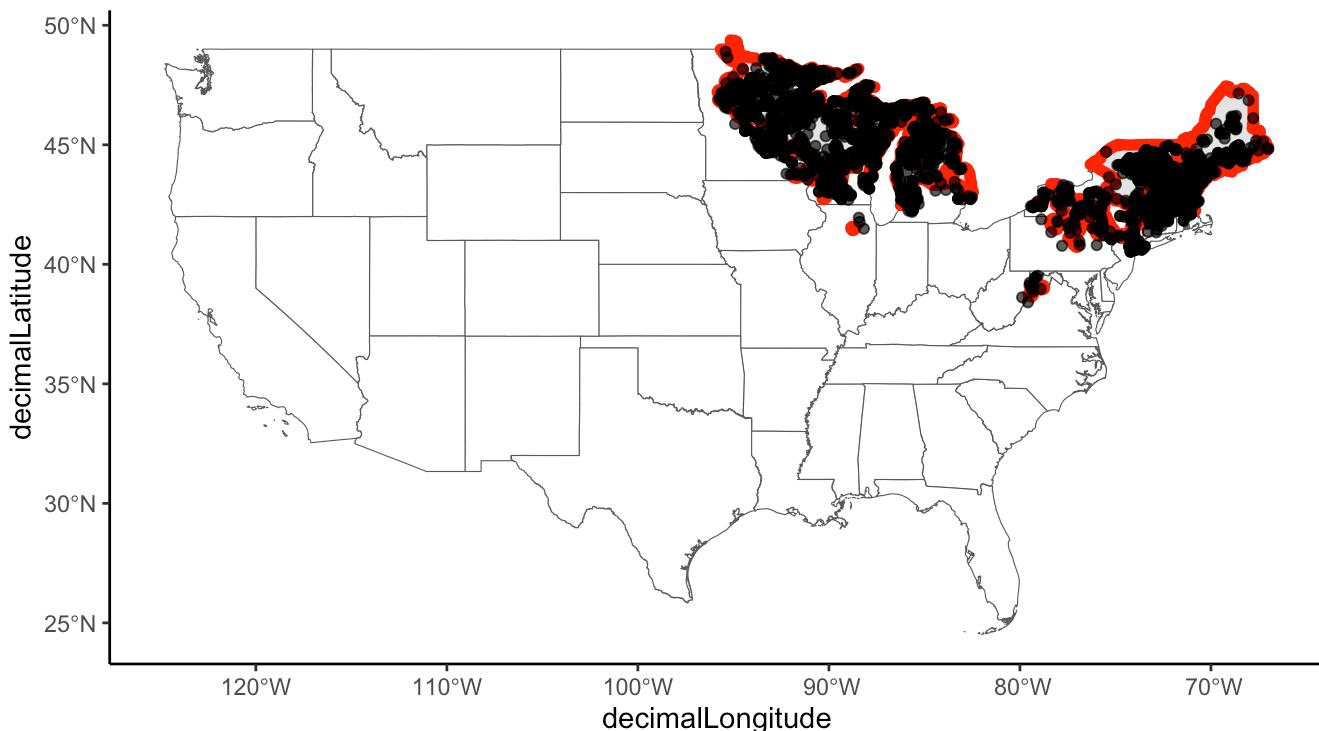
```
## Testing natural ranges
```

```
## Warning in cc_iucn(x = PIRE.occ, range = PIRE_clipped, lon =
## "decimalLongitude", : reprojecting reference to '+proj=longlat +datum=WGS84
## +no_defs'
```

```
## Flagged 425 records.
```

```
PIRE_occ_final = PIRE.occ[PIRE_flag, ]
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = PIRE_clipped, col = "red", linewidth = 2)+
  geom_point(data = PIRE_occ_final, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
ggsave("../Plots/PIRE.range.pdf", width = 12, height = 8)
```

Subset for *Pinus rigida*

```
PIRI.occ = gbif %>%
  filter(species == "Pinus rigida") %>%
  select(species,decimalLatitude,decimalLongitude)
```

Read in range map

```
PIRI.range = st_read("../USTreeAtlas/shp/pinurigi/")
```

```
## Reading layer `pinurigi' from data source
##   `/Users/samanthaworthy/Documents/GitHub/USTreeAtlas/shp/pinurigi'
##   using driver `ESRI Shapefile'
## Simple feature collection with 154 features and 5 fields
## Geometry type: POLYGON
## Dimension:      XY
## Bounding box:  xmin: -88.39619 ymin: 33.68433 xmax: -68.12421 ymax: 45.25713
## CRS:           NA
```

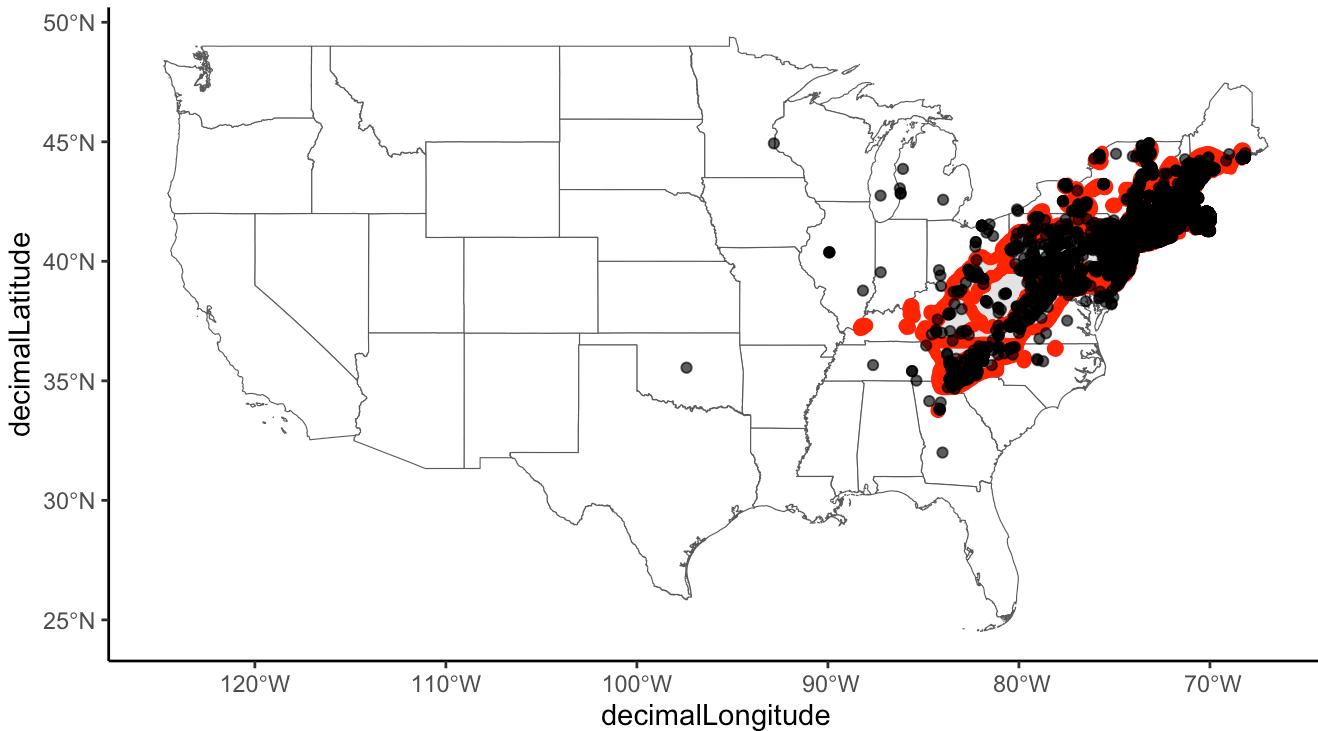
The projection is geographic with latitude and longitude. The datum is NAD27 which is EPSG:4267. The ellipsoid is Clarke 1866, and the transformation parameters

```
st_crs(PIRI.range) <- 4267
```

```
PIRI_clipped = st_intersection(PIRI.range, states.map)
```

```
## Warning: attribute variables are assumed to be spatially constant throughout
## all geometries
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = PIRI_clipped, col = "red", linewidth = 2)+
  geom_point(data = PIRI.occ, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
PIRI_clipped$species = "Pinus rigida"
PIRI_flag = cc_iucn(x = PIRI.occ, range = PIRI_clipped, lon = "decimalLongitude", lat =
"decimalLatitude",
value = "flagged", buffer = 50000)
```

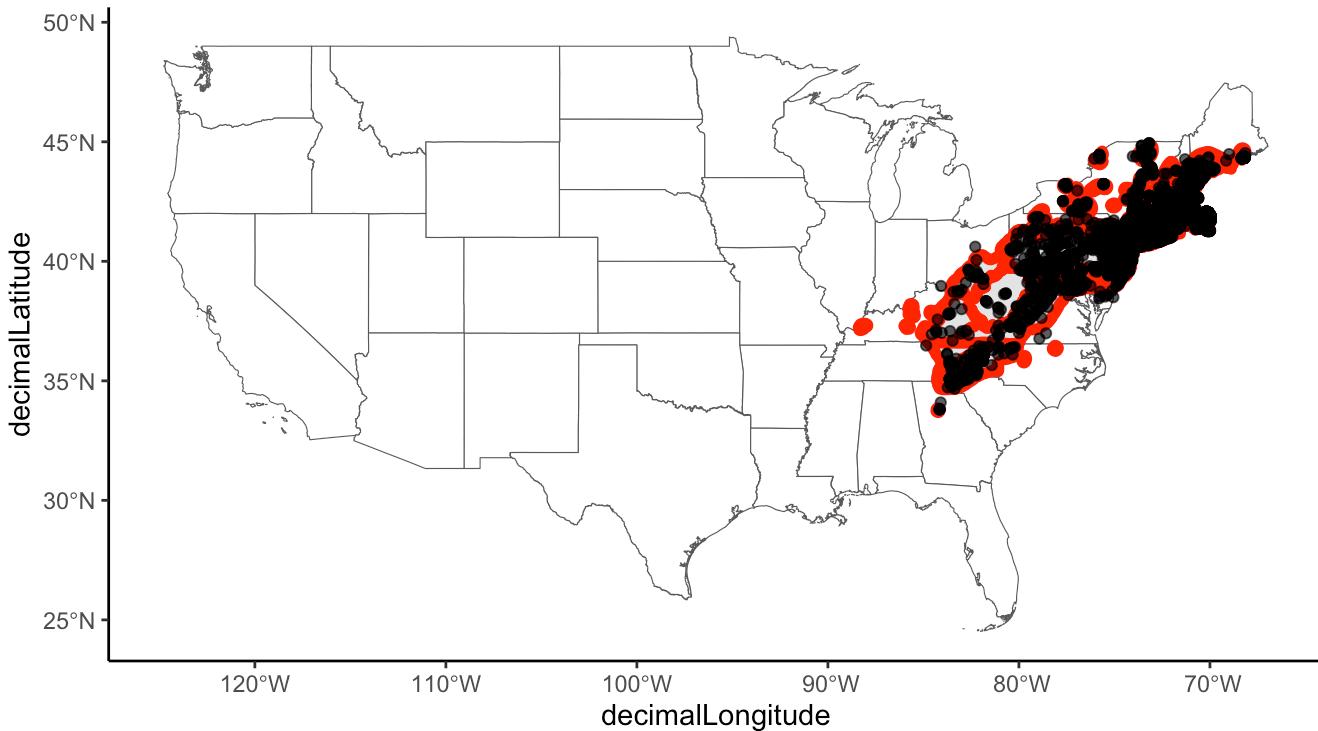
```
## Testing natural ranges
```

```
## Warning in cc_iucn(x = PIRI.occ, range = PIRI_clipped, lon =
## "decimalLongitude", : reprojecting reference to '+proj=longlat +datum=WGS84
## +no_defs'
```

```
## Flagged 45 records.
```

```
PIRI_occ_final = PIRI.occ[PIRI_flag, ]
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = PIRI_clipped, col = "red", linewidth = 2)+
  geom_point(data = PIRI_occ_final, aes(x = decimalLongitude, y = decimalLatitude), colo
r = "black", alpha = 0.7)+
  theme_classic()
```



```
ggsave("../Plots/PIRI.range.pdf", width = 12, height = 8)
```

Subset for *Pinus serotina*

```
PISE.occ = gbif %>%
  filter(species == "Pinus serotina") %>%
  select(species,decimalLatitude,decimalLongitude)
```

Read in range map

```
PISE.range = st_read("../USTreeAtlas/shp/pinusero/")
```

```
## Reading layer `pinusero' from data source
##   `/Users/samanthaworthy/Documents/GitHub/USTreeAtlas/shp/pinusero'
##   using driver `ESRI Shapefile'
## Simple feature collection with 40 features and 5 fields
## Geometry type: POLYGON
## Dimension:     XY
## Bounding box:  xmin: -87.52861 ymin: 28.02775 xmax: -74.69576 ymax: 39.87193
## CRS:           NA
```

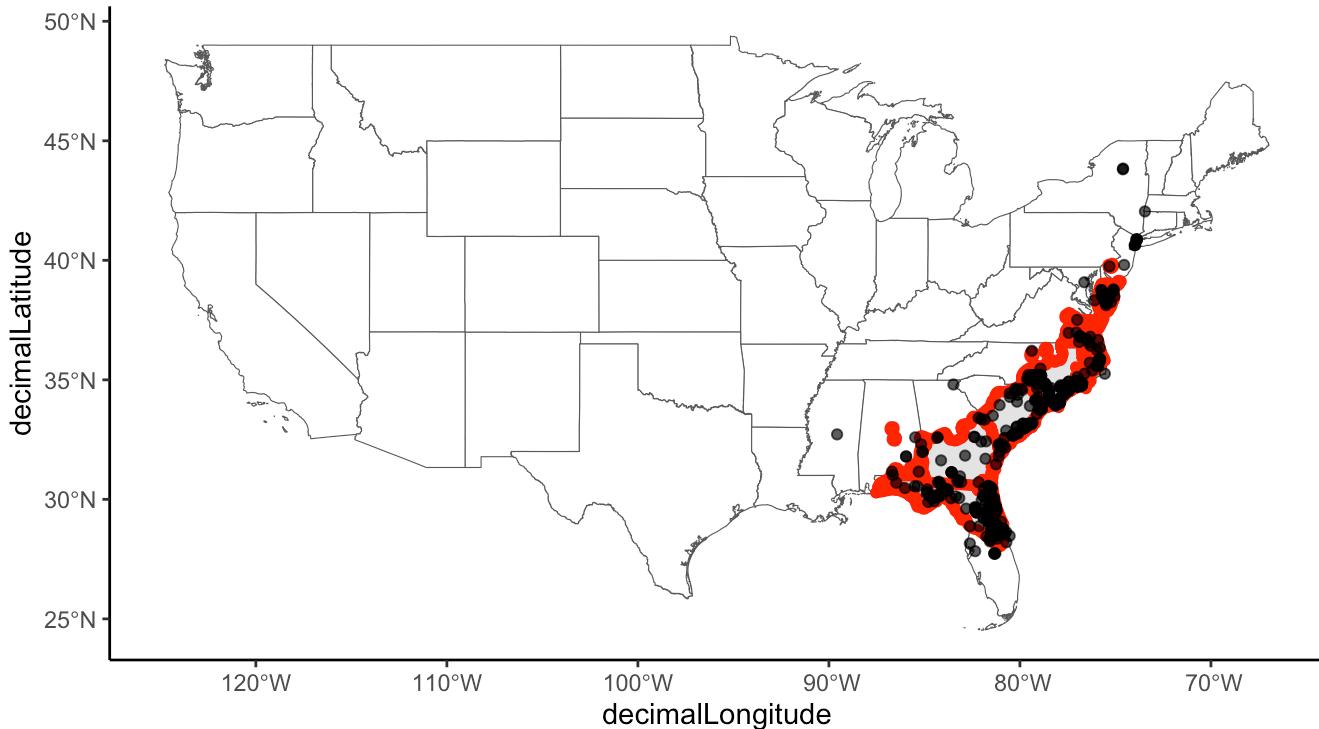
The projection is geographic with latitude and longitude. The datum is NAD27 which is EPSG:4267. The ellipsoid is Clarke 1866, and the transformation parameters

```
st_crs(PISE.range) <- 4267
```

```
PISE_clipped = st_intersection(PISE.range, states.map)
```

```
## Warning: attribute variables are assumed to be spatially constant throughout
## all geometries
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = PISE_clipped, col = "red", linewidth = 2)+
  geom_point(data = PISE.occ, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
PISE_clipped$species = "Pinus serotina"
PISE_flag = cc_iucn(x = PISE.occ, range = PISE_clipped, lon = "decimalLongitude", lat =
"decimalLatitude",
                     value = "flagged", buffer = 50000)
```

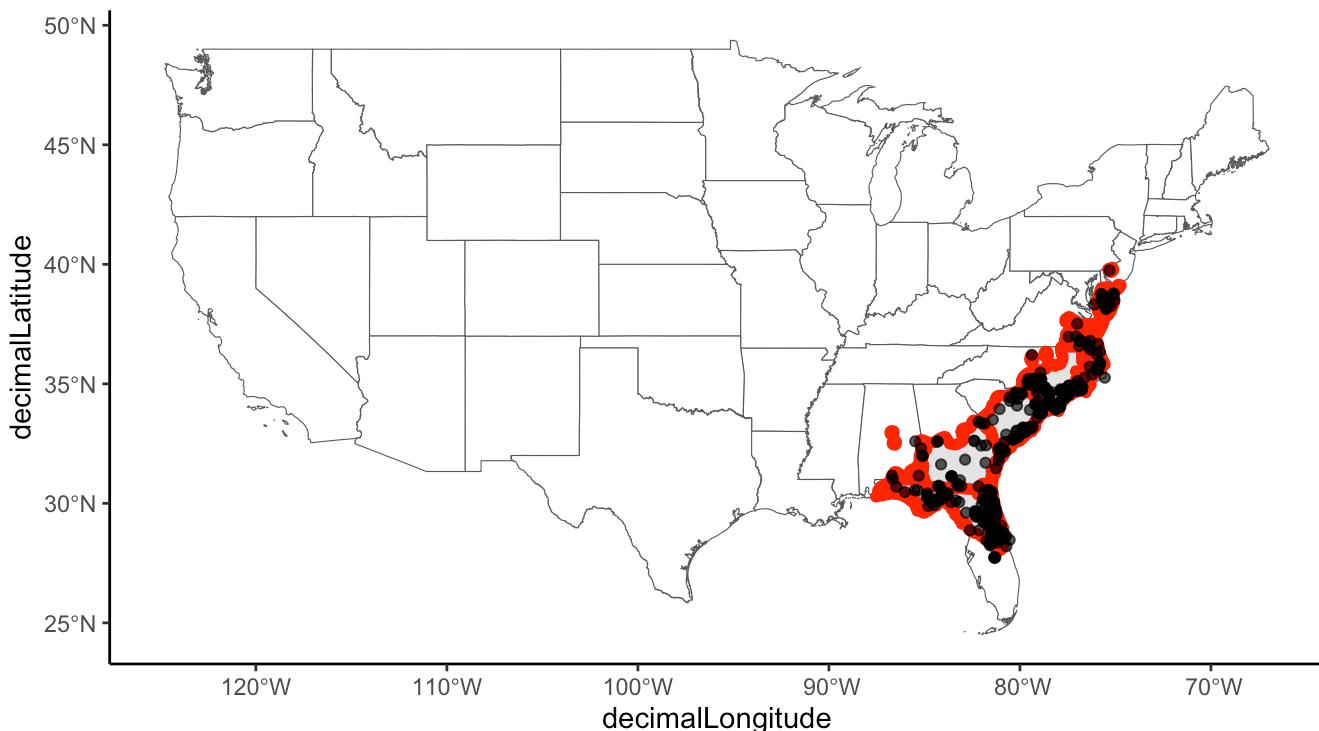
```
## Testing natural ranges
```

```
## Warning in cc_iucn(x = PISE.occ, range = PISE_clipped, lon =
## "decimalLongitude", : reprojecting reference to '+proj=longlat +datum=WGS84
## +no_defs'
```

```
## Flagged 18 records.
```

```
PISE_occ_final = PISE.occ[PISE_flag, ]
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = PISE_clipped, col = "red", linewidth = 2)+
  geom_point(data = PISE_occ_final, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
ggsave("../Plots/PISE.range.pdf", width = 12, height = 8)
```

Subset for *Pinus strobus*

```
PIST.occ = gbif %>%
  filter(species == "Pinus strobus") %>%
  select(species,decimalLatitude,decimalLongitude)
```

Read in range map

```
PIST.range = st_read("../USTreeAtlas/shp/pinustrb/")
```

```
## Reading layer `pinustrb' from data source
##   `/Users/samanthaworthy/Documents/GitHub/USTreeAtlas/shp/pinustrb'
##   using driver `ESRI Shapefile'
## Simple feature collection with 264 features and 5 fields
## Geometry type: POLYGON
## Dimension:      XY
## Bounding box:  xmin: -95.83807 ymin: 34.27946 xmax: -52.61445 ymax: 51.11618
## CRS:           NA
```

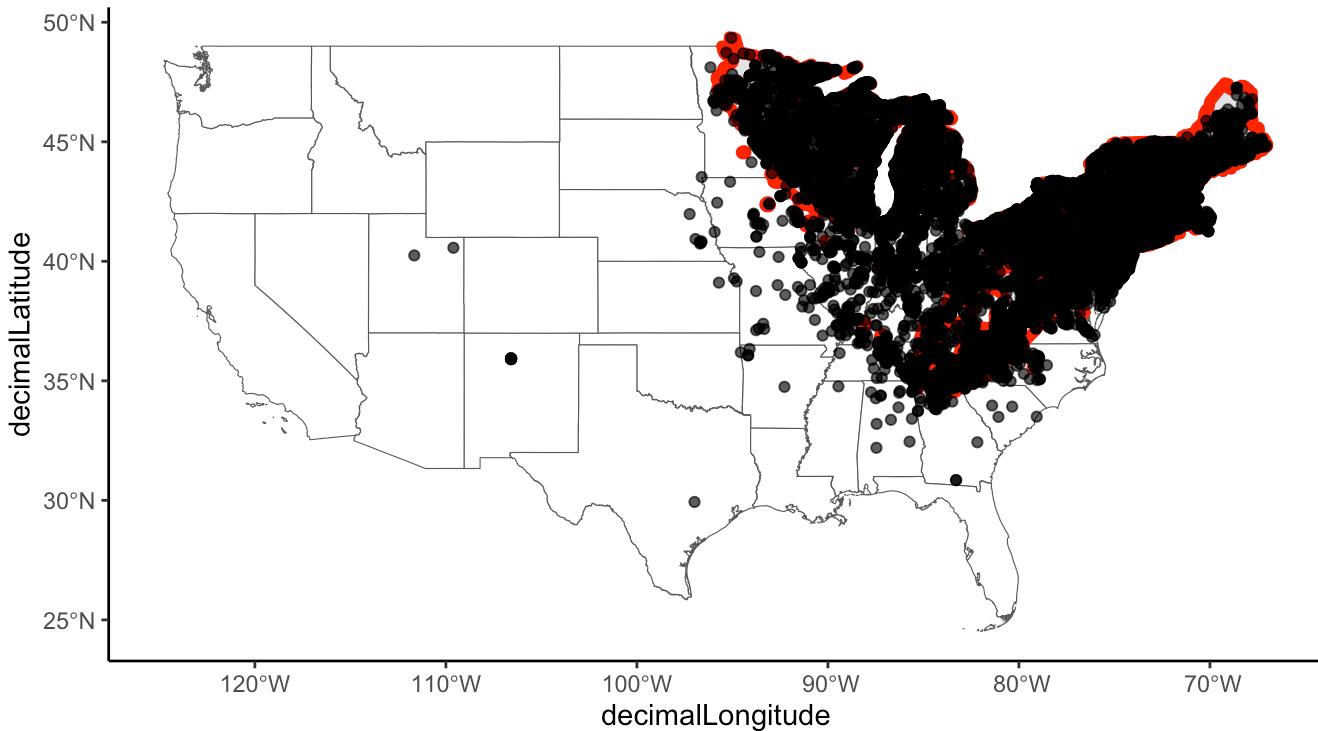
The projection is geographic with latitude and longitude. The datum is NAD27 which is EPSG:4267. The ellipsoid is Clarke 1866, and the transformation parameters

```
st_crs(PIST.range) <- 4267
```

```
PIST_clipped = st_intersection(PIST.range, states.map)
```

```
## Warning: attribute variables are assumed to be spatially constant throughout
## all geometries
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = PIST_clipped, col = "red", linewidth = 2)+
  geom_point(data = PIST.occ, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
PIST_clipped$species = "Pinus strobus"
PIST_flag = cc_iucn(x = PIST.occ, range = PIST_clipped, lon = "decimalLongitude", lat =
"decimalLatitude",
value = "flagged", buffer = 50000)
```

