Making predictions

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So far...

- Build, check & select models for detectability
- Build, check & select models for abundance
- Make some ecological inference about smooths
- what about predictions

What predictions do we want to make?

- Abundance estimates
- Maps of abundance
- These are related

Let's talk about maps

What does a map mean?

- Grids!
- Each cell is an abundance estimate
- Whole map is a "snapshot"
- Sum all the cells to get the overall abundance
- Sum a subset to get a stratified estimate

Going back to the formula

Model:

$$n_j = A_j \hat{p}_j \exp \left[\beta_0 + s(y_j) + s(Depth_j)\right] + \epsilon_j$$

Predictions (index r):

$$n_r = A_r \exp[\beta_0 + s(y_r) + s(Depth_r)]$$

Need to "fill-in" values for A_r , y_r and $Depth_r$.

Predicting

- With these values can use predict in R
- predict(model, newdata=data)

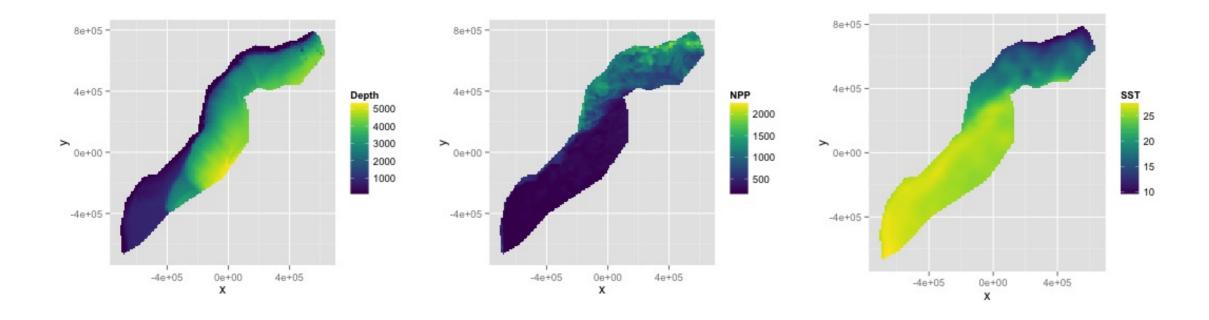
Rasters

- Jason has talked about rasters a bit
- In R, the data. frame is king
- Fortunately as.data.frame exists
- Make our "stack" and then convert to data.frame

Prediction data

```
Depth
                                       SST
                                                NPP off.set
126 547984.6
             788254
                      153.59825
                                 9.049170 1462.521
                                                       1e + 08
             788254
                      552.31067
    557984.6
                                 9.413981 1465.410
                                                       1e + 08
258 527984.6 778254
                       96.81992
                                 9.699239 1429.432
                                                       1e + 08
                      138.23763
259 537984.6 778254
                                 9.727216 1424.862
                                                       1e + 08
260 547984.6
             778254
                      505.14386
                                 9.880866 1379.351
                                                       1e+08
261 557984.6 778254 1317.59521 10.091471 1348.544
                                                       1e + 08
```

Predictors

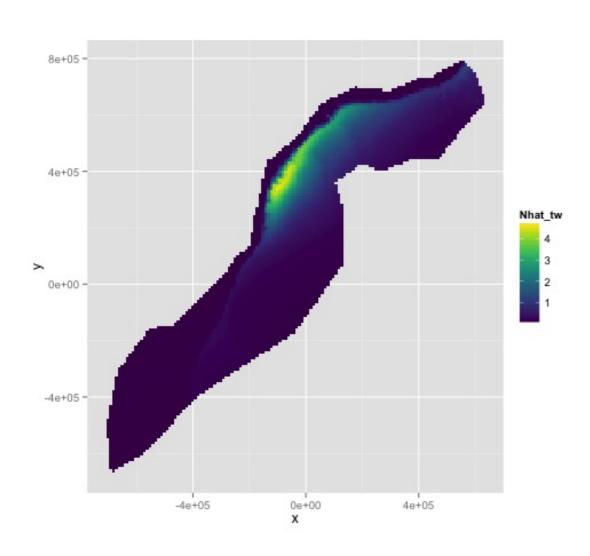


Making a prediction

- Add another column to the prediction data
- Plotting then easier (in R)

```
predgrid$Nhat_tw <- predict(dsm_all_tw_rm, predgrid)</pre>
```