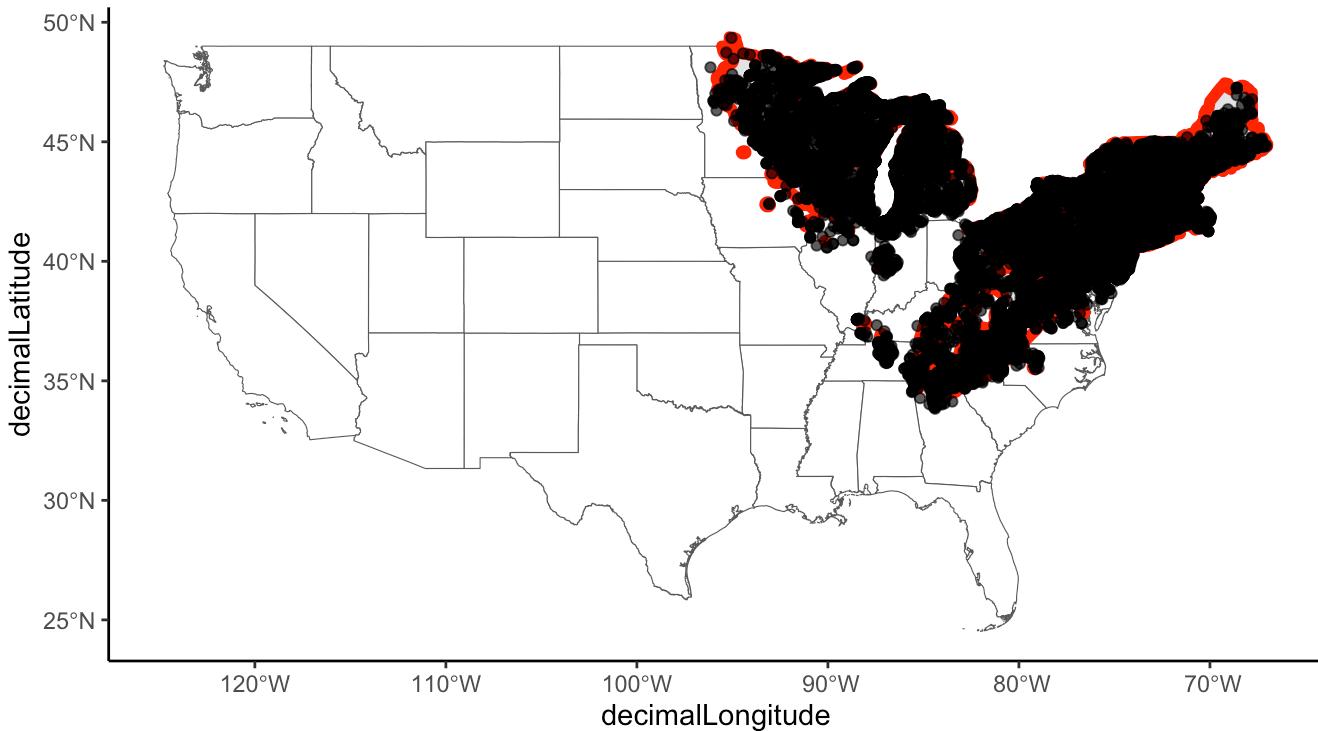
```
## Testing natural ranges
```

```
## Warning in cc_iucn(x = PIST.occ, range = PIST_clipped, lon =
## "decimalLongitude", : reprojecting reference to '+proj=longlat +datum=WGS84
## +no_defs'
```

```
## Flagged 1083 records.
```

```
PIST_occ_final = PIST.occ[PIST_flag, ]
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = PIST_clipped, col = "red", linewidth = 2)+
  geom_point(data = PIST_occ_final, aes(x = decimalLongitude, y = decimalLatitude), colo
r = "black", alpha = 0.7)+
  theme_classic()
```



```
ggsave("../Plots/PIST.range.pdf", width = 12, height = 8)
```

Subset for *Pinus taeda*

```
PITA.occ = gbif %>%
  filter(species == "Pinus taeda") %>%
  select(species,decimalLatitude,decimalLongitude)
```

Read in range map

```
PITA.range = st_read("../USTreeAtlas/shp/pinutaed/")
```

```
## Reading layer `pinutaed' from data source
##   `/Users/samanthaworthy/Documents/GitHub/USTreeAtlas/shp/pinutaed'
##   using driver `ESRI Shapefile'
## Simple feature collection with 58 features and 5 fields
## Geometry type: POLYGON
## Dimension:     XY
## Bounding box:  xmin: -97.6138 ymin: 28.22558 xmax: -75.01347 ymax: 39.50686
## CRS:           NA
```

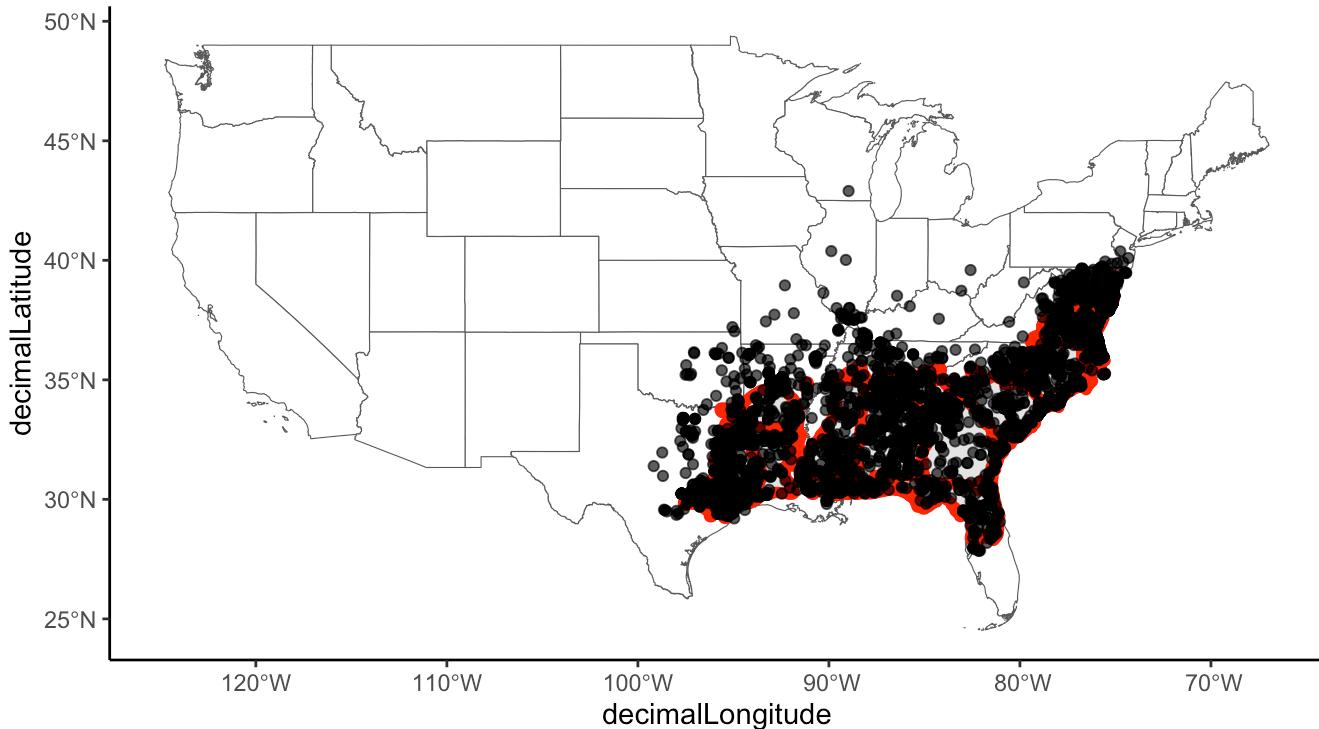
The projection is geographic with latitude and longitude. The datum is NAD27 which is EPSG:4267. The ellipsoid is Clarke 1866, and the transformation parameters

```
st_crs(PITA.range) <- 4267
```

```
PITA_clipped = st_intersection(PITA.range, states.map)
```

```
## Warning: attribute variables are assumed to be spatially constant throughout
## all geometries
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = PITA_clipped, col = "red", linewidth = 2)+
  geom_point(data = PITA.occ, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
PITA_clipped$species = "Pinus taeda"
PITA_flag = cc_iucn(x = PITA.occ, range = PITA_clipped, lon = "decimalLongitude", lat =
"decimalLatitude",
                     value = "flagged", buffer = 50000)
```

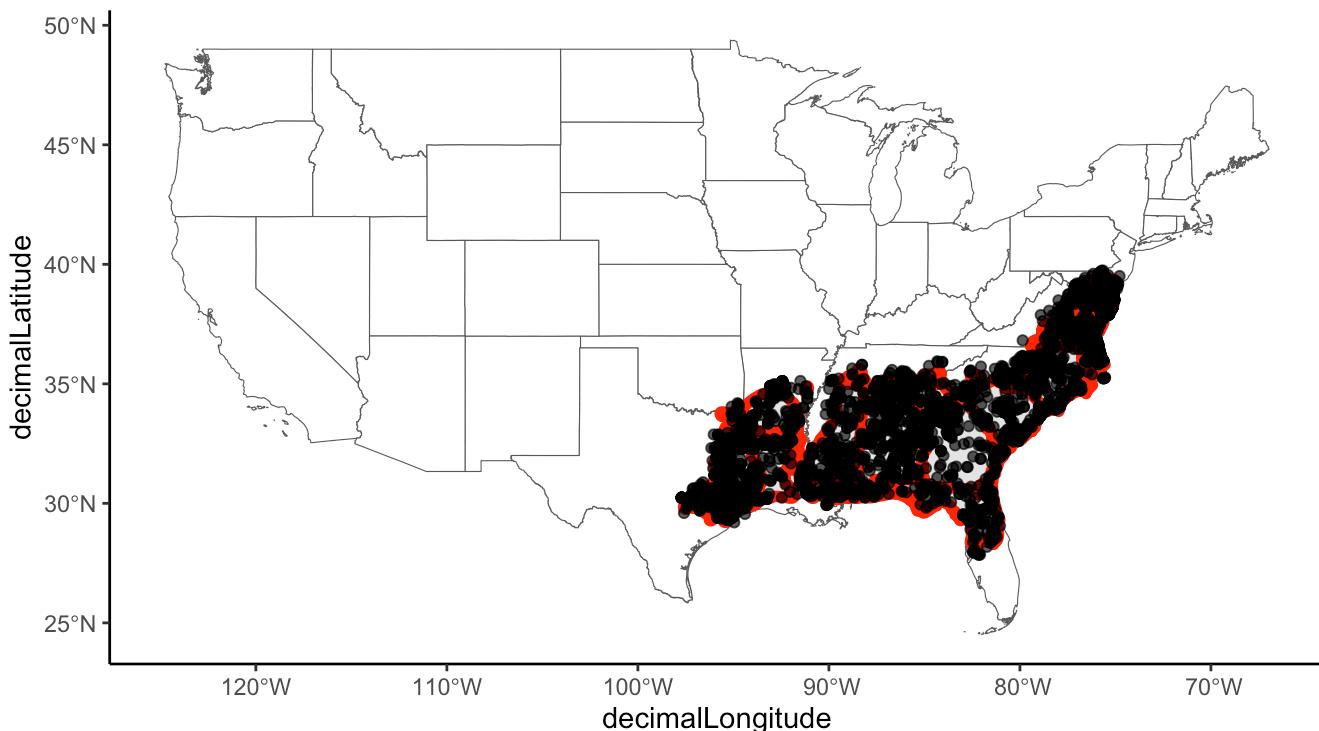
```
## Testing natural ranges
```

```
## Warning in cc_iucn(x = PITA.occ, range = PITA_clipped, lon =
## "decimalLongitude", : reprojecting reference to '+proj=longlat +datum=WGS84
## +no_defs'
```

```
## Flagged 359 records.
```

```
PITA_occ_final = PITA.occ[PITA_flag, ]
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = PITA_clipped, col = "red", linewidth = 2)+
  geom_point(data = PITA_occ_final, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
ggsave("../Plots/PITA.range.pdf", width = 12, height = 8)
```

Subset for *Pinus virginiana*

```
PIVI2.occ = gbif %>%
  filter(species == "Pinus virginiana") %>%
  select(species,decimalLatitude,decimalLongitude)
```

Read in range map

```
PIVI2.range = st_read("../USTreeAtlas/shp/pinuvirg")
```

```
## Reading layer `pinuvirg' from data source
##   `/Users/samanthaworthy/Documents/GitHub/USTreeAtlas/shp/pinuvirg'
##   using driver `ESRI Shapefile'
## Simple feature collection with 36 features and 5 fields
## Geometry type: POLYGON
## Dimension:      XY
## Bounding box:  xmin: -89.41452 ymin: 32.30019 xmax: -73.15847 ymax: 41.37672
## CRS:           NA
```

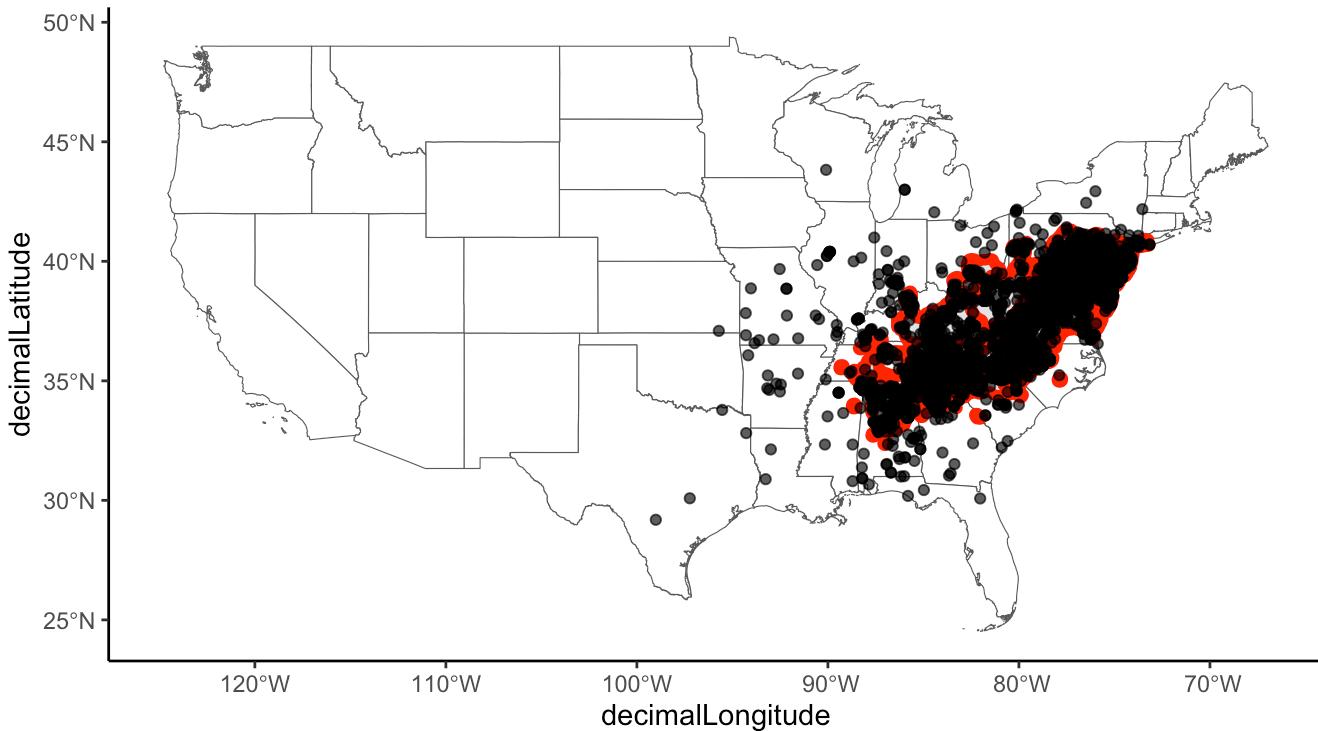
The projection is geographic with latitude and longitude. The datum is NAD27 which is EPSG:4267. The ellipsoid is Clarke 1866, and the transformation parameters

```
st_crs(PIVI2.range) <- 4267
```

```
PIVI2_clipped = st_intersection(PIVI2.range, states.map)
```

```
## Warning: attribute variables are assumed to be spatially constant throughout
## all geometries
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = PIVI2_clipped, col = "red", linewidth = 2)+
  geom_point(data = PIVI2.occ, aes(x = decimalLongitude, y = decimalLatitude), color =
"black", alpha = 0.7)+
  theme_classic()
```



```
PIVI2_clipped$species = "Pinus virginiana"
PIVI2_flag = cc_iucn(x = PIVI2.occ, range = PIVI2_clipped, lon = "decimalLongitude", lat = "decimalLatitude",
                      value = "flagged", buffer = 50000)
```

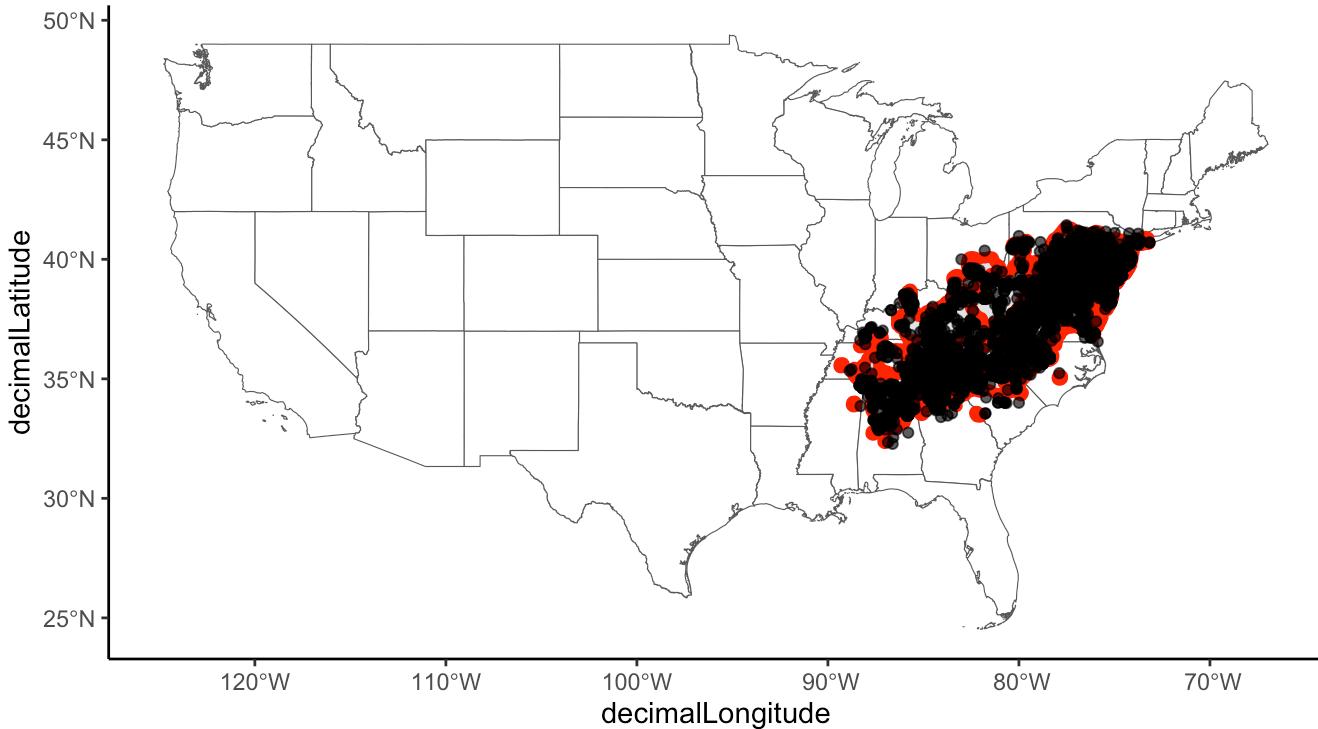
```
## Testing natural ranges
```

```
## Warning in cc_iucn(x = PIVI2.occ, range = PIVI2_clipped, lon =
## "decimalLongitude", : reprojecting reference to '+proj=longlat +datum=WGS84
## +no_defs'
```

```
## Flagged 141 records.
```

```
PIVI2_occ_final = PIVI2.occ[PIVI2_flag, ]
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = PIVI2_clipped, col = "red", linewidth = 2)+
  geom_point(data = PIVI2_occ_final, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
ggsave("../Plots/PIVI2.range.pdf", width = 12, height = 8)
```

Subset for *Planera aquatica*

```
PLAQ.occ = gbif %>%
  filter(species == "Planera aquatica") %>%
  select(species,decimalLatitude,decimalLongitude)
```

Read in range map

```
PLAQ.range = st_read("../USTreeAtlas/shp/planaqua/")
```

```
## Reading layer `planaqua' from data source
##   `/Users/samanthaworthy/Documents/GitHub/USTreeAtlas/shp/planaqua'
##   using driver `ESRI Shapefile'
## Simple feature collection with 17 features and 5 fields
## Geometry type: POLYGON
## Dimension:     XY
## Bounding box:  xmin: -96.84963 ymin: 29.49777 xmax: -78.27449 ymax: 37.5579
## CRS:           NA
```

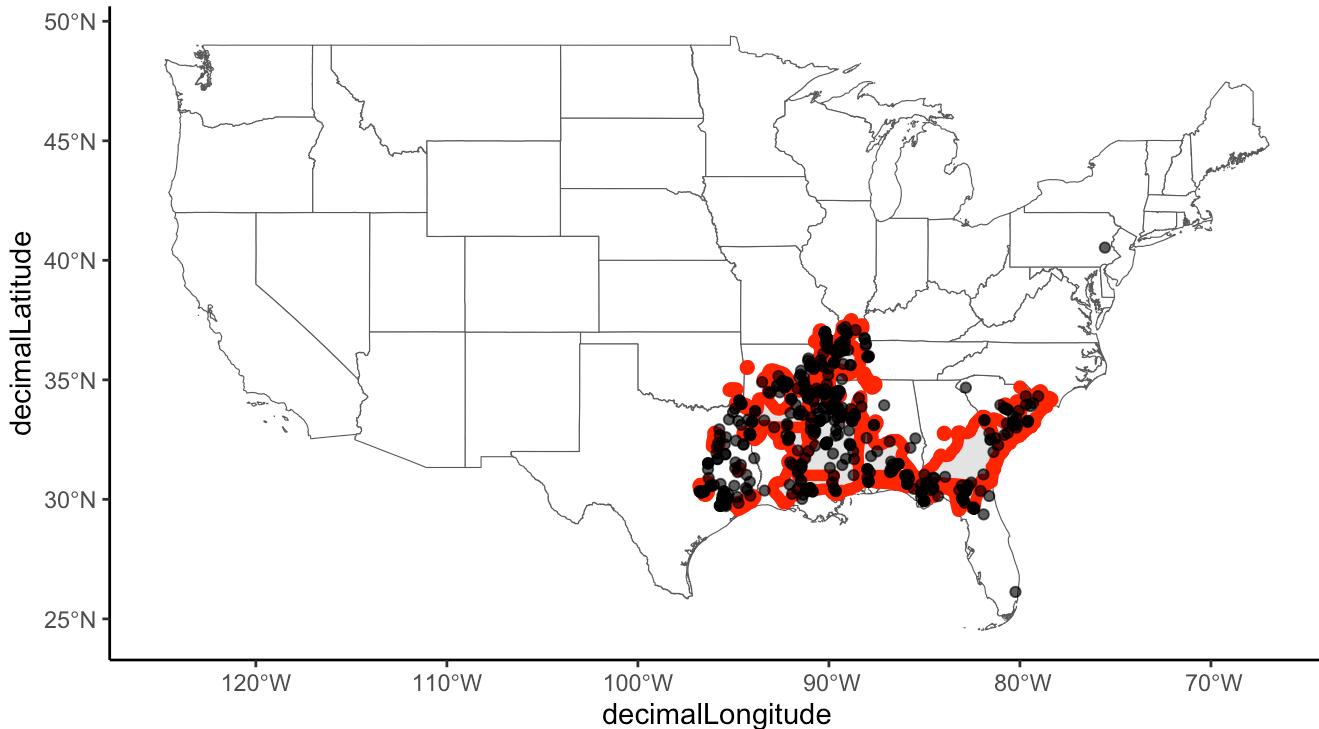
The projection is geographic with latitude and longitude. The datum is NAD27 which is EPSG:4267. The ellipsoid is Clarke 1866, and the transformation parameters

```
st_crs(PLAQ.range) <- 4267
```

```
PLAQ_clipped = st_intersection(PLAQ.range, states.map)
```

```
## Warning: attribute variables are assumed to be spatially constant throughout
## all geometries
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = PLAQ_clipped, col = "red", linewidth = 2)+
  geom_point(data = PLAQ.occ, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
PLAQ_clipped$species = "Planera aquatica"
PLAQ_flag = cc_iucn(x = PLAQ.occ, range = PLAQ_clipped, lon = "decimalLongitude", lat =
"decimalLatitude",
                     value = "flagged", buffer = 50000)
```

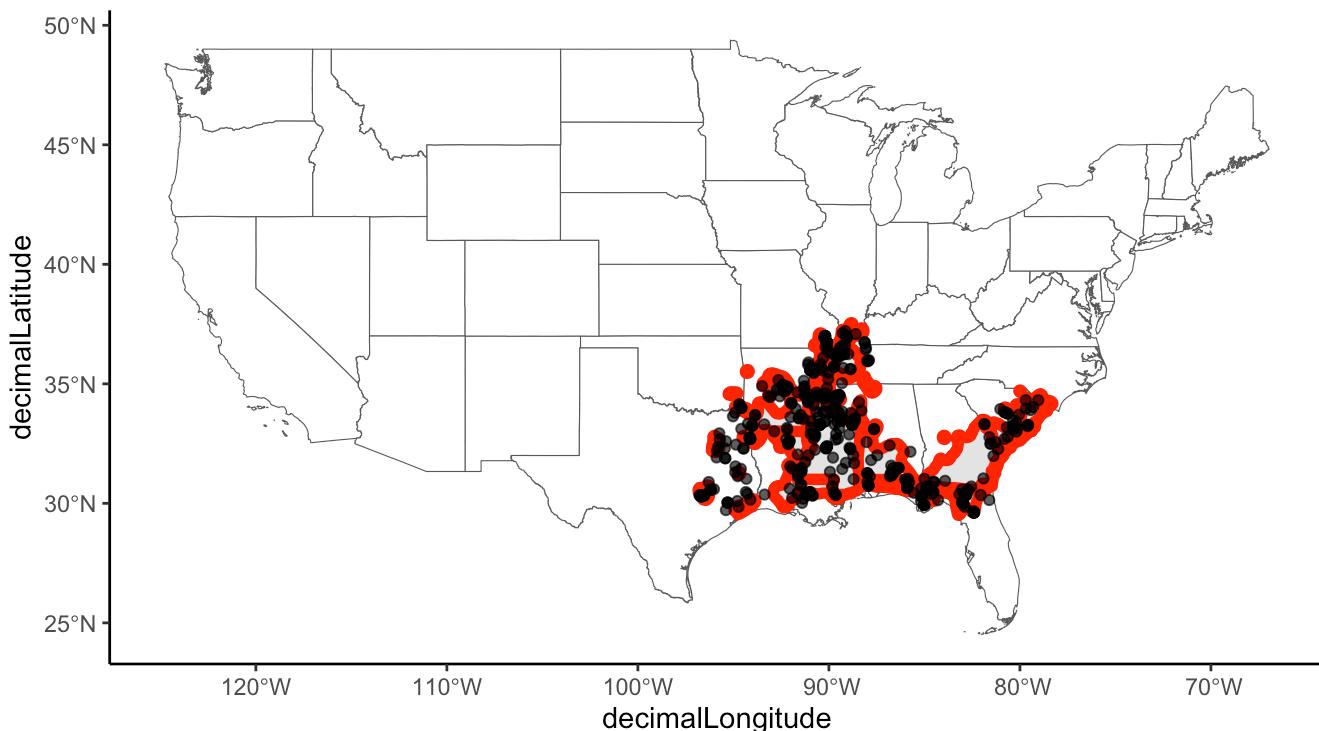
```
## Testing natural ranges
```

```
## Warning in cc_iucn(x = PLAQ.occ, range = PLAQ_clipped, lon =
## "decimalLongitude", : reprojecting reference to '+proj=longlat +datum=WGS84
## +no_defs'
```

```
## Flagged 62 records.
```

```
PLAQ_occ_final = PLAQ.occ[PLAQ_flag, ]
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = PLAQ_clipped, col = "red", linewidth = 2)+
  geom_point(data = PLAQ_occ_final, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
ggsave("../Plots/PLAQ.range.pdf", width = 12, height = 8)
```

Subset for *Platanus occidentalis*

```
PLOC.occ = gbif %>%
  filter(species == "Platanus occidentalis") %>%
  select(species,decimalLatitude,decimalLongitude)
```

Read in range map

```
PL0C.range = st_read("../USTreeAtlas/shp/platocci/")

## Reading layer `platocci' from data source
##   `/Users/samanthaworthy/Documents/GitHub/USTreeAtlas/shp/platocci'
##   using driver `ESRI Shapefile'
## Simple feature collection with 77 features and 5 fields
## Geometry type: POLYGON
## Dimension:      XY
## Bounding box:  xmin: -102.2446 ymin: 21.80153 xmax: -69.63906 ymax: 44.61452
## CRS:           NA
```

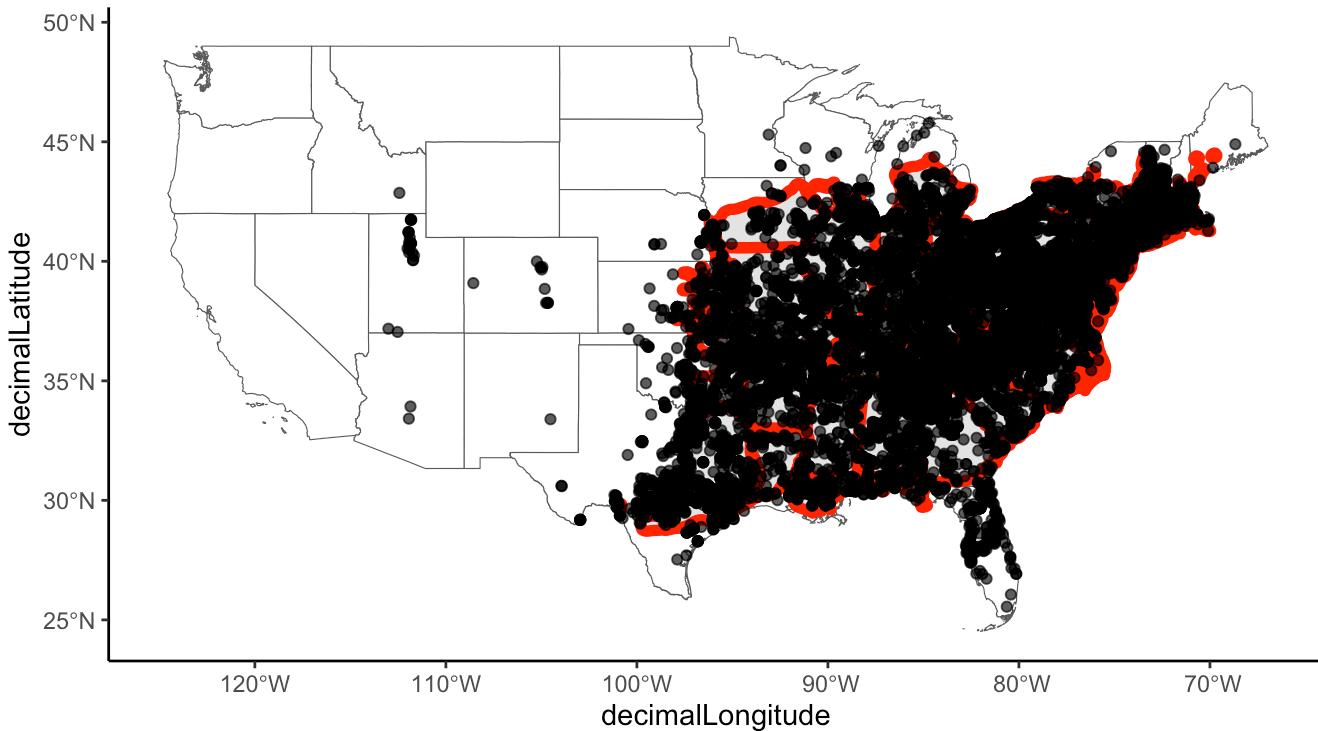
The projection is geographic with latitude and longitude. The datum is NAD27 which is EPSG:4267. The ellipsoid is Clarke 1866, and the transformation parameters

```
st_crs(PL0C.range) <- 4267
```

```
PL0C_clipped = st_intersection(PL0C.range, states.map)
```

```
## Warning: attribute variables are assumed to be spatially constant throughout
## all geometries
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = PL0C_clipped, col = "red", linewidth = 2)+
  geom_point(data = PL0C.occ, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
PL0C_clipped$species = "Platanus occidentalis"
PL0C_flag = cc_iucn(x = PL0C.occ, range = PL0C_clipped, lon = "decimalLongitude", lat =
"decimalLatitude",
value = "flagged", buffer = 50000)
```

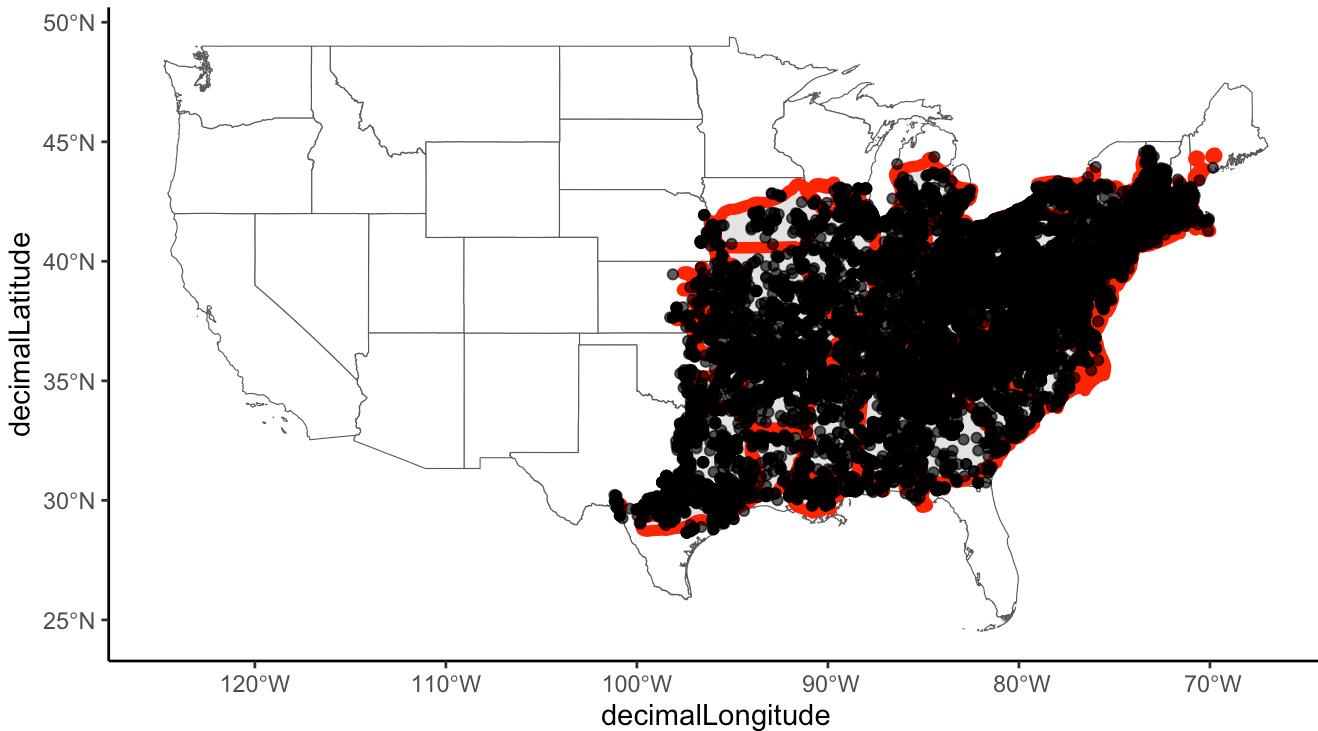
```
## Testing natural ranges
```

```
## Warning in cc_iucn(x = PL0C.occ, range = PL0C_clipped, lon =
## "decimalLongitude", : reprojecting reference to '+proj=longlat +datum=WGS84
## +no_defs'
```

```
## Flagged 619 records.
```

```
PL0C_occ_final = PL0C.occ[PL0C_flag, ]
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = PL0C_clipped, col = "red", linewidth = 2)+
  geom_point(data = PL0C_occ_final, aes(x = decimalLongitude, y = decimalLatitude), colo
r = "black", alpha = 0.7)+
  theme_classic()
```



```
ggsave("../Plots/PL0C.range.pdf", width = 12, height = 8)
```

Subset for *Populus balsamifera*

```
P0BA2.occ = gbif %>%
  filter(species == "Populus balsamifera") %>%
  select(species,decimalLatitude,decimalLongitude)
```

Read in range map

```
P0BA2.range = st_read("../USTreeAtlas/shp/popubals/")
```

```
## Reading layer `popubals' from data source
##   `/Users/samanthaworthy/Documents/GitHub/USTreeAtlas/shp/popubals'
##   using driver `ESRI Shapefile'
## Simple feature collection with 415 features and 5 fields
## Geometry type: POLYGON
## Dimension:     XY
## Bounding box:  xmin: -163.9213 ymin: 38.58866 xmax: -52.61445 ymax: 69.24193
## CRS:           NA
```

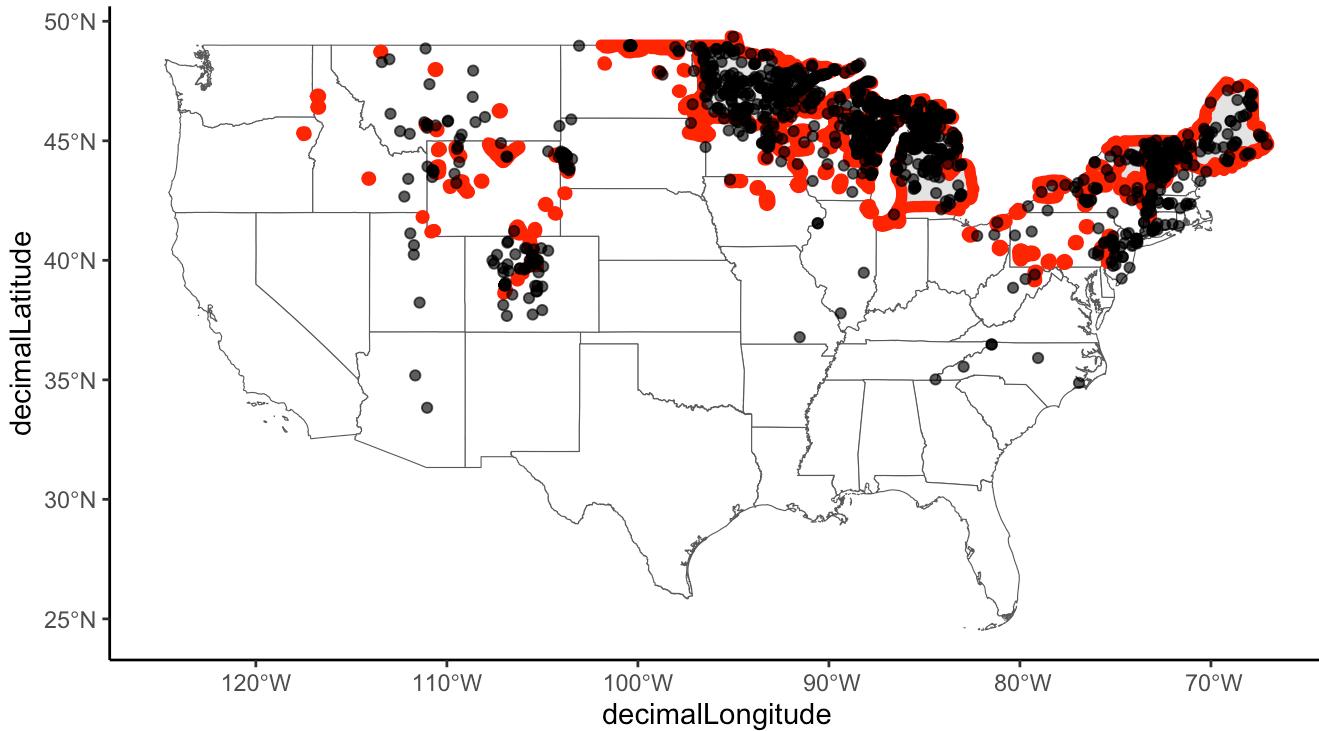
The projection is geographic with latitude and longitude. The datum is NAD27 which is EPSG:4267. The ellipsoid is Clarke 1866, and the transformation parameters

```
st_crs(POBA2.range) <- 4267
```

```
POBA2_clipped = st_intersection(POBA2.range, states.map)
```

```
## Warning: attribute variables are assumed to be spatially constant throughout
## all geometries
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = POBA2_clipped, col = "red", linewidth = 2)+
  geom_point(data = POBA2.occ, aes(x = decimalLongitude, y = decimalLatitude), color =
"black", alpha = 0.7)+
  theme_classic()
```



```
POBA2_clipped$species = "Populus balsamifera"
POBA2_flag = cc_iucn(x = POBA2.occ, range = POBA2_clipped, lon = "decimalLongitude", lat =
"decimalLatitude",
                      value = "flagged", buffer = 50000)
```

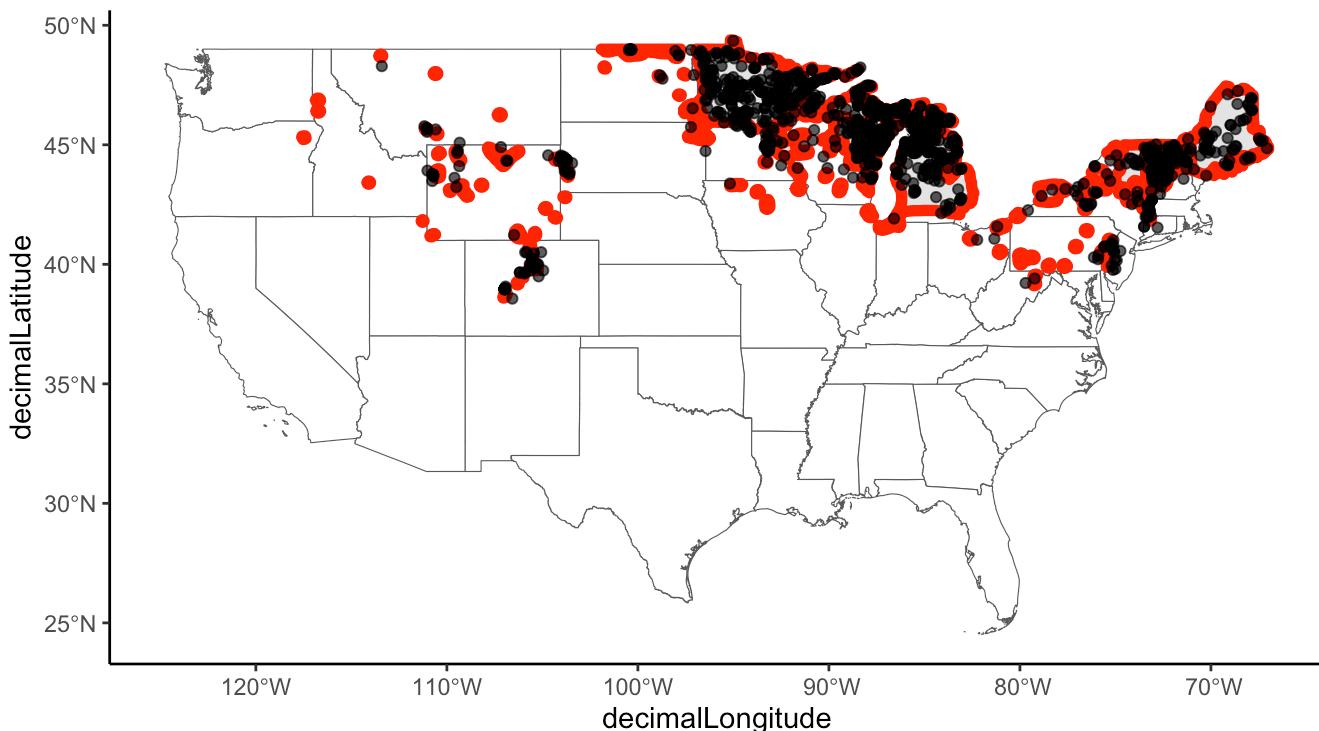
```
## Testing natural ranges
```

```
## Warning in cc_iucn(x = P0BA2.occ, range = P0BA2_clipped, lon =
## "decimalLongitude", : reprojecting reference to '+proj=longlat +datum=WGS84
## +no_defs'
```

```
## Flagged 106 records.
```

```
P0BA2_occ_final = P0BA2.occ[P0BA2_flag, ]
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = P0BA2_clipped, col = "red", linewidth = 2)+
  geom_point(data = P0BA2_occ_final, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
ggsave("../Plots/P0BA2.range.pdf", width = 12, height = 8)
```

Subset for *Populus deltoides*

```
PODE3.occ = gbif %>%
  filter(species == "Populus deltoides") %>%
  select(species,decimalLatitude,decimalLongitude)
```

Read in range map

```
PODE3.range = st_read("../USTreeAtlas/shp/popudelt/")
```

```
## Reading layer `popudelt' from data source
##   `/Users/samanthaworthy/Documents/GitHub/USTreeAtlas/shp/popudelt'
##   using driver `ESRI Shapefile'
## Simple feature collection with 79 features and 5 fields
## Geometry type: POLYGON
## Dimension:      XY
## Bounding box:  xmin: -114.3961 ymin: 27.32564 xmax: -72.24688 ymax: 52.14172
## CRS:           NA
```

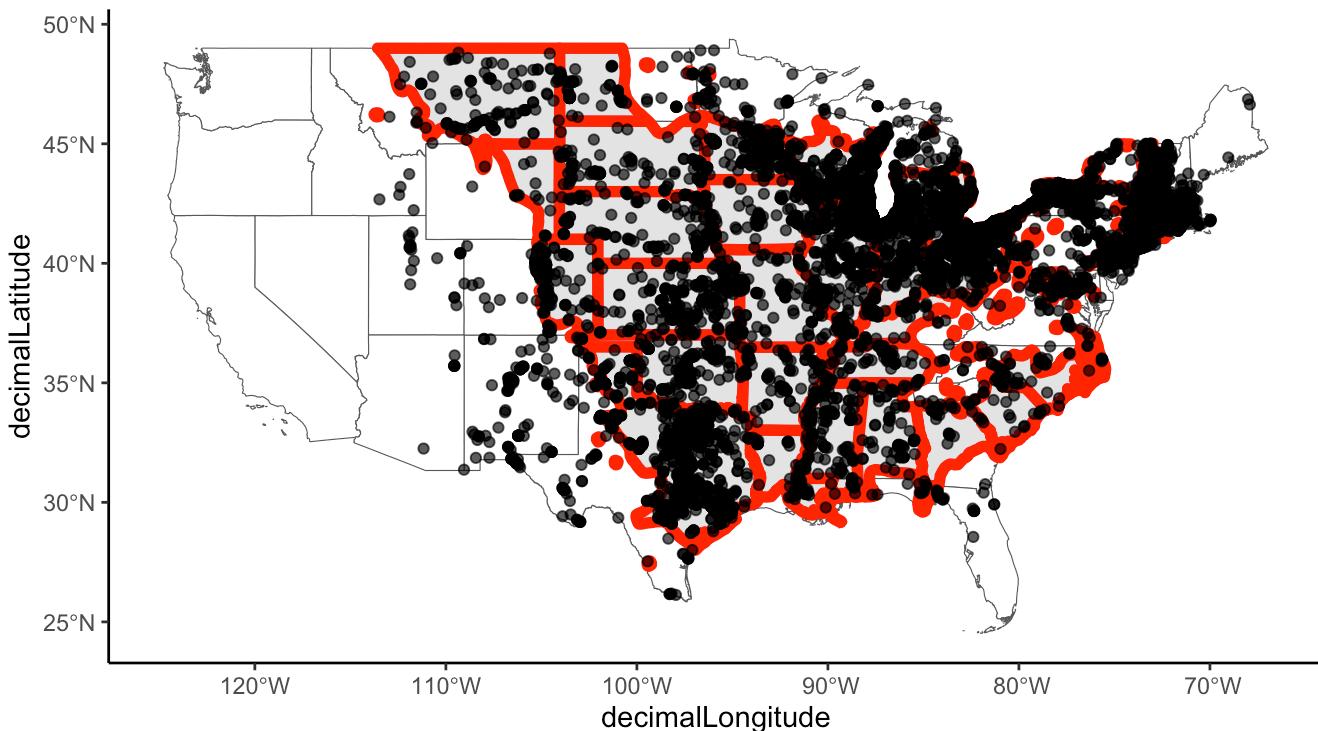
The projection is geographic with latitude and longitude. The datum is NAD27 which is EPSG:4267. The ellipsoid is Clarke 1866, and the transformation parameters

```
st_crs(PODE3.range) <- 4267
```

```
PODE3_clipped = st_intersection(PODE3.range, states.map)
```

```
## Warning: attribute variables are assumed to be spatially constant throughout
## all geometries
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = PODE3_clipped, col = "red", linewidth = 2)+
  geom_point(data = PODE3.occ, aes(x = decimalLongitude, y = decimalLatitude), color =
"black", alpha = 0.7)+
  theme_classic()
```



```
PODE3_clipped$species = "Populus deltoides"
PODE3_flag = cc_iucn(x = PODE3.occ, range = PODE3_clipped, lon = "decimalLongitude", lat = "decimalLatitude",
                      value = "flagged", buffer = 50000)
```