Maps of predictions



```
p <- ggplot(predgrid) +

geom_tile(aes(x=x,y=y,fill=Nhat_tw))
+
    scale_fill_viridis() +
    coord_equal()
print(p)</pre>
```

Total abundance

Each cell has an abundance, sum to get total

```
sum(predict(dsm_all_tw_rm, predgrid))
```

[1] 2491.864

Subsetting

R subsetting lets you calculate "interesting" estimates:

```
# how many sperm whales at depths less than 2500m?
sum(predgrid$Nhat_tw[predgrid$Depth <= 2500])

[1] 1006.271

# how many sperm whales North of 0?
sum(predgrid$Nhat_tw[predgrid$x>0])

[1] 1383.744
```

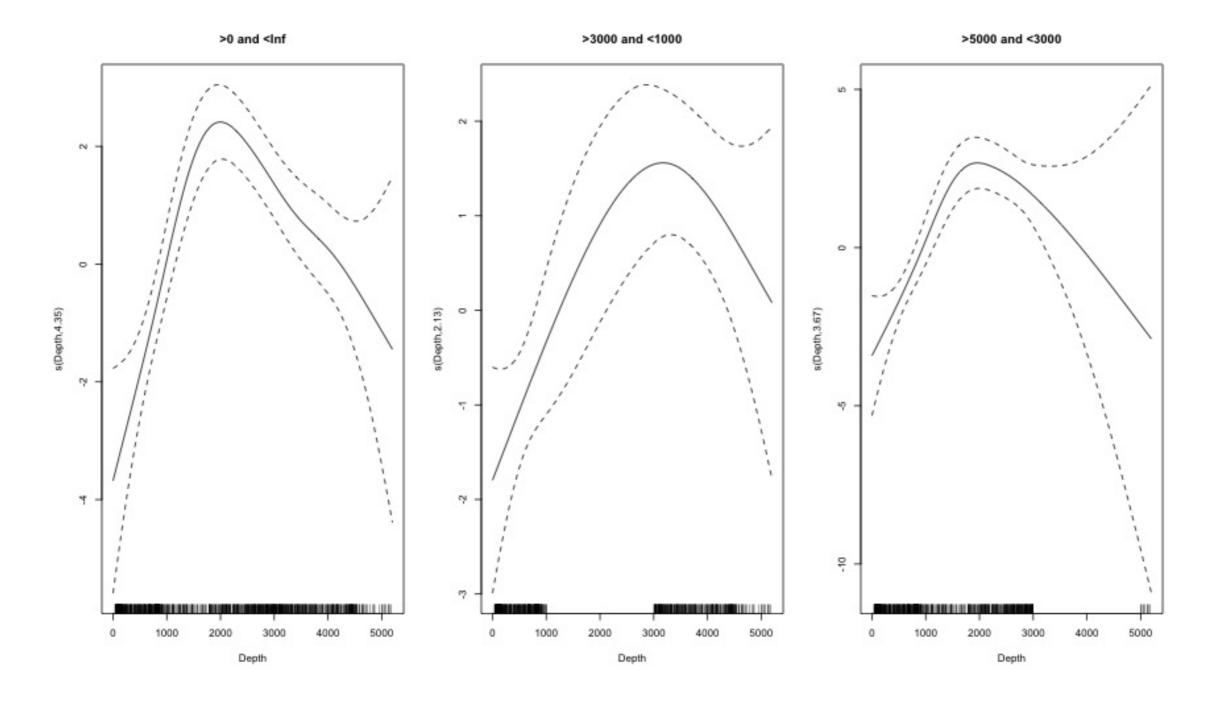
Extrapolation

DANGER WILL ROBINSON, DANGER

What do we mean by extrapolation?

- Predicting at values outside those observed
- What does "outside" mean?
- Multidimensional problem

"Outside"



Temporal extrapolation

- Models are temporally implicit (mostly)
- Dynamic variables change seasonally
- Migration can be an issue
- Need to understand what the predictions are

Extrapolation

- Extrapolation is fraught with issues
- In general, try not to do it!
- Want to be predicting "inside the rug"
- More on this in the "advanced" lecture

Recap

- Using predict
- Getting "overall" abundance
- Subsetting
- Plotting in R
- Extrapolation (and its dangers)