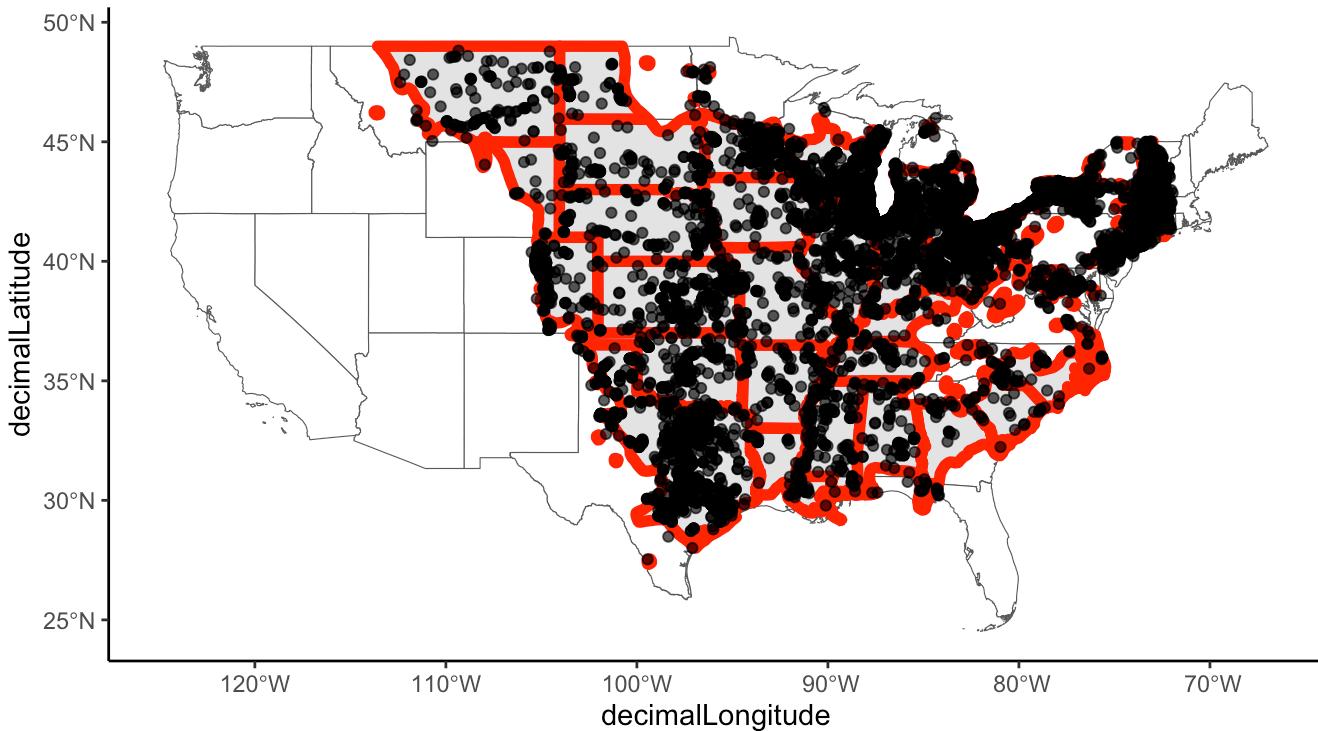
```
## Testing natural ranges
```

```
## Warning in cc_iucn(x = PODE3.occ, range = PODE3_clipped, lon =
## "decimalLongitude", : reprojecting reference to '+proj=longlat +datum=WGS84
## +no_defs'
```

```
## Flagged 908 records.
```

```
PODE3_occ_final = PODE3.occ[PODE3_flag, ]
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = PODE3_clipped, col = "red", linewidth = 2)+
  geom_point(data = PODE3_occ_final, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
ggsave("../Plots/P0DE3.range.pdf", width = 12, height = 8)
```

Subset for *Populus grandidentata*

```
P0GR4.occ = gbif %>%
  filter(species == "Populus grandidentata") %>%
  select(species,decimalLatitude,decimalLongitude)
```

Read in range map

```
P0GR4.range = st_read("../USTreeAtlas/shp/popugran/")
```

```
## Reading layer `popugran' from data source
##   `/Users/samanthaworthy/Documents/GitHub/USTreeAtlas/shp/popugran'
##   using driver `ESRI Shapefile'
## Simple feature collection with 157 features and 5 fields
## Geometry type: POLYGON
## Dimension:     XY
## Bounding box:  xmin: -96.50261 ymin: 35.13372 xmax: -59.68972 ymax: 49.99322
## CRS:           NA
```

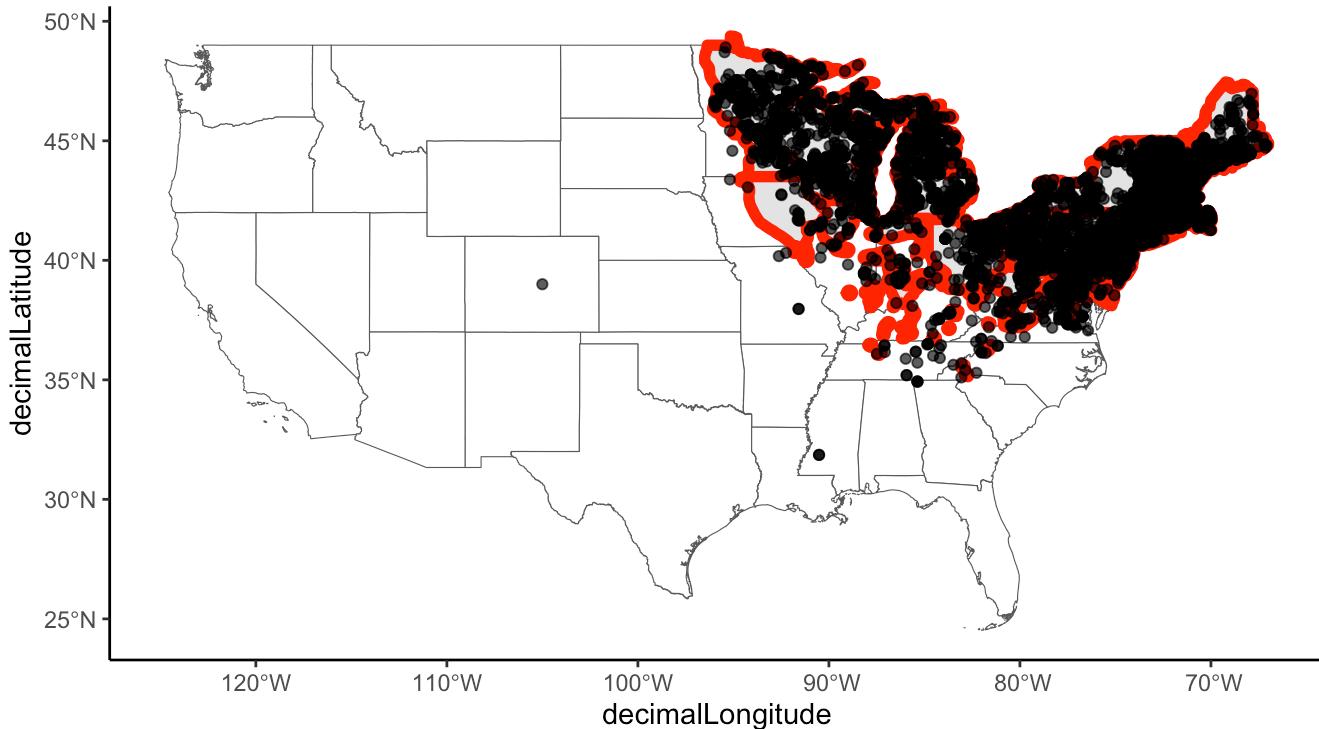
The projection is geographic with latitude and longitude. The datum is NAD27 which is EPSG:4267. The ellipsoid is Clarke 1866, and the transformation parameters

```
st_crs(POGR4.range) <- 4267
```

```
POGR4_clipped = st_intersection(POGR4.range, states.map)
```

```
## Warning: attribute variables are assumed to be spatially constant throughout
## all geometries
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = POGR4_clipped, col = "red", linewidth = 2)+
  geom_point(data = POGR4.occ, aes(x = decimalLongitude, y = decimalLatitude), color =
"black", alpha = 0.7)+
  theme_classic()
```



```
POGR4_clipped$species = "Populus grandidentata"
POGR4_flag = cc_iucn(x = POGR4.occ, range = POGR4_clipped, lon = "decimalLongitude", lat =
"decimalLatitude",
                      value = "flagged", buffer = 50000)
```

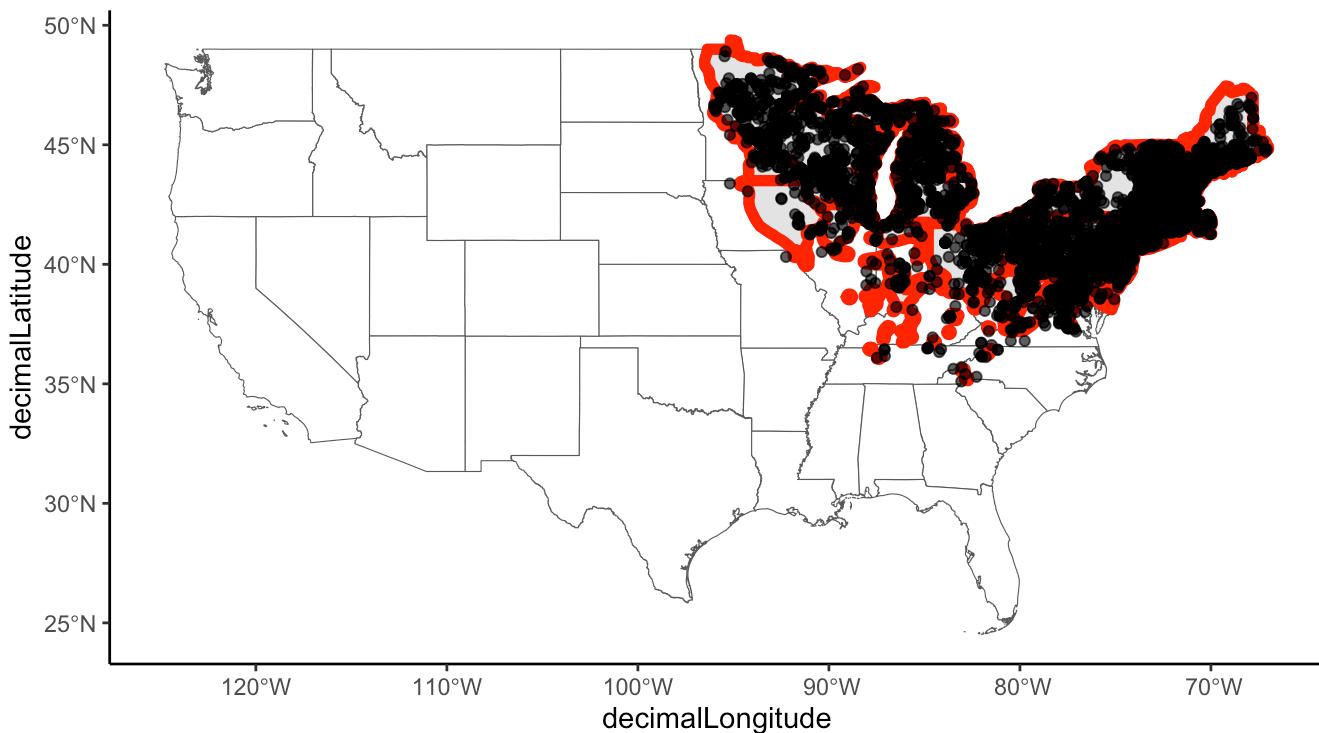
```
## Testing natural ranges
```

```
## Warning in cc_iucn(x = P0GR4.occ, range = P0GR4_clipped, lon =
## "decimalLongitude", : reprojecting reference to '+proj=longlat +datum=WGS84
## +no_defs'
```

```
## Flagged 53 records.
```

```
P0GR4_occ_final = P0GR4.occ[P0GR4_flag, ]
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = P0GR4_clipped, col = "red", linewidth = 2)+
  geom_point(data = P0GR4_occ_final, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
ggsave("../Plots/P0GR4.range.pdf", width = 12, height = 8)
```

Subset for *Populus heterophylla*

```
P0HE4.occ = gbif %>%
  filter(species == "Populus heterophylla") %>%
  select(species,decimalLatitude,decimalLongitude)
```

Read in range map

```
P0HE4.range = st_read("../USTreeAtlas/shp/popuhete/")
```

```
## Reading layer `popuhete' from data source
##   `/Users/samanthaworthy/Documents/GitHub/USTreeAtlas/shp/popuhete'
##   using driver `ESRI Shapefile'
## Simple feature collection with 79 features and 5 fields
## Geometry type: POLYGON
## Dimension:      XY
## Bounding box:  xmin: -92.28237 ymin: 29.70388 xmax: -71.85611 ymax: 42.36729
## CRS:           NA
```

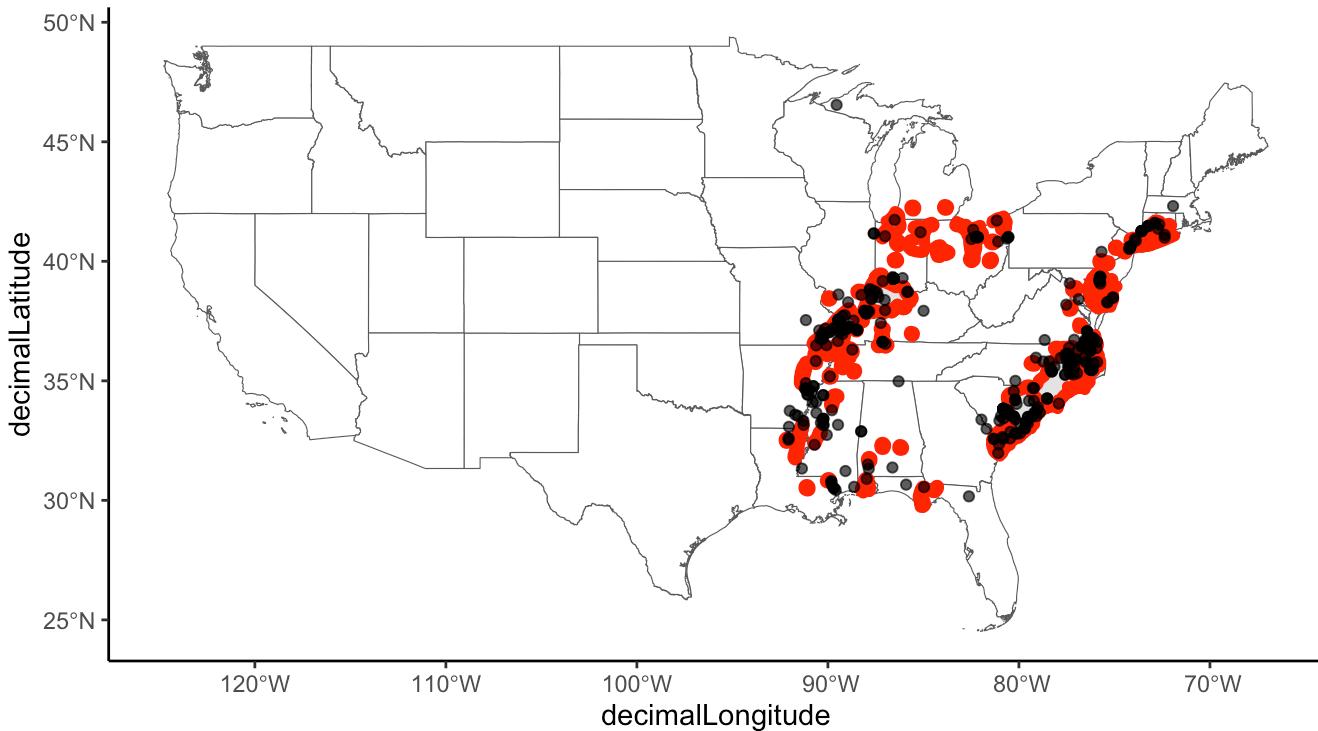
The projection is geographic with latitude and longitude. The datum is NAD27 which is EPSG:4267. The ellipsoid is Clarke 1866, and the transformation parameters

```
st_crs(P0HE4.range) <- 4267
```

```
P0HE4_clipped = st_intersection(P0HE4.range, states.map)
```

```
## Warning: attribute variables are assumed to be spatially constant throughout
## all geometries
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = P0HE4_clipped, col = "red", linewidth = 2)+
  geom_point(data = P0HE4.occ, aes(x = decimalLongitude, y = decimalLatitude), color =
"black", alpha = 0.7)+
  theme_classic()
```



```
P0HE4_clipped$species = "Populus heterophylla"
P0HE4_flag = cc_iucn(x = P0HE4.occ, range = P0HE4_clipped, lon = "decimalLongitude", lat = "decimalLatitude",
= "flagged", buffer = 50000)
```

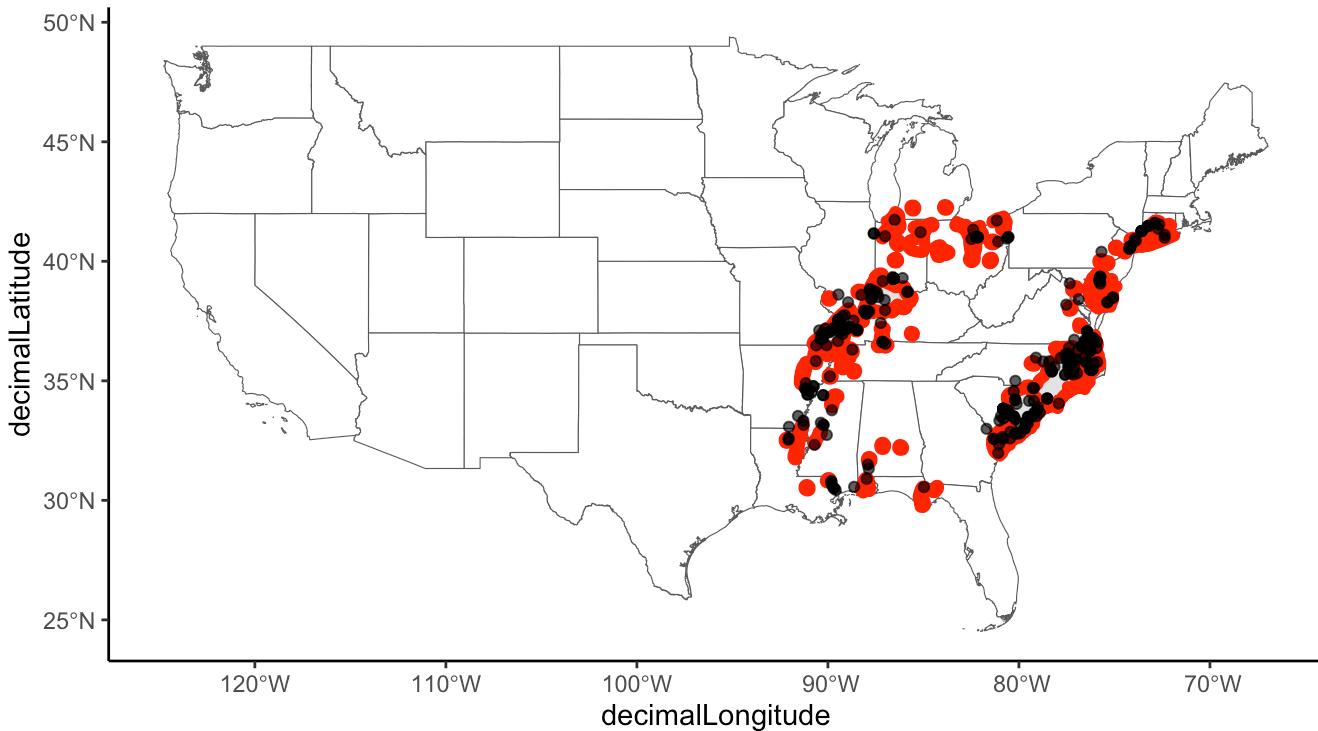
```
## Testing natural ranges
```

```
## Warning in cc_iucn(x = P0HE4.occ, range = P0HE4_clipped, lon =
## "decimalLongitude", : reprojecting reference to '+proj=longlat +datum=WGS84
## +no_defs'
```

```
## Flagged 23 records.
```

```
P0HE4_occ_final = P0HE4.occ[P0HE4_flag, ]
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = P0HE4_clipped, col = "red", linewidth = 2)+
  geom_point(data = P0HE4_occ_final, aes(x = decimalLongitude, y = decimalLatitude), col = "black", alpha = 0.7)+
  theme_classic()
```



```
ggsave("../Plots/P0HE4.range.pdf", width = 12, height = 8)
```

Subset for *Populus tremuloides*

```
P0TR5.occ = gbif %>%
  filter(species == "Populus tremuloides") %>%
  select(species,decimalLatitude,decimalLongitude)
```

Read in range map

```
P0TR5.range = st_read("../USTreeAtlas/shp/poputrem/")
```

```
## Reading layer `poputrem' from data source
##   `/Users/samanthaworthy/Documents/GitHub/USTreeAtlas/shp/poputrem'
##   using driver `ESRI Shapefile'
## Simple feature collection with 534 features and 5 fields
## Geometry type: POLYGON
## Dimension:     XY
## Bounding box:  xmin: -163.7564 ymin: 20.77411 xmax: -52.61445 ymax: 69.2738
## CRS:           NA
```

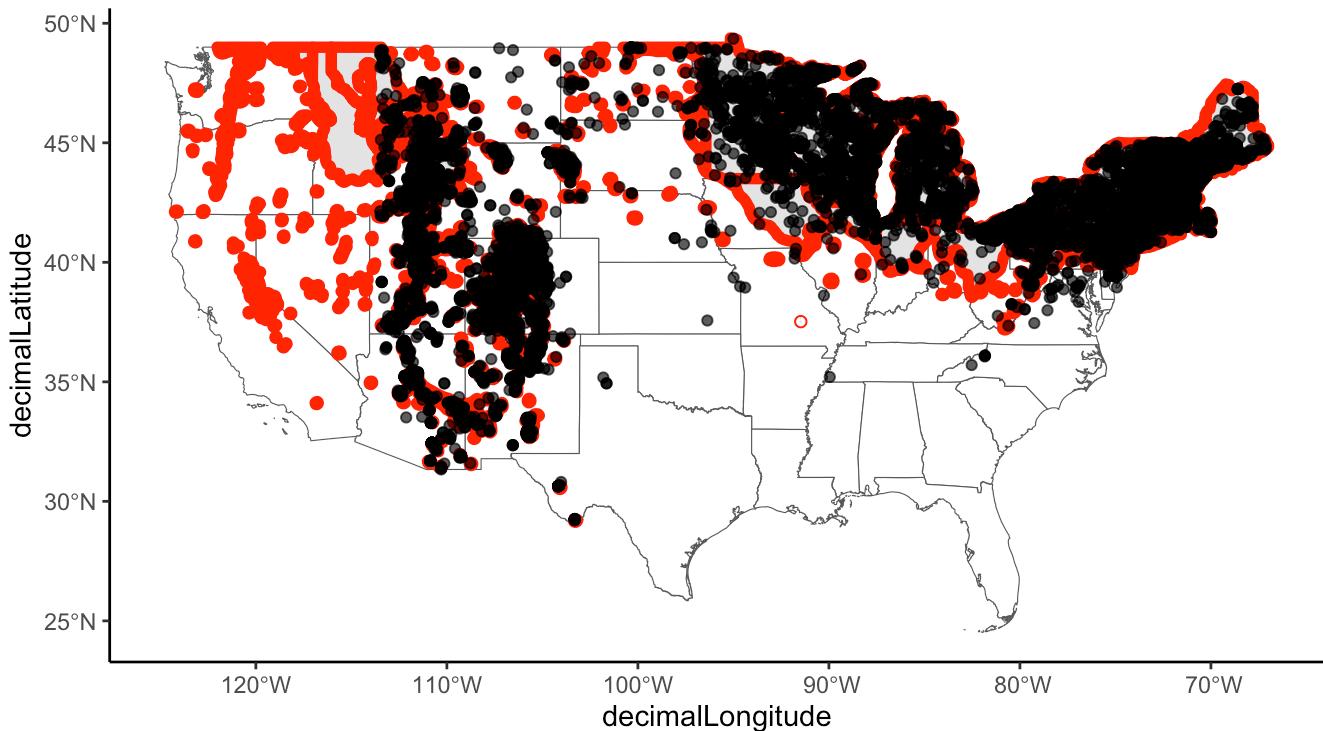
The projection is geographic with latitude and longitude. The datum is NAD27 which is EPSG:4267. The ellipsoid is Clarke 1866, and the transformation parameters

```
st_crs(POTR5.range) <- 4267
```

```
POTR5_clipped = st_intersection(POTR5.range, states.map)
```

```
## Warning: attribute variables are assumed to be spatially constant throughout
## all geometries
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = POTR5_clipped, col = "red", linewidth = 2)+
  geom_point(data = POTR5.occ, aes(x = decimalLongitude, y = decimalLatitude), color =
"black", alpha = 0.7)+
  theme_classic()
```



```
POTR5_clipped$species = "Populus tremuloides"
POTR5_flag = cc_iucn(x = POTR5.occ, range = POTR5_clipped, lon = "decimalLongitude", lat =
"decimalLatitude",
                      value = "flagged", buffer = 50000)
```

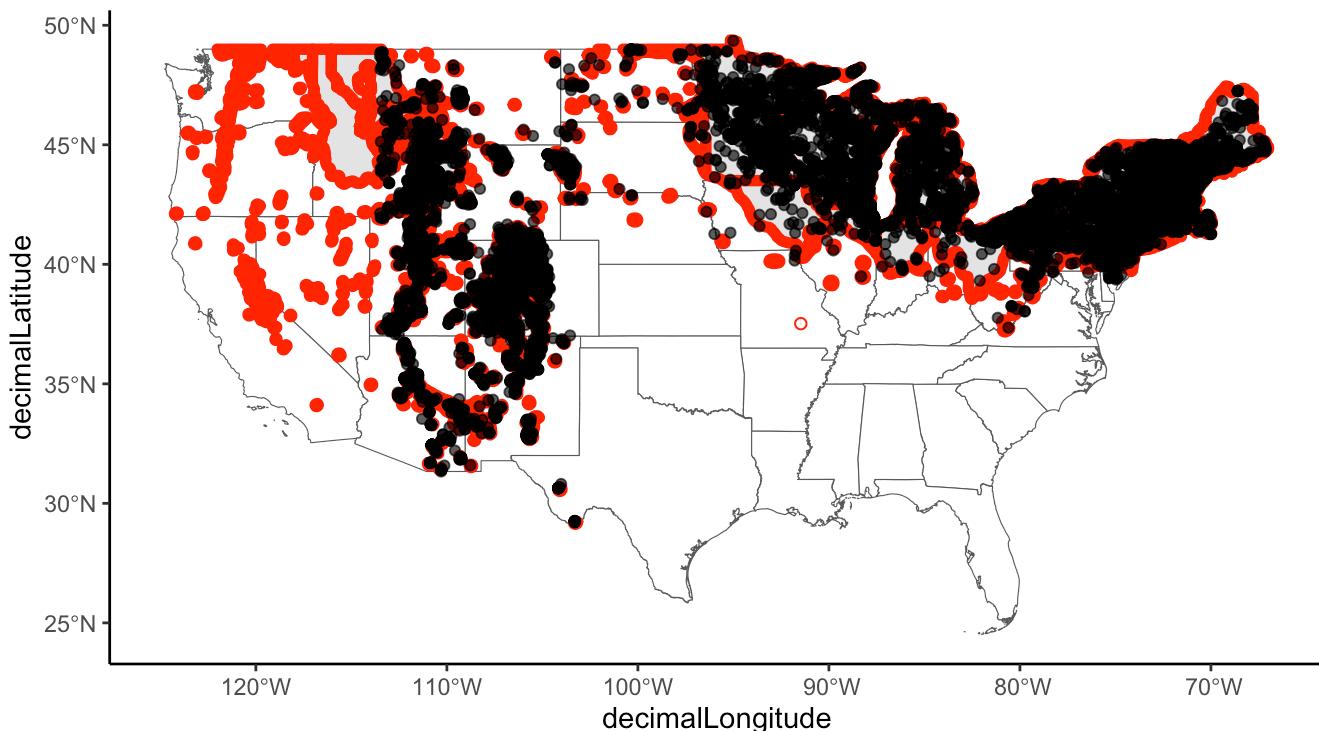
```
## Testing natural ranges
```

```
## Warning in cc_iucn(x = P0TR5.occ, range = P0TR5_clipped, lon =
## "decimalLongitude", : reprojecting reference to '+proj=longlat +datum=WGS84
## +no_defs'
```

```
## Flagged 129 records.
```

```
P0TR5_occ_final = P0TR5.occ[P0TR5_flag, ]
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = P0TR5_clipped, col = "red", linewidth = 2)+
  geom_point(data = P0TR5_occ_final, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
ggsave("../Plots/P0TR5.range.pdf", width = 12, height = 8)
```

Subset for *Prunus americana*

```
PRAM.occ = gbif %>%
  filter(species == "Prunus americana") %>%
  select(species,decimalLatitude,decimalLongitude)
```

Read in range map

```
PRAM.range = st_read("../USTreeAtlas/shp/prunamer/")
```

```
## Reading layer `prunamer' from data source
##   `/Users/samanthaworthy/Documents/GitHub/USTreeAtlas/shp/prunamer'
##   using driver `ESRI Shapefile'
## Simple feature collection with 71 features and 5 fields
## Geometry type: POLYGON
## Dimension:      XY
## Bounding box:  xmin: -114.464 ymin: 28.57408 xmax: -70.17076 ymax: 50.03462
## CRS:           NA
```

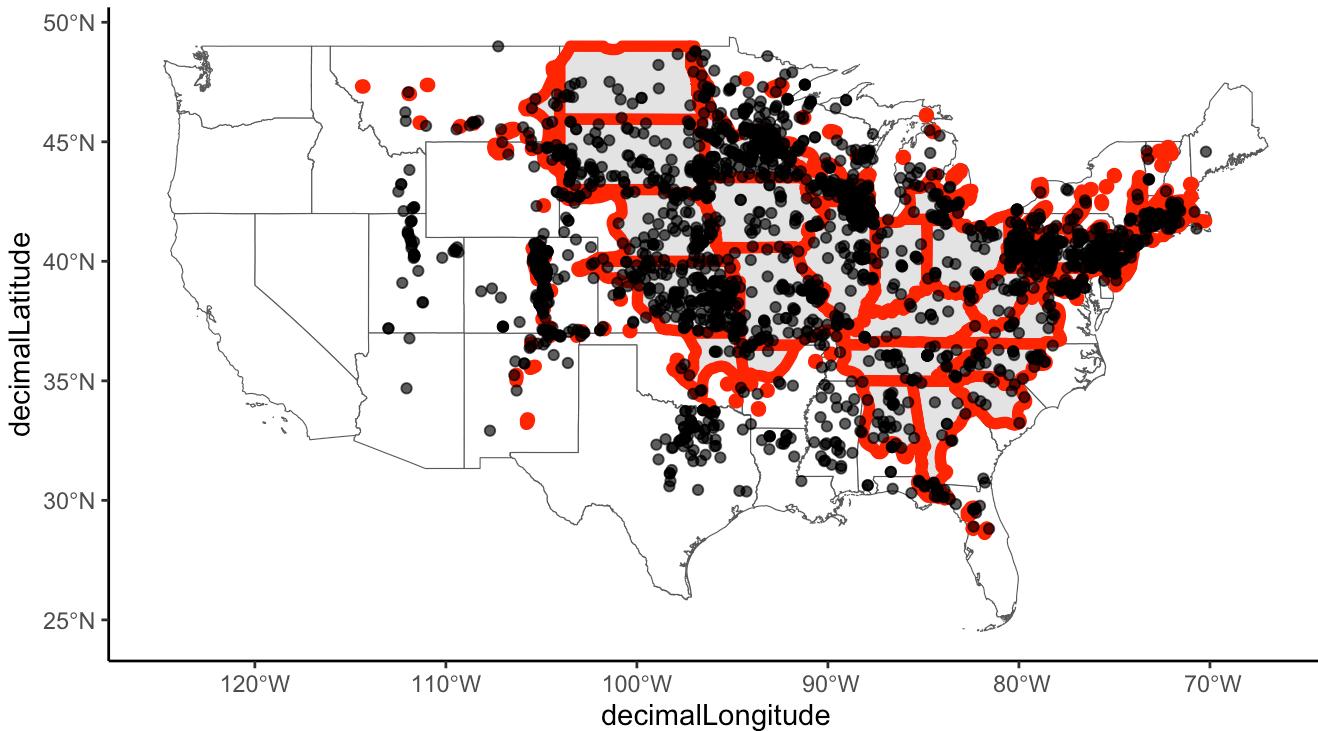
The projection is geographic with latitude and longitude. The datum is NAD27 which is EPSG:4267. The ellipsoid is Clarke 1866, and the transformation parameters

```
st_crs(PRAM.range) <- 4267
```

```
PRAM_clipped = st_intersection(PRAM.range, states.map)
```

```
## Warning: attribute variables are assumed to be spatially constant throughout
## all geometries
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = PRAM_clipped, col = "red", linewidth = 2)+
  geom_point(data = PRAM.occ, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
PRAM_clipped$species = "Prunus americana"
PRAM_flag = cc_iucn(x = PRAM.occ, range = PRAM_clipped, lon = "decimalLongitude", lat =
"decimalLatitude",
                     value = "flagged", buffer = 50000)
```

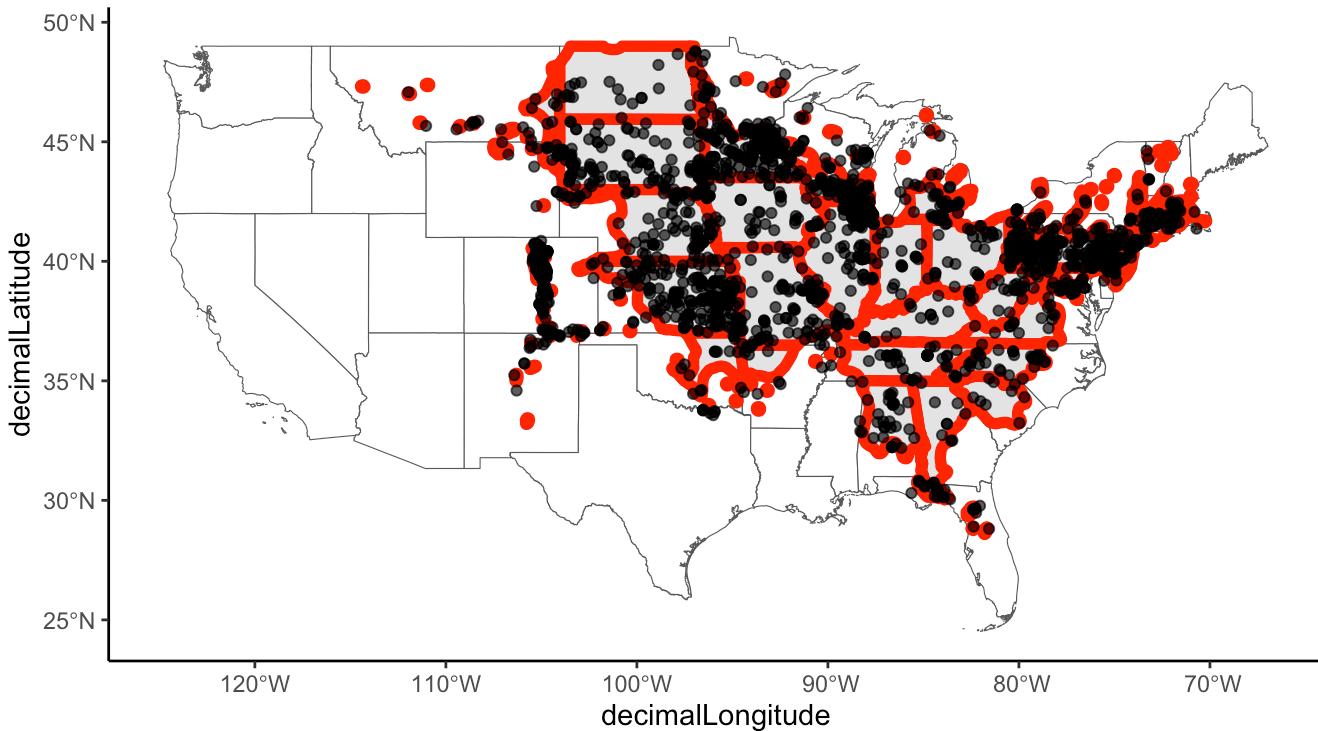
```
## Testing natural ranges
```

```
## Warning in cc_iucn(x = PRAM.occ, range = PRAM_clipped, lon =
## "decimalLongitude", : reprojecting reference to '+proj=longlat +datum=WGS84
## +no_defs'
```

```
## Flagged 230 records.
```

```
PRAM_occ_final = PRAM.occ[PRAM_flag, ]
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = PRAM_clipped, col = "red", linewidth = 2)+
  geom_point(data = PRAM_occ_final, aes(x = decimalLongitude, y = decimalLatitude), colo
r = "black", alpha = 0.7)+
  theme_classic()
```



```
ggsave("../Plots/PRAM.range.pdf", width = 12, height = 8)
```

Subset for *Prunus pensylvanica*

```
PRPE2.occ = gbif %>%
  filter(species == "Prunus pensylvanica") %>%
  select(species,decimalLatitude,decimalLongitude)
```

Read in range map

```
PRPE2.range = st_read("../USTreeAtlas/shp/prunpens/")
```

```
## Reading layer `prunpens` from data source
##   `/Users/samanthaworthy/Documents/GitHub/USTreeAtlas/shp/prunpens'
##   using driver `ESRI Shapefile'
## Simple feature collection with 336 features and 5 fields
## Geometry type: POLYGON
## Dimension:     XY
## Bounding box:  xmin: -128.2946 ymin: 34.80802 xmax: -52.61445 ymax: 62.31179
## CRS:           NA
```

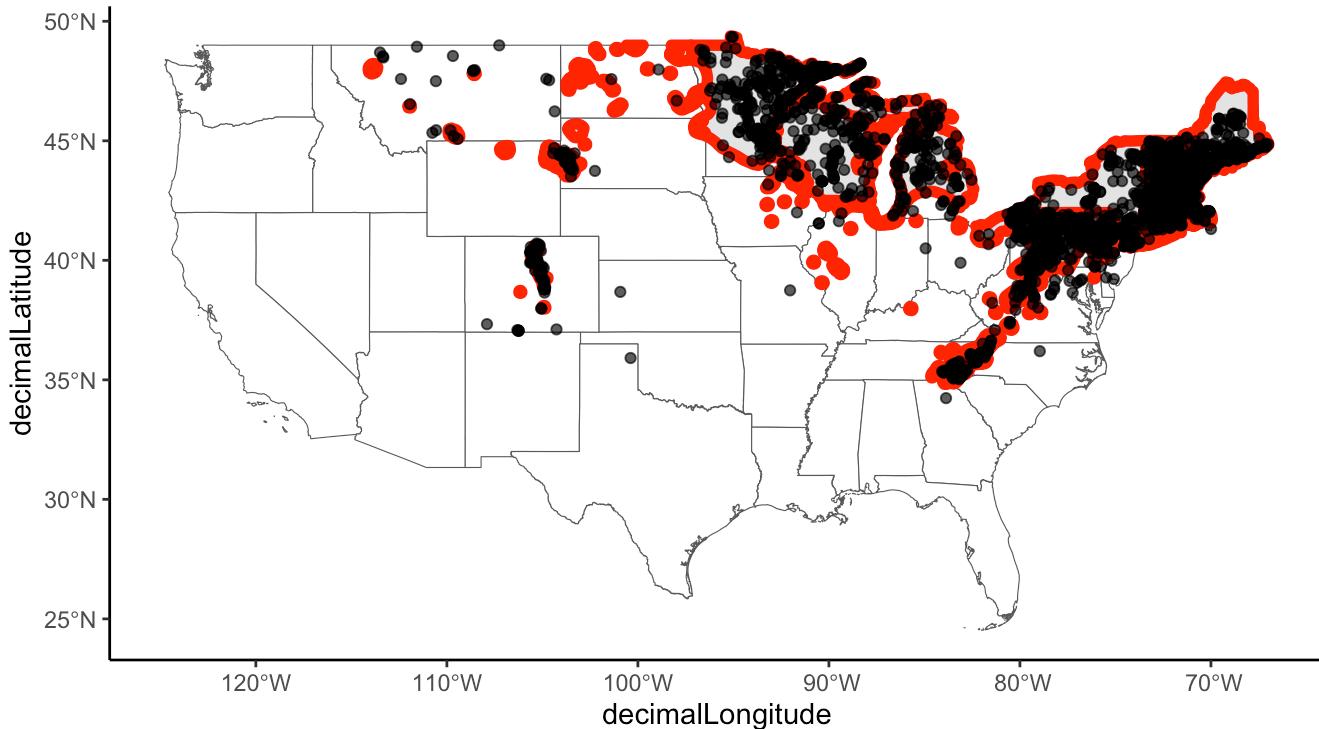
The projection is geographic with latitude and longitude. The datum is NAD27 which is EPSG:4267. The ellipsoid is Clarke 1866, and the transformation parameters

```
st_crs(PRPE2.range) <- 4267
```

```
PRPE2_clipped = st_intersection(PRPE2.range, states.map)
```

```
## Warning: attribute variables are assumed to be spatially constant throughout
## all geometries
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = PRPE2_clipped, col = "red", linewidth = 2)+
  geom_point(data = PRPE2.occ, aes(x = decimalLongitude, y = decimalLatitude), color =
"black", alpha = 0.7)+
  theme_classic()
```



```
PRPE2_clipped$species = "Prunus pensylvanica"
PRPE2_flag = cc_iucn(x = PRPE2.occ, range = PRPE2_clipped, lon = "decimalLongitude", lat =
"decimalLatitude",
                      value = "flagged", buffer = 50000)
```

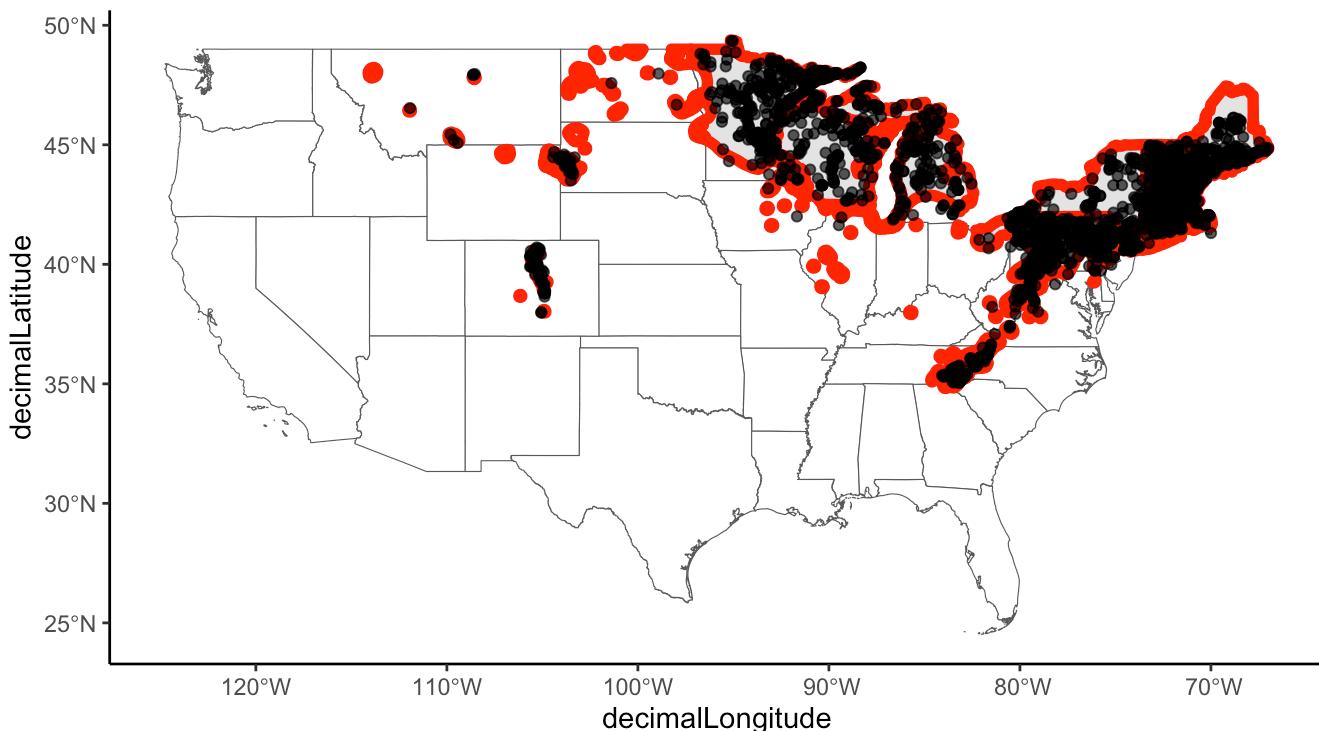
```
## Testing natural ranges
```

```
## Warning in cc_iucn(x = PRPE2.occ, range = PRPE2_clipped, lon =
## "decimalLongitude", : reprojecting reference to '+proj=longlat +datum=WGS84
## +no_defs'
```

```
## Flagged 41 records.
```

```
PRPE2_occ_final = PRPE2.occ[PRPE2_flag, ]
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = PRPE2_clipped, col = "red", linewidth = 2)+
  geom_point(data = PRPE2_occ_final, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
ggsave("../Plots/PRPE2.range.pdf", width = 12, height = 8)
```

Subset for *Prunus serotina*

```
PRSE2.occ = gbif %>%
  filter(species == "Prunus serotina") %>%
  select(species,decimalLatitude,decimalLongitude)
```

Read in range map

```
PRSE2.range = st_read("../USTreeAtlas/shp/prunsero/")

## Reading layer `prunsero' from data source
##   '/Users/samanthaworthy/Documents/GitHub/USTreeAtlas/shp/prunsero'
##   using driver `ESRI Shapefile'
## Simple feature collection with 200 features and 5 fields
## Geometry type: POLYGON
## Dimension:      XY
## Bounding box:  xmin: -113.9141 ymin: 14.56384 xmax: -63.3591 ymax: 47.8594
## CRS:           NA
```

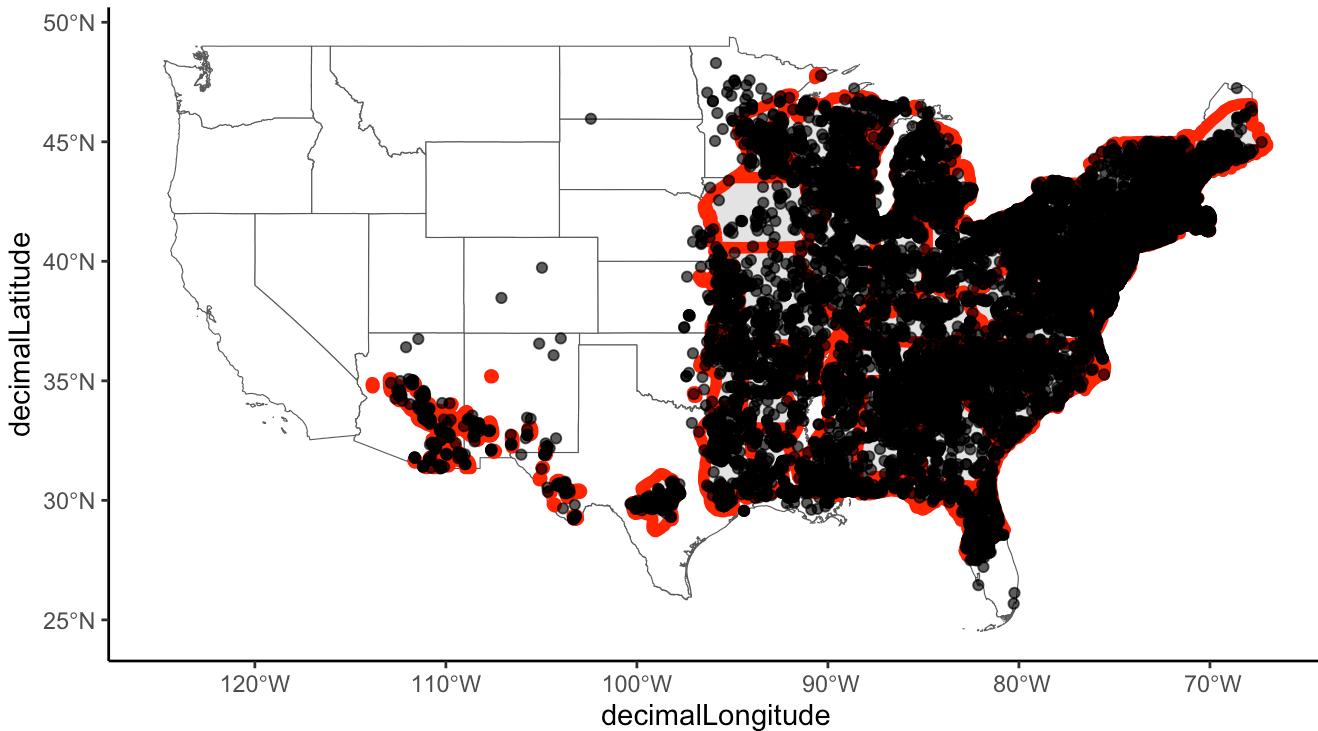
The projection is geographic with latitude and longitude. The datum is NAD27 which is EPSG:4267. The ellipsoid is Clarke 1866, and the transformation parameters

```
st_crs(PRSE2.range) <- 4267
```

```
PRSE2_clipped = st_intersection(PRSE2.range, states.map)
```

```
## Warning: attribute variables are assumed to be spatially constant throughout
## all geometries
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = PRSE2_clipped, col = "red", linewidth = 2)+
  geom_point(data = PRSE2.occ, aes(x = decimalLongitude, y = decimalLatitude), color =
"black", alpha = 0.7)+
  theme_classic()
```



```
PRSE2_clipped$species = "Prunus serotina"
PRSE2_flag = cc_iucn(x = PRSE2.occ, range = PRSE2_clipped, lon = "decimalLongitude", lat = "decimalLatitude",
                      value = "flagged", buffer = 50000)
```

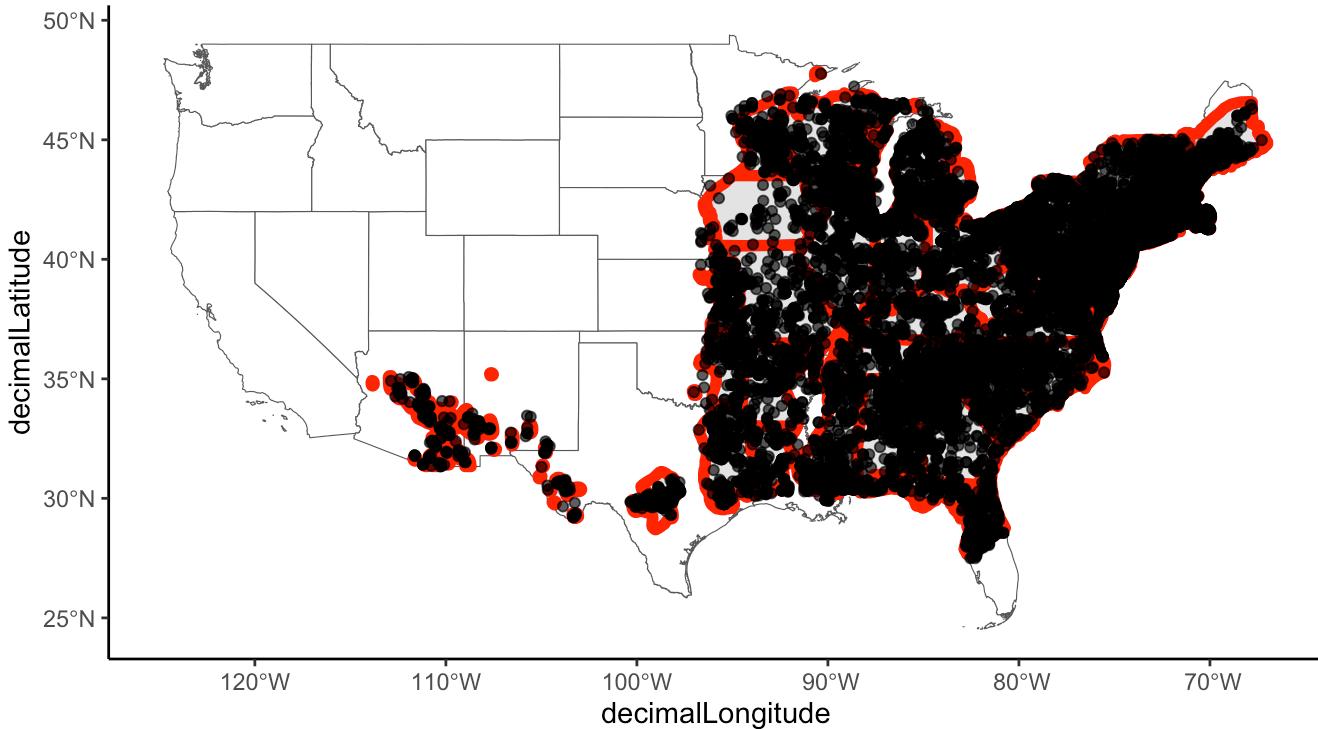
```
## Testing natural ranges
```

```
## Warning in cc_iucn(x = PRSE2.occ, range = PRSE2_clipped, lon =
## "decimalLongitude", : reprojecting reference to '+proj=longlat +datum=WGS84
## +no_defs'
```

```
## Flagged 99 records.
```

```
PRSE2_occ_final = PRSE2.occ[PRSE2_flag, ]
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = PRSE2_clipped, col = "red", linewidth = 2)+
  geom_point(data = PRSE2_occ_final, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
ggsave("../Plots/PRSE2.range.pdf", width = 12, height = 8)
```

Subset for *Prunus virginiana*

```
PRVI.occ = gbif %>%
  filter(species == "Prunus virginiana") %>%
  select(species,decimalLatitude,decimalLongitude)
```

Read in range map

```
PRVI.range = st_read("../USTreeAtlas/shp/prunvirg/")
```

```
## Reading layer `prunvirg' from data source
##   `/Users/samanthaworthy/Documents/GitHub/USTreeAtlas/shp/prunvirg'
##   using driver `ESRI Shapefile'
## Simple feature collection with 397 features and 5 fields
## Geometry type: POLYGON
## Dimension:     XY
## Bounding box:  xmin: -130.5808 ymin: 30.24095 xmax: -53.03568 ymax: 61.54309
## CRS:           NA
```

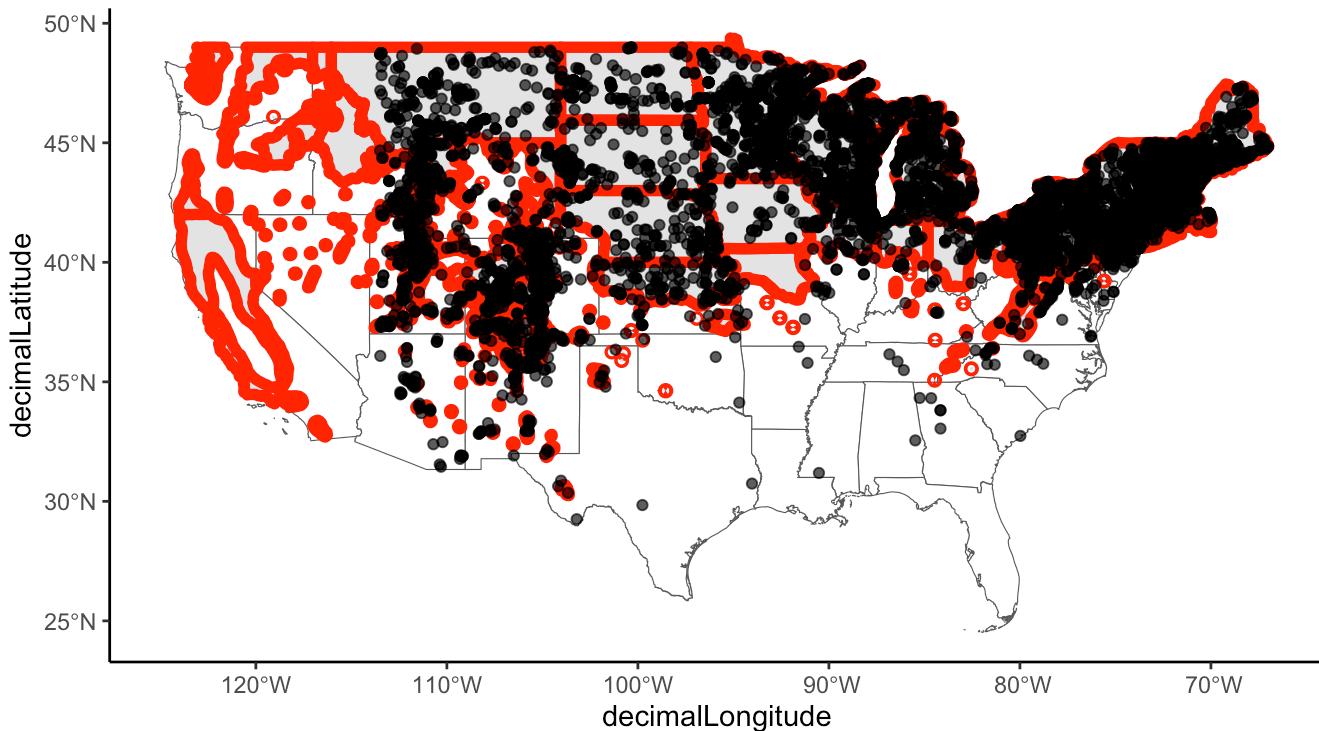
The projection is geographic with latitude and longitude. The datum is NAD27 which is EPSG:4267. The ellipsoid is Clarke 1866, and the transformation parameters

```
st_crs(PRFI.range) <- 4267
```

```
PRVI_clipped = st_intersection(PRFI.range, states.map)
```

```
## Warning: attribute variables are assumed to be spatially constant throughout
## all geometries
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = PRVI_clipped, col = "red", linewidth = 2)+
  geom_point(data = PRVI.occ, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
PRVI_clipped$species = "Prunus virginiana"
PRVI_flag = cc_iucn(x = PRVI.occ, range = PRVI_clipped, lon = "decimalLongitude", lat =
"decimalLatitude",
                     value = "flagged", buffer = 50000)
```

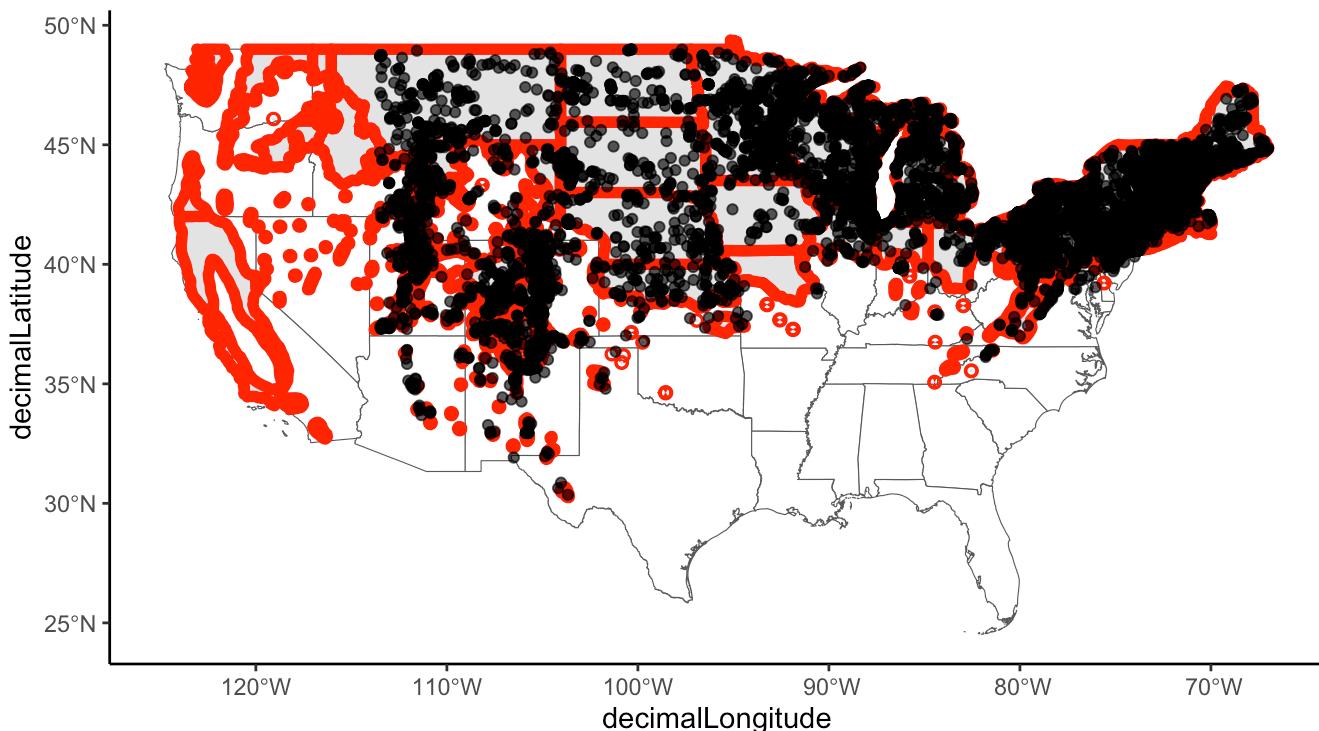
```
## Testing natural ranges
```

```
## Warning in cc_iucn(x = PRVI.occ, range = PRVI_clipped, lon =
## "decimalLongitude", : reprojecting reference to '+proj=longlat +datum=WGS84
## +no_defs'
```

```
## Flagged 105 records.
```

```
PRVI_occ_final = PRVI.occ[PRVI_flag, ]
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = PRVI_clipped, col = "red", linewidth = 2)+
  geom_point(data = PRVI_occ_final, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
ggsave("../Plots/PRVI.range.pdf", width = 12, height = 8)
```

Subset for *Quercus alba*

```
QUAL.occ = gbif %>%
  filter(species == "Quercus alba") %>%
  select(species, decimalLatitude, decimalLongitude)
```

Read in range map

```
QUAL.range = st_read("../USTreeAtlas/shp/queralba/")
```

```
## Reading layer `queralba' from data source
##   `/Users/samanthaworthy/Documents/GitHub/USTreeAtlas/shp/queralba'
##   using driver `ESRI Shapefile'
## Simple feature collection with 82 features and 5 fields
## Geometry type: POLYGON
## Dimension:      XY
## Bounding box:  xmin: -96.34524 ymin: 29.63241 xmax: -69.11673 ymax: 46.45134
## CRS:           NA
```

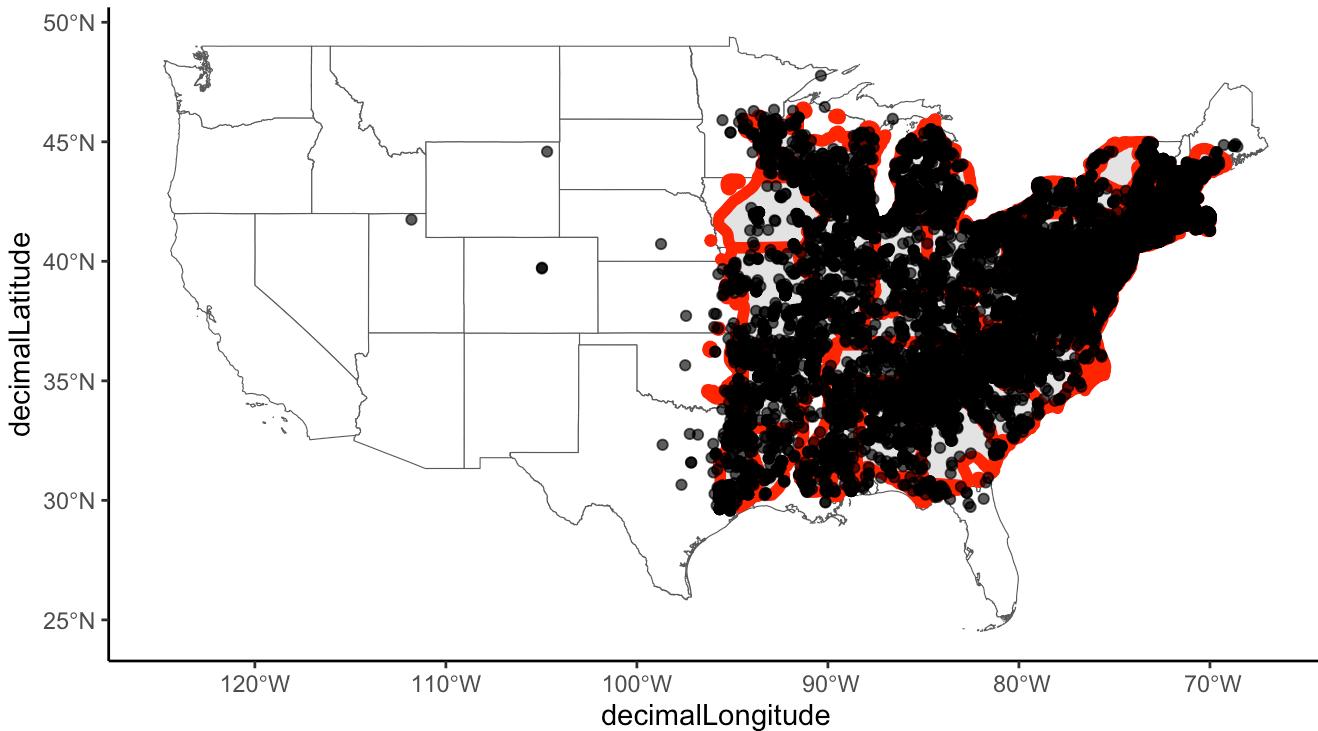
The projection is geographic with latitude and longitude. The datum is NAD27 which is EPSG:4267. The ellipsoid is Clarke 1866, and the transformation parameters

```
st_crs(QUAL.range) <- 4267
```

```
QUAL_clipped = st_intersection(QUAL.range, states.map)
```

```
## Warning: attribute variables are assumed to be spatially constant throughout
## all geometries
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = QUAL_clipped, col = "red", linewidth = 2)+
  geom_point(data = QUAL.occ, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
QUAL_clipped$species = "Quercus alba"
QUAL_flag = cc_iucn(x = QUAL.occ, range = QUAL_clipped, lon = "decimalLongitude", lat =
"decimalLatitude",
value = "flagged", buffer = 50000)
```

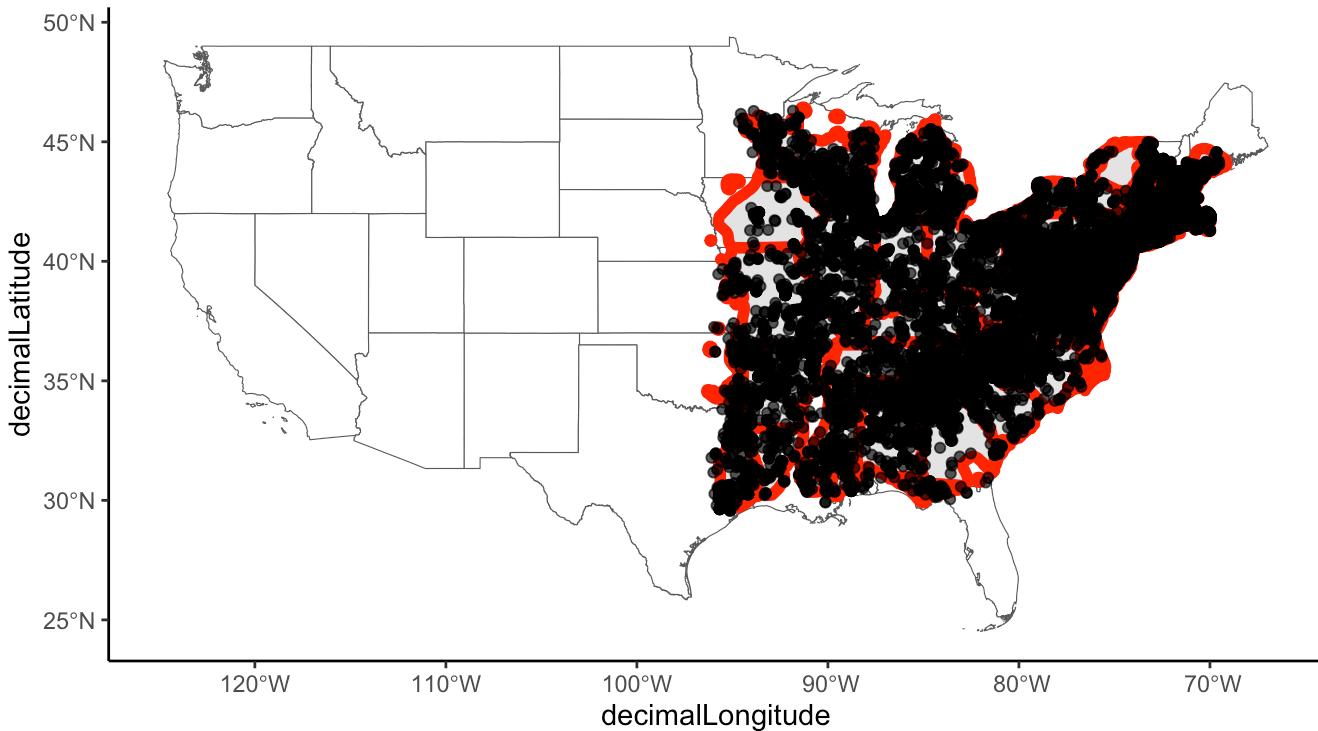
```
## Testing natural ranges
```

```
## Warning in cc_iucn(x = QUAL.occ, range = QUAL_clipped, lon =
## "decimalLongitude", : reprojecting reference to '+proj=longlat +datum=WGS84
## +no_defs'
```

```
## Flagged 31 records.
```

```
QUAL_occ_final = QUAL.occ[QUAL_flag, ]
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = QUAL_clipped, col = "red", linewidth = 2)+
  geom_point(data = QUAL_occ_final, aes(x = decimalLongitude, y = decimalLatitude), colo
r = "black", alpha = 0.7)+
  theme_classic()
```



```
ggsave("../Plots/QUAL.range.pdf", width = 12, height = 8)
```

Subset for *Quercus bicolor*

```
QUBI.occ = gbif %>%
  filter(species == "Quercus bicolor") %>%
  select(species,decimalLatitude,decimalLongitude)
```

Read in range map

```
QUBI.range = st_read("../USTreeAtlas/shp/querbico/")
```

```
## Reading layer `querbico' from data source
##   `/Users/samanthaworthy/Documents/GitHub/USTreeAtlas/shp/querbico'
##   using driver `ESRI Shapefile'
## Simple feature collection with 49 features and 5 fields
## Geometry type: POLYGON
## Dimension:     XY
## Bounding box:  xmin: -96.39155 ymin: 35.17383 xmax: -70.02106 ymax: 46.36058
## CRS:           NA
```

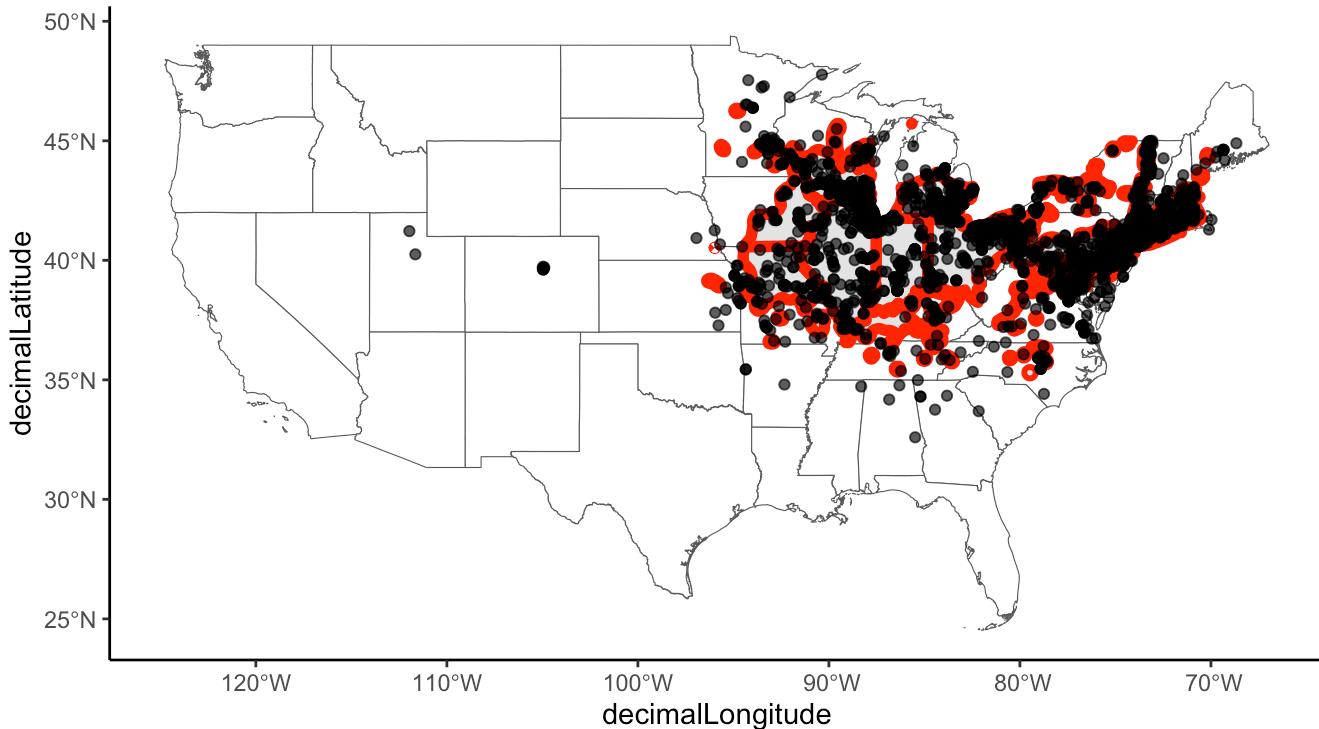
The projection is geographic with latitude and longitude. The datum is NAD27 which is EPSG:4267. The ellipsoid is Clarke 1866, and the transformation parameters

```
st_crs(QUBI.range) <- 4267
```

```
QUBI_clipped = st_intersection(QUBI.range, states.map)
```

```
## Warning: attribute variables are assumed to be spatially constant throughout
## all geometries
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = QUBI_clipped, col = "red", linewidth = 2)+
  geom_point(data = QUBI.occ, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
QUBI_clipped$species = "Quercus bicolor"
QUBI_flag = cc_iucn(x = QUBI.occ, range = QUBI_clipped, lon = "decimalLongitude", lat =
"decimalLatitude",
                     value = "flagged", buffer = 50000)
```

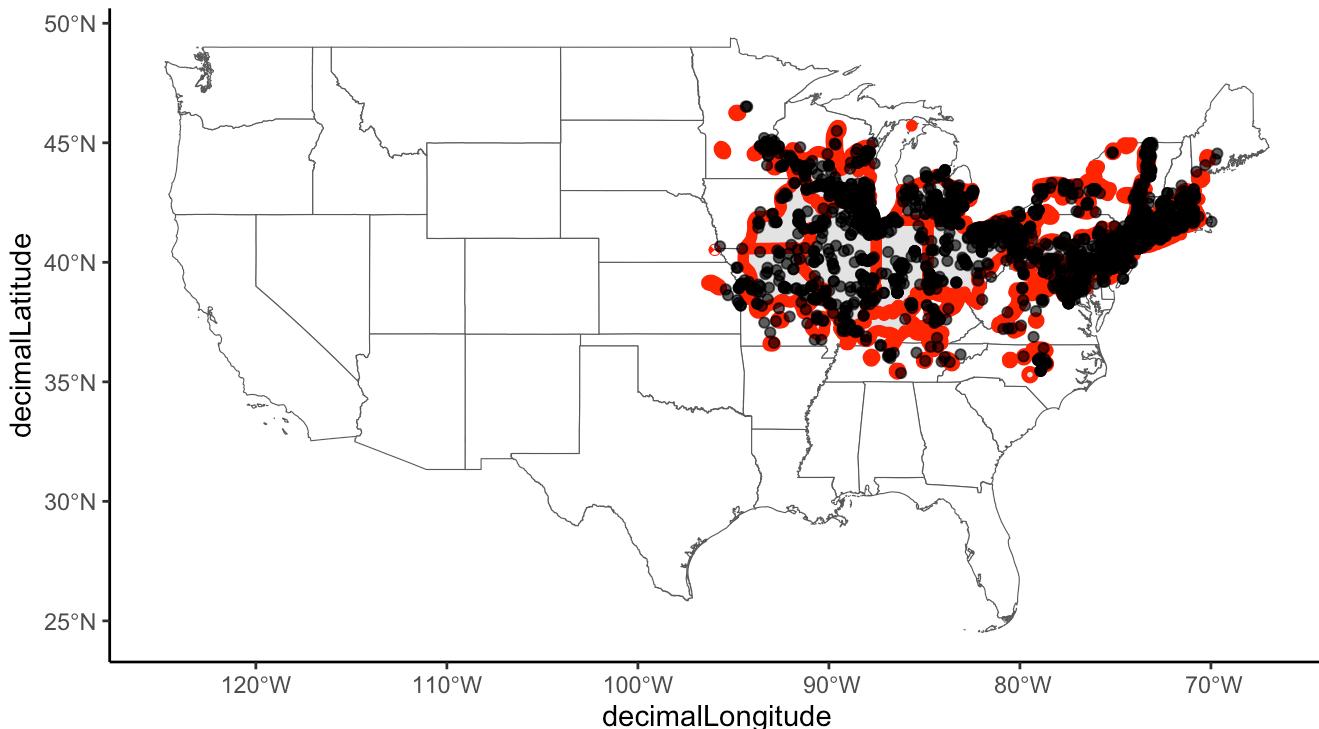
```
## Testing natural ranges
```

```
## Warning in cc_iucn(x = QUBI.occ, range = QUBI_clipped, lon =
## "decimalLongitude", : reprojecting reference to '+proj=longlat +datum=WGS84
## +no_defs'
```

```
## Flagged 97 records.
```

```
QUBI_occ_final = QUBI.occ[QUBI_flag, ]
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = QUBI_clipped, col = "red", linewidth = 2)+
  geom_point(data = QUBI_occ_final, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
ggsave("../Plots/QUBI.range.pdf", width = 12, height = 8)
```

Subset for *Quercus coccinea*

```
QUC02.occ = gbif %>%
  filter(species == "Quercus coccinea") %>%
  select(species,decimalLatitude,decimalLongitude)
```

Read in range map

```
QUC02.range = st_read("../USTreeAtlas/shp/quercocc/")

## Reading layer `quercocc' from data source
##   `/Users/samanthaworthy/Documents/GitHub/USTreeAtlas/shp/quercocc'
##   using driver `ESRI Shapefile'
## Simple feature collection with 76 features and 5 fields
## Geometry type: POLYGON
## Dimension:      XY
## Bounding box:  xmin: -92.35469 ymin: 31.22379 xmax: -69.87 ymax: 44.1226
## CRS:           NA
```

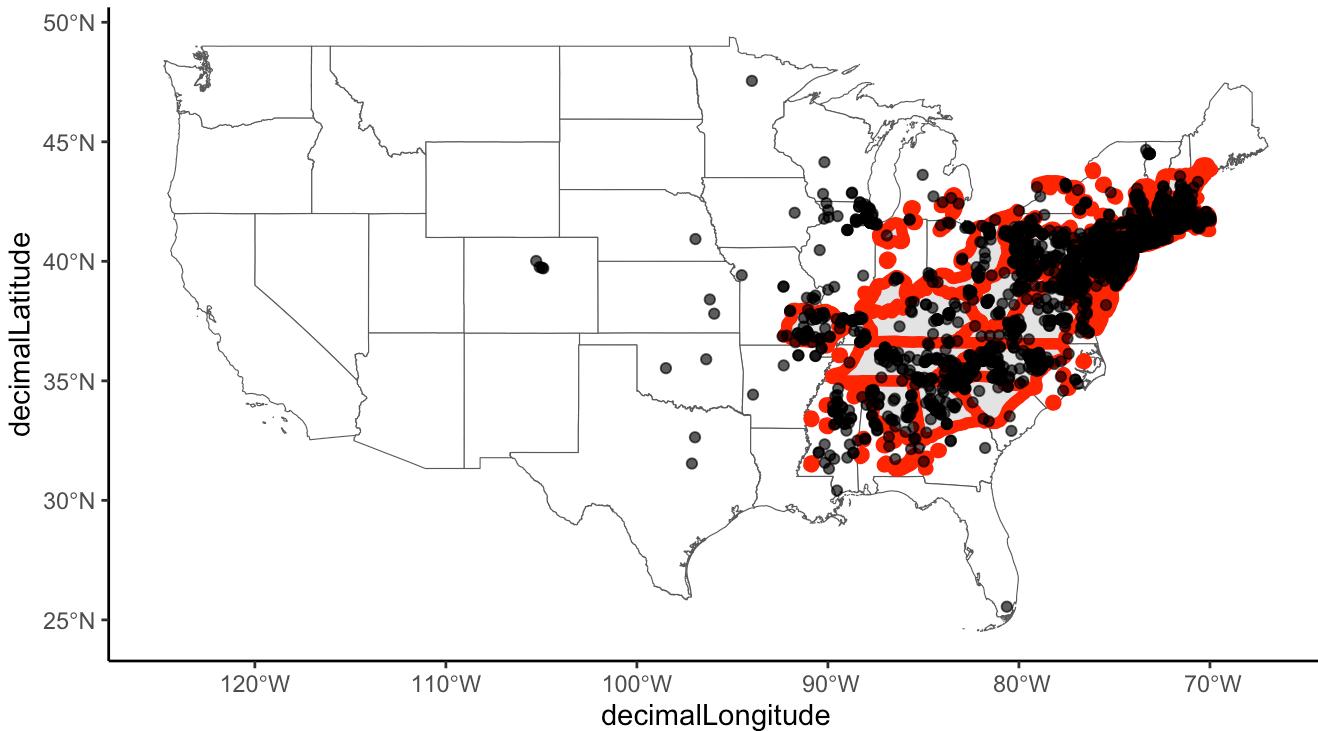
The projection is geographic with latitude and longitude. The datum is NAD27 which is EPSG:4267. The ellipsoid is Clarke 1866, and the transformation parameters

```
st_crs(QUC02.range) <- 4267
```

```
QUC02_clipped = st_intersection(QUC02.range, states.map)
```

```
## Warning: attribute variables are assumed to be spatially constant throughout
## all geometries
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = QUC02_clipped, col = "red", linewidth = 2)+
  geom_point(data = QUC02.occ, aes(x = decimalLongitude, y = decimalLatitude), color =
"black", alpha = 0.7)+
  theme_classic()
```



```
QUC02_clipped$species = "Quercus coccinea"
QUC02_flag = cc_iucn(x = QUC02.occ, range = QUC02_clipped, lon = "decimalLongitude", lat = "decimalLatitude",
                      value = "flagged", buffer = 50000)
```

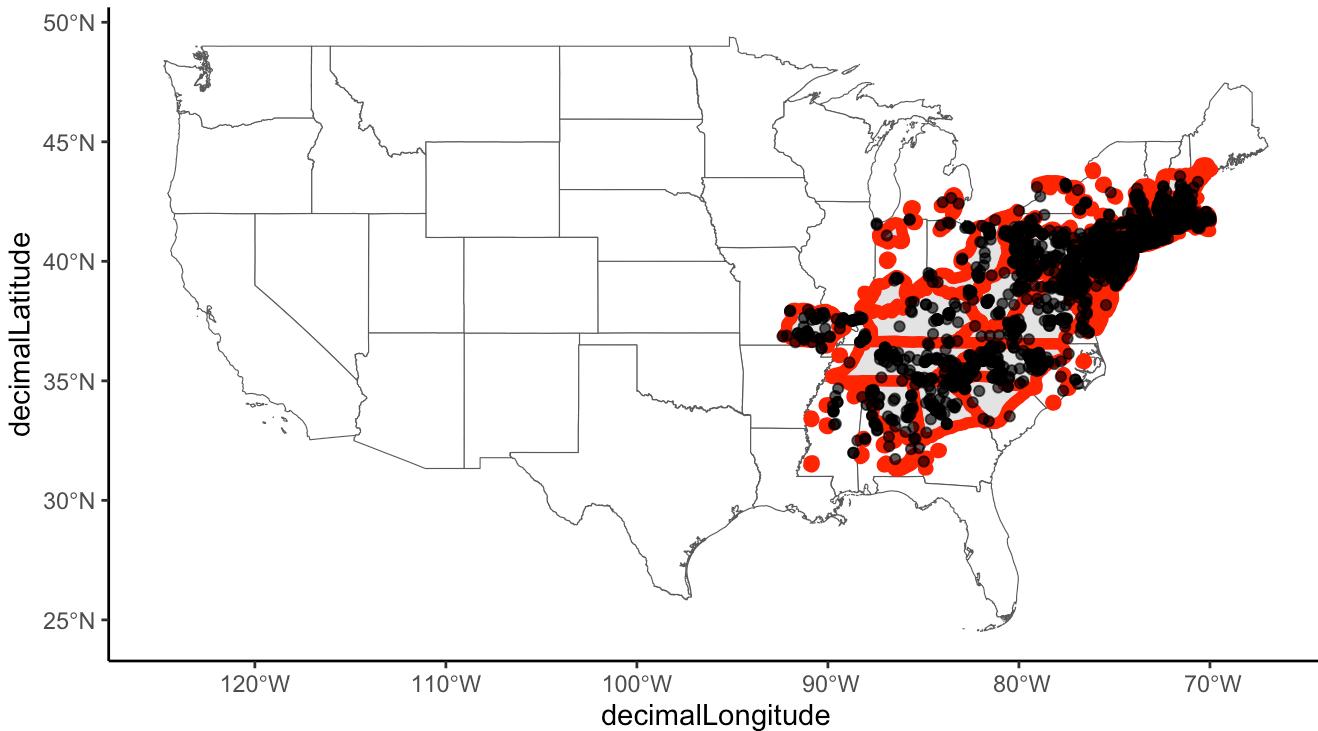
```
## Testing natural ranges
```

```
## Warning in cc_iucn(x = QUC02.occ, range = QUC02_clipped, lon =
## "decimalLongitude", : reprojecting reference to '+proj=longlat +datum=WGS84
## +no_defs'
```

```
## Flagged 116 records.
```

```
QUC02_occ_final = QUC02.occ[QUC02_flag, ]
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = QUC02_clipped, col = "red", linewidth = 2)+
  geom_point(data = QUC02_occ_final, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
ggsave("../Plots/QUC02.range.pdf", width = 12, height = 8)
```

Subset for *Quercus ellipsoidalis*

```
QUEL.occ = gbif %>%
  filter(species == "Quercus ellipsoidalis") %>%
  select(species,decimalLatitude,decimalLongitude)
```

Read in range map

```
QUEL.range = st_read("../USTreeAtlas/shp/querelli/")
```

```
## Reading layer `querelli' from data source
##   `/Users/samanthaworthy/Documents/GitHub/USTreeAtlas/shp/querelli'
##   using driver `ESRI Shapefile'
## Simple feature collection with 22 features and 5 fields
## Geometry type: POLYGON
## Dimension:     XY
## Bounding box:  xmin: -96.91765 ymin: 40.28243 xmax: -82.88901 ymax: 48.66541
## CRS:           NA
```

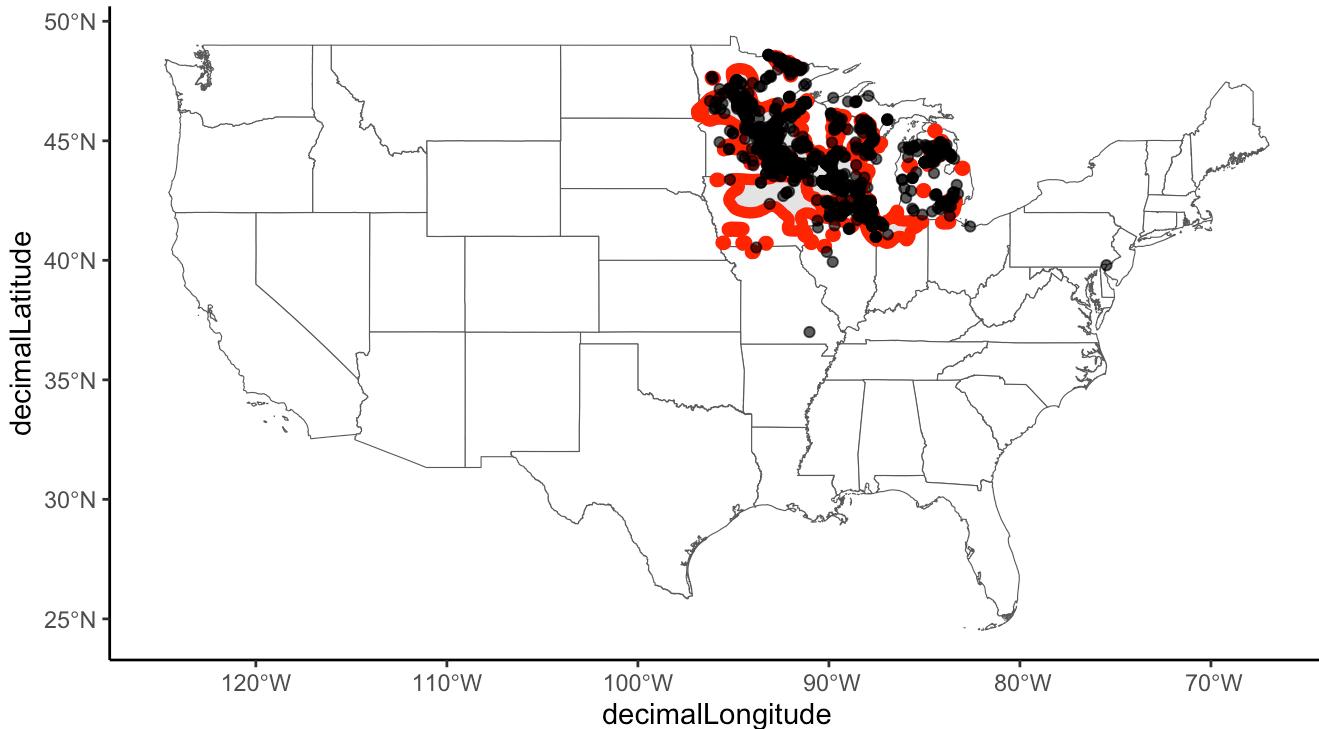
The projection is geographic with latitude and longitude. The datum is NAD27 which is EPSG:4267. The ellipsoid is Clarke 1866, and the transformation parameters

```
st_crs(QUEL.range) <- 4267
```

```
QUEL_clipped = st_intersection(QUEL.range, states.map)
```

```
## Warning: attribute variables are assumed to be spatially constant throughout
## all geometries
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = QUEL_clipped, col = "red", linewidth = 2)+
  geom_point(data = QUEL.occ, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
QUEL_clipped$species = "Quercus ellipsoidalis"
QUEL_flag = cc_iucn(x = QUEL.occ, range = QUEL_clipped, lon = "decimalLongitude", lat =
"decimalLatitude",
                     value = "flagged", buffer = 50000)
```

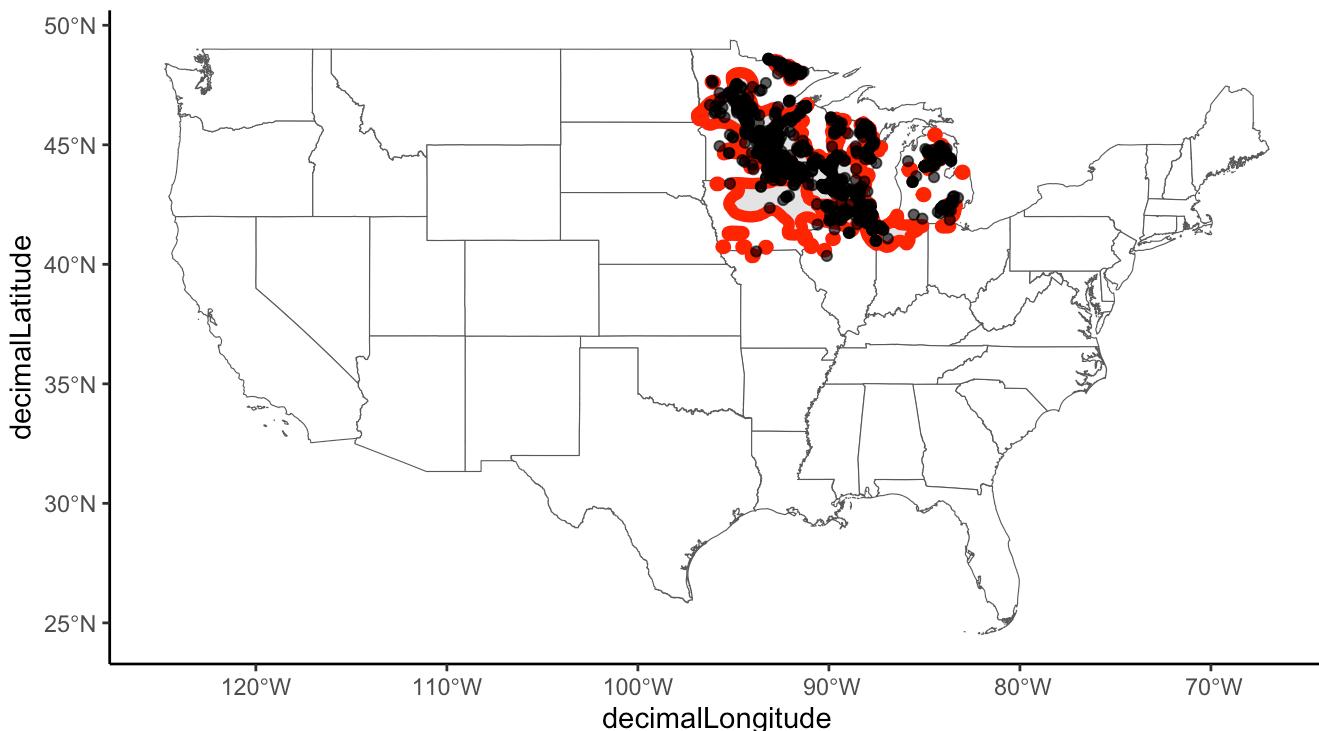
```
## Testing natural ranges
```

```
## Warning in cc_iucn(x = QUEL.occ, range = QUEL_clipped, lon =
## "decimalLongitude", : reprojecting reference to '+proj=longlat +datum=WGS84
## +no_defs'
```

```
## Flagged 39 records.
```

```
QUEL_occ_final = QUEL.occ[QUEL_flag, ]
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = QUEL_clipped, col = "red", linewidth = 2)+
  geom_point(data = QUEL_occ_final, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
ggsave("../Plots/QUEL.range.pdf", width = 12, height = 8)
```

Subset for *Quercus falcata*

```
QUFA.occ = gbif %>%
  filter(species == "Quercus falcata") %>%
  select(species,decimalLatitude,decimalLongitude)
```

Read in range map

```
QUFA.range = st_read("../USTreeAtlas/shp/querfalc/")
```

```
## Reading layer `querfalc' from data source
##   `/Users/samanthaworthy/Documents/GitHub/USTreeAtlas/shp/querfalc'
##   using driver `ESRI Shapefile'
## Simple feature collection with 58 features and 5 fields
## Geometry type: POLYGON
## Dimension:      XY
## Bounding box:  xmin: -96.82243 ymin: 28.8895 xmax: -73.46515 ymax: 40.73988
## CRS:           NA
```

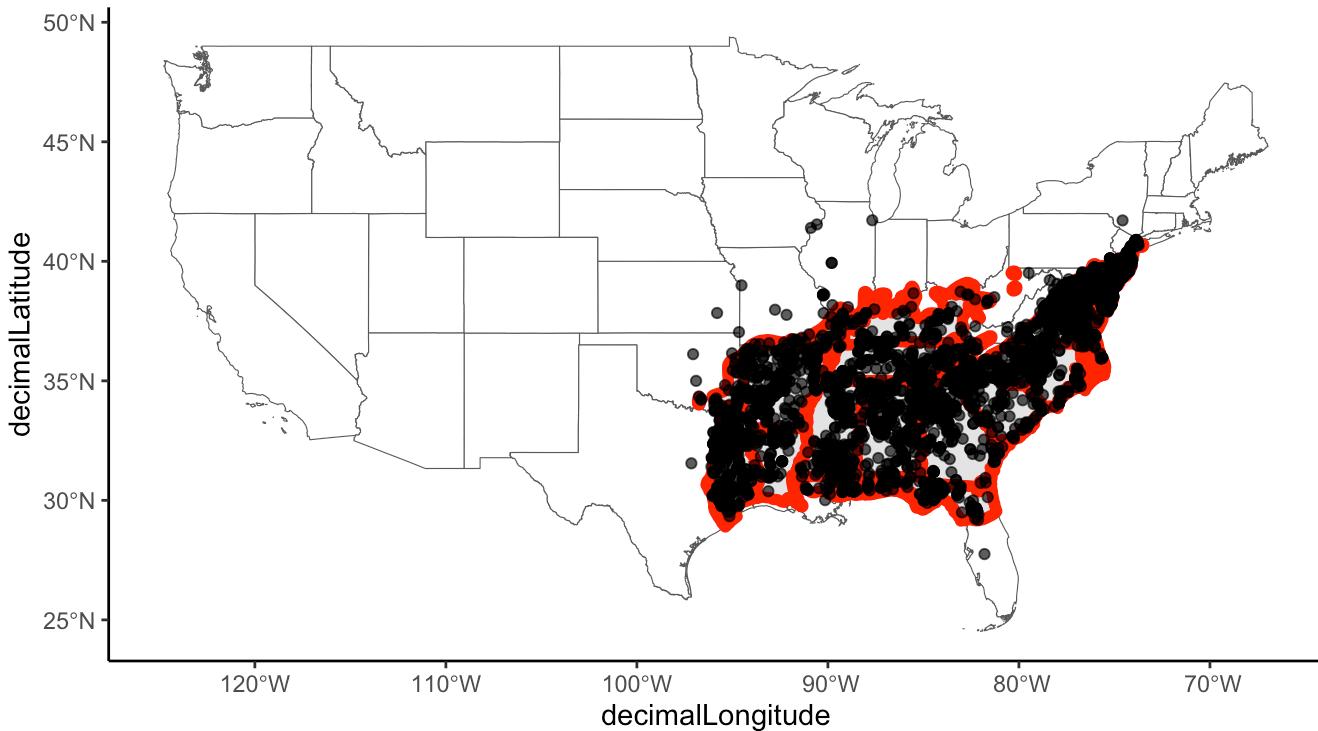
The projection is geographic with latitude and longitude. The datum is NAD27 which is EPSG:4267. The ellipsoid is Clarke 1866, and the transformation parameters

```
st_crs(QUFA.range) <- 4267
```

```
QUFA_clipped = st_intersection(QUFA.range, states.map)
```

```
## Warning: attribute variables are assumed to be spatially constant throughout
## all geometries
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = QUFA_clipped, col = "red", linewidth = 2)+
  geom_point(data = QUFA.occ, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
QUFA_clipped$species = "Quercus falcata"
QUFA_flag = cc_iucn(x = QUFA.occ, range = QUFA_clipped, lon = "decimalLongitude", lat =
"decimalLatitude",
value = "flagged", buffer = 50000)
```

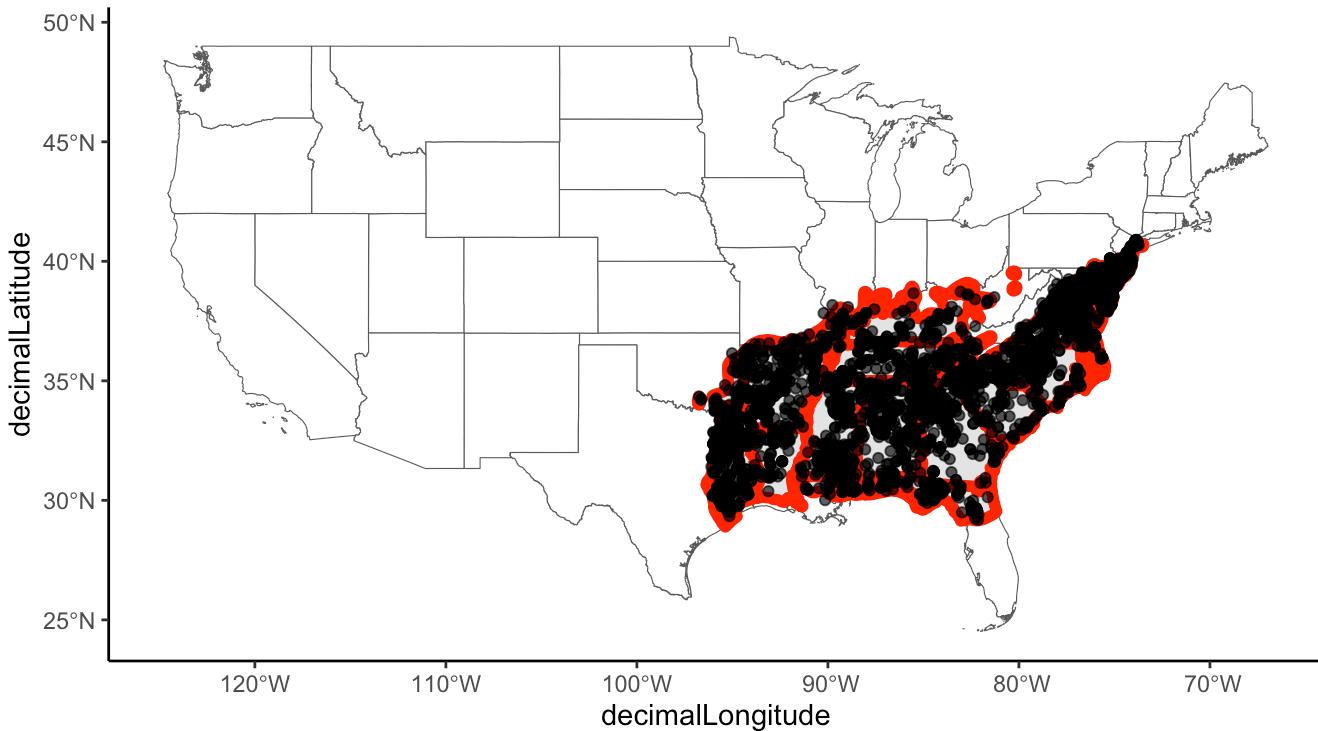
```
## Testing natural ranges
```

```
## Warning in cc_iucn(x = QUFA.occ, range = QUFA_clipped, lon =
## "decimalLongitude", : reprojecting reference to '+proj=longlat +datum=WGS84
## +no_defs'
```

```
## Flagged 24 records.
```

```
QUFA_occ_final = QUFA.occ[QUFA_flag, ]
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = QUFA_clipped, col = "red", linewidth = 2)+
  geom_point(data = QUFA_occ_final, aes(x = decimalLongitude, y = decimalLatitude), colo
r = "black", alpha = 0.7)+
  theme_classic()
```



```
ggsave("../Plots/QUFA.range.pdf", width = 12, height = 8)
```

Subset for *Quercus ilicifolia*

```
QUIL.occ = gbif %>%
  filter(species == "Quercus ilicifolia") %>%
  select(species,decimalLatitude,decimalLongitude)
```

Read in range map

```
QUIL.range = st_read("../USTreeAtlas/shp/querilic/")
```

```
## Reading layer `querilic' from data source
##   `/Users/samanthaworthy/Documents/GitHub/USTreeAtlas/shp/querilic'
##   using driver `ESRI Shapefile'
## Simple feature collection with 46 features and 5 fields
## Geometry type: POLYGON
## Dimension:     XY
## Bounding box:  xmin: -81.30976 ymin: 35.22381 xmax: -67.91949 ymax: 44.84274
## CRS:           NA
```

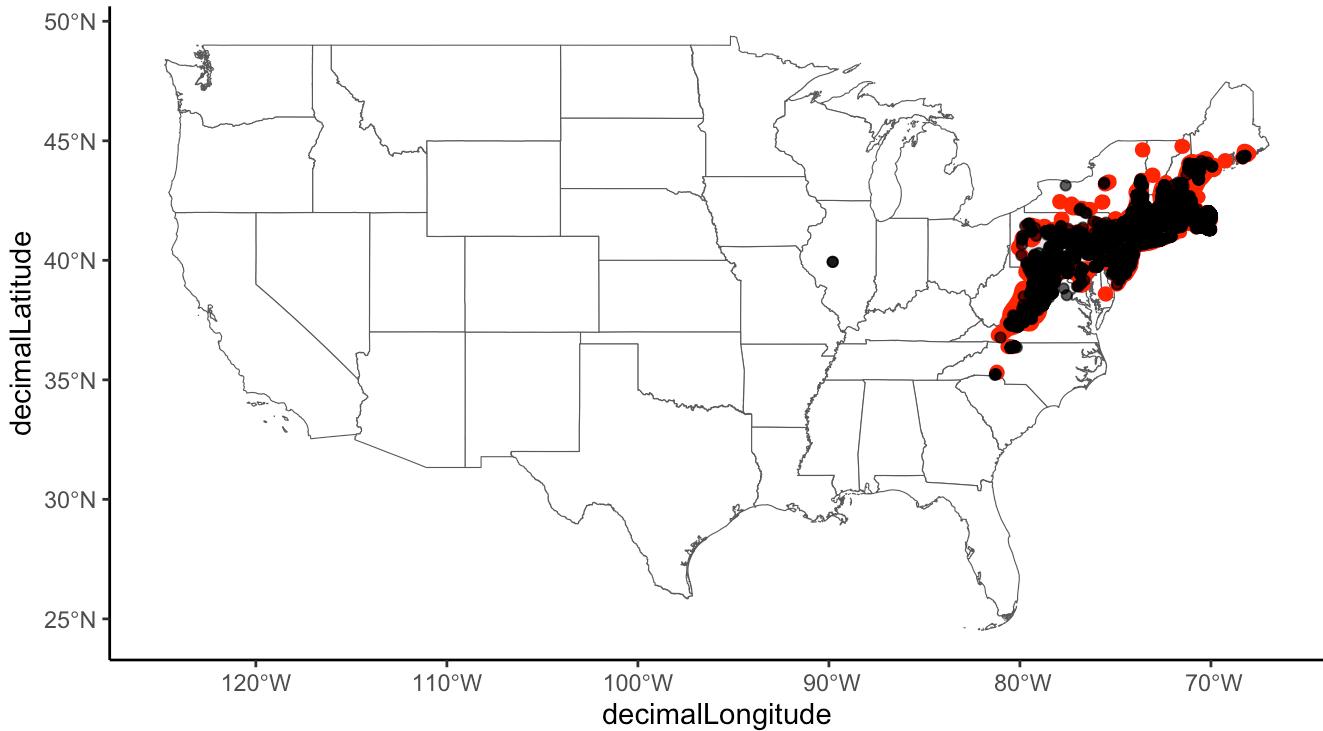
The projection is geographic with latitude and longitude. The datum is NAD27 which is EPSG:4267. The ellipsoid is Clarke 1866, and the transformation parameters

```
st_crs(QUIL.range) <- 4267
```

```
QUIL_clipped = st_intersection(QUIL.range, states.map)
```

```
## Warning: attribute variables are assumed to be spatially constant throughout
## all geometries
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = QUIL_clipped, col = "red", linewidth = 2)+
  geom_point(data = QUIL.occ, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
QUIL_clipped$species = "Quercus ilicifolia"
QUIL_flag = cc_iucn(x = QUIL.occ, range = QUIL_clipped, lon = "decimalLongitude", lat =
"decimalLatitude",
                     value = "flagged", buffer = 50000)
```

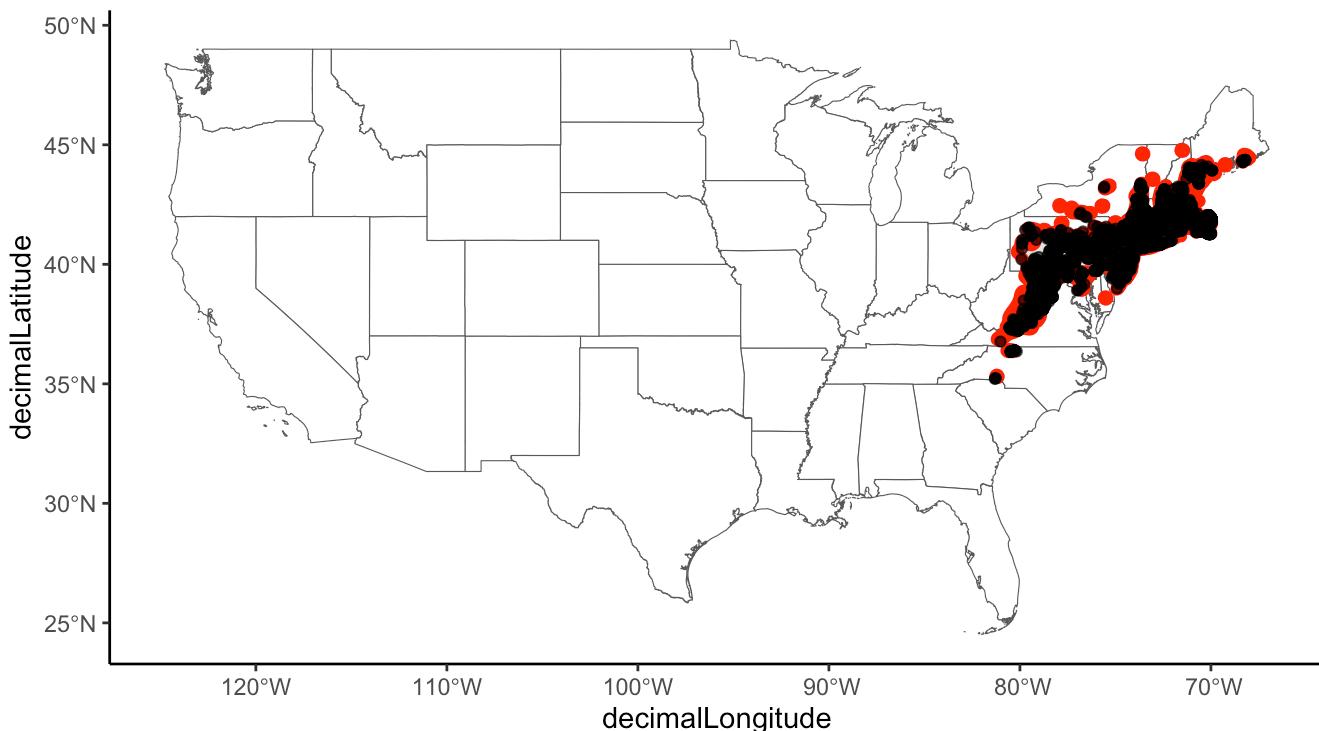
```
## Testing natural ranges
```

```
## Warning in cc_iucn(x = QUIL.occ, range = QUIL_clipped, lon =
## "decimalLongitude", : reprojecting reference to '+proj=longlat +datum=WGS84
## +no_defs'
```

```
## Flagged 5 records.
```

```
QUIL_occ_final = QUIL.occ[QUIL_flag, ]
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = QUIL_clipped, col = "red", linewidth = 2)+
  geom_point(data = QUIL_occ_final, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
ggsave("../Plots/QUIL.range.pdf", width = 12, height = 8)
```

Subset for *Quercus imbricaria*

```
QUIM.occ = gbif %>%
  filter(species == "Quercus imbricaria") %>%
  select(species,decimalLatitude,decimalLongitude)
```

Read in range map

```
QUIM.range = st_read("../USTreeAtlas/shp/querimbr/")
```

```
## Reading layer `querimbr' from data source
##   `/Users/samanthaworthy/Documents/GitHub/USTreeAtlas/shp/querimbr'
##   using driver `ESRI Shapefile'
## Simple feature collection with 38 features and 5 fields
## Geometry type: POLYGON
## Dimension:      XY
## Bounding box:  xmin: -96.96888 ymin: 31.03043 xmax: -75.56732 ymax: 42.31751
## CRS:           NA
```

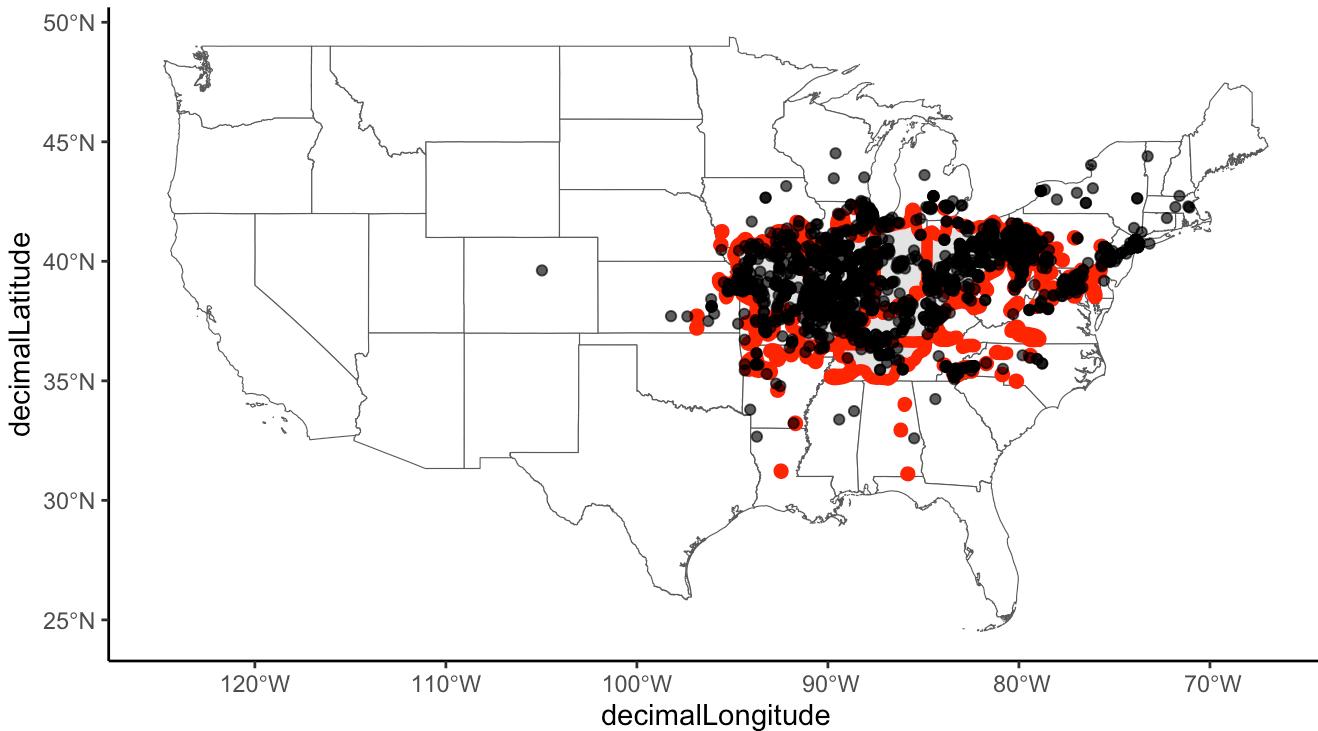
The projection is geographic with latitude and longitude. The datum is NAD27 which is EPSG:4267. The ellipsoid is Clarke 1866, and the transformation parameters

```
st_crs(QUIM.range) <- 4267
```

```
QUIM_clipped = st_intersection(QUIM.range, states.map)
```

```
## Warning: attribute variables are assumed to be spatially constant throughout
## all geometries
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = QUIM_clipped, col = "red", linewidth = 2)+
  geom_point(data = QUIM.occ, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
QUIM_clipped$species = "Quercus imbricaria"
QUIM_flag = cc_iucn(x = QUIM.occ, range = QUIM_clipped, lon = "decimalLongitude", lat =
"decimalLatitude",
                     value = "flagged", buffer = 50000)
```

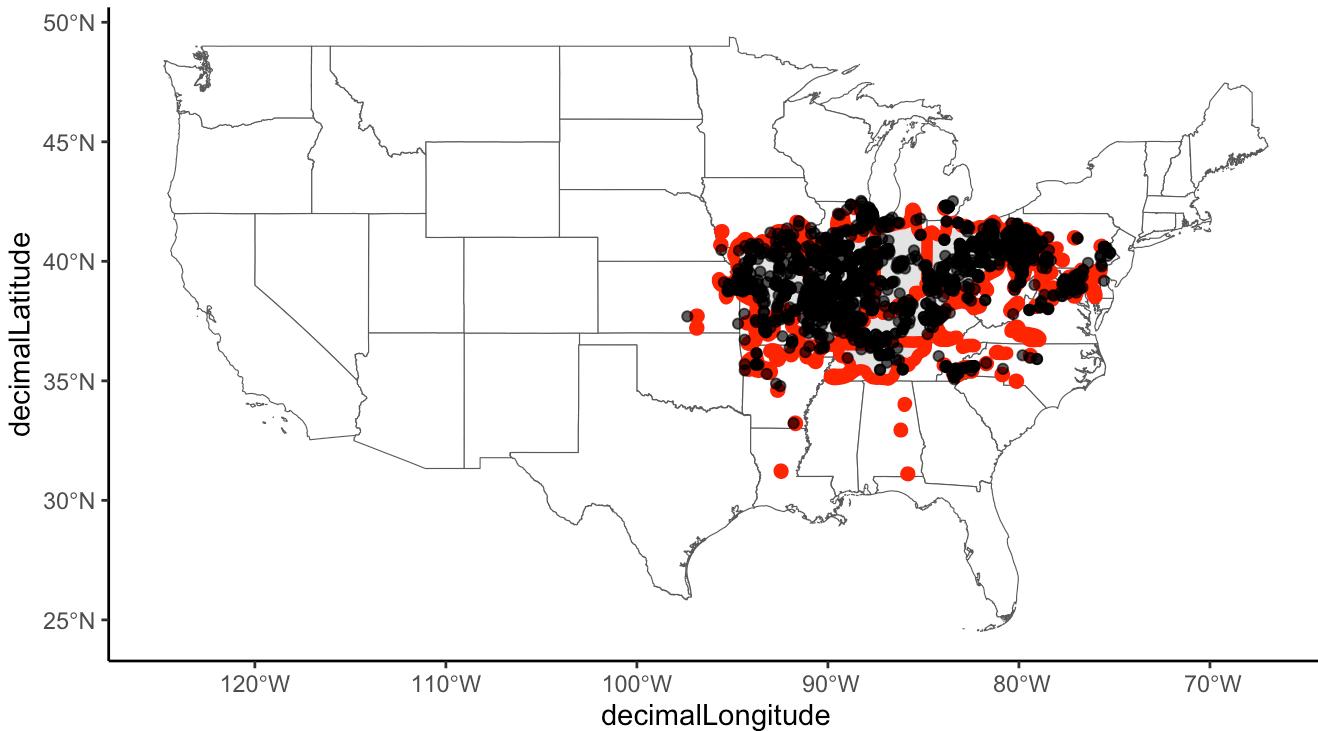
```
## Testing natural ranges
```

```
## Warning in cc_iucn(x = QUIM.occ, range = QUIM_clipped, lon =
## "decimalLongitude", : reprojecting reference to '+proj=longlat +datum=WGS84
## +no_defs'
```

```
## Flagged 1035 records.
```

```
QUIM_occ_final = QUIM.occ[QUIM_flag, ]
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = QUIM_clipped, col = "red", linewidth = 2)+
  geom_point(data = QUIM_occ_final, aes(x = decimalLongitude, y = decimalLatitude), colo
r = "black", alpha = 0.7)+
  theme_classic()
```



```
ggsave("../Plots/QUIM.range.pdf", width = 12, height = 8)
```

Subset for *Quercus incana*

```
QUIN.occ = gbif %>%
  filter(species == "Quercus incana") %>%
  select(species,decimalLatitude,decimalLongitude)
```

Read in range map

```
QUIN.range = st_read("../USTreeAtlas/shp/querinca/")
```

```
## Reading layer `querinca' from data source
##   `/Users/samanthaworthy/Documents/GitHub/USTreeAtlas/shp/querinca'
##   using driver `ESRI Shapefile'
## Simple feature collection with 55 features and 5 fields
## Geometry type: POLYGON
## Dimension:     XY
## Bounding box:  xmin: -97.78163 ymin: 26.41639 xmax: -75.77622 ymax: 36.8999
## CRS:           NA
```

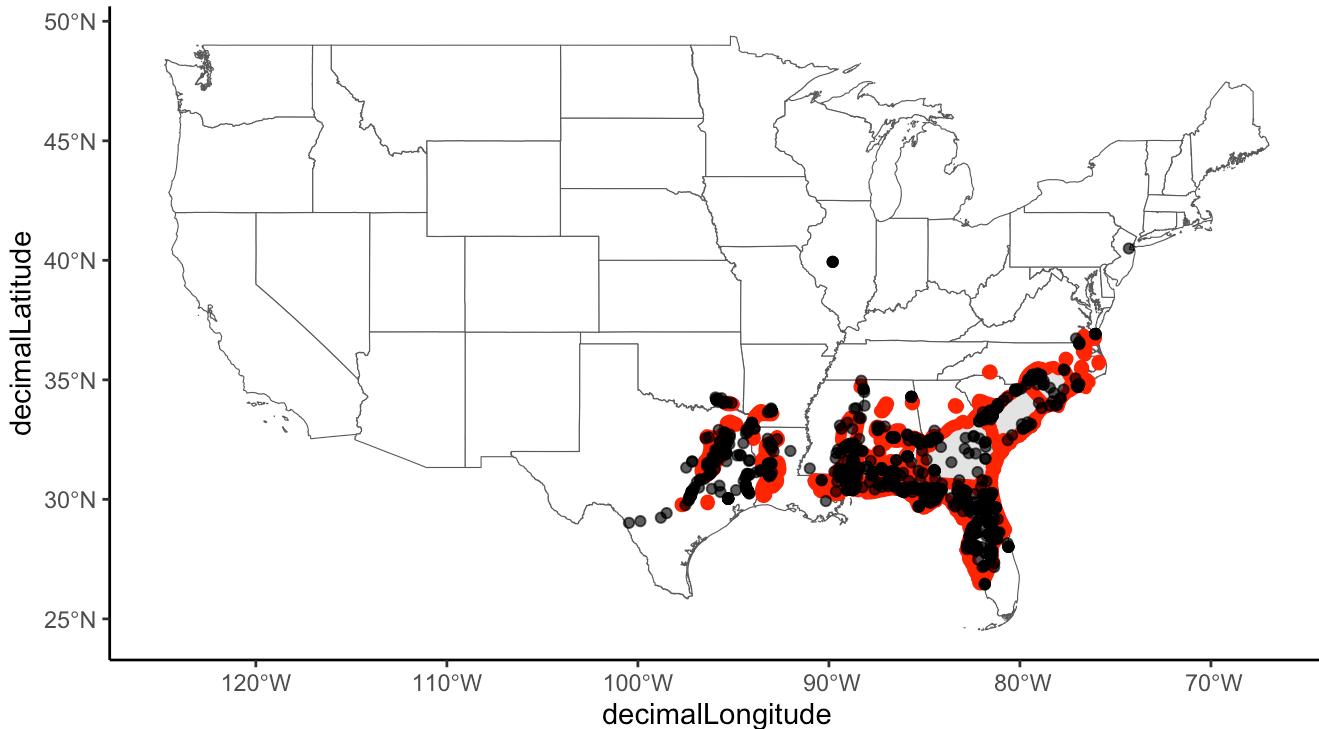
The projection is geographic with latitude and longitude. The datum is NAD27 which is EPSG:4267. The ellipsoid is Clarke 1866, and the transformation parameters

```
st_crs(QUIN.range) <- 4267
```

```
QUIN_clipped = st_intersection(QUIN.range, states.map)
```

```
## Warning: attribute variables are assumed to be spatially constant throughout
## all geometries
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = QUIN_clipped, col = "red", linewidth = 2)+
  geom_point(data = QUIN.occ, aes(x = decimalLongitude, y = decimalLatitude), color = "black", alpha = 0.7)+
  theme_classic()
```



```
QUIN_clipped$species = "Quercus incana"
QUIN_flag = cc_iucn(x = QUIN.occ, range = QUIN_clipped, lon = "decimalLongitude", lat =
"decimalLatitude",
                     value = "flagged", buffer = 50000)
```

```
## Testing natural ranges
```

```
## Warning in cc_iucn(x = QUIN.occ, range = QUIN_clipped, lon =
## "decimalLongitude", : reprojecting reference to '+proj=longlat +datum=WGS84
## +no_defs'
```

```
## Flagged 80 records.
```

```
QUIN_occ_final = QUIN.occ[QUIN_flag, ]
```

```
ggplot()+
  geom_sf(data = states.map, fill = "white")+
  geom_sf(data = QUIN_clipped, col = "red", linewidth = 2)+
  geom_point(data = QUIN_occ_final, aes(x = decimalLongitude, y = decimalLatitude), colo
r = "black", alpha = 0.7)+
  theme_classic()
```