Modeling swordfish daytime vertical habitat in the North Pacific Ocean from pop-up archival tags

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28 tags, 5 recovered, 23 tracks
Distributions

daytime basking
a. tag #8832

b. tag #49070
hypoxia-based habitat compression

Prince & Goodyear 2006
Daytime mean depth (basking events removed)

Mean : 386 m
Median : 360 m
Family: gaussian  
Link function: identity  

Formula:  
\[ \text{mdt} \sim s(\log(\text{chl}), \text{k} = 20) + s(\text{ox400}, \text{k} = 25) + s(\text{ox400}, \text{T400}, \text{k} = 30) \]

Parametric coefficients:  

| term      | Estimate | Std. Error | t value | Pr(>|t|) |
|-----------|----------|------------|---------|----------|
| (Intercept)| 380.197  | 2.733      | 139.1   | <2e-16 ***|

Approximate significance of smooth terms:  

<table>
<thead>
<tr>
<th>term</th>
<th>edf</th>
<th>Ref.df</th>
<th>F</th>
<th>p-value</th>
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</thead>
</table>
| s(log(chl)) | 17.07 | 18.50 | 10.729 | < 2e-16 ***  
| s(ox400)     | 16.70 | 19.67 | 3.233  | 3.6e-06 ***  
| s(ox400,T400) | 21.53 | 24.12 | 12.336 | < 2e-16 ***  

R-sq.(adj) = 0.771  
Deviance explained = 79%  
GCV score = 5822.8  
Scale est. = 4937.5  
n = 661

chl from MODIS-Aqua  
ox400 from the World Ocean Atlas  
T400 from the tags PDT data
PREDICTIONS
Constant isolume?

Carey & Robison 1981
Sepulveda et al. 2010
Minimum concentration encountered: 0.16 mL/L (tag #67457), at a depth of 504m, in March, longitude = 242.3°E, latitude = 17.7°N
Summary

→ daytime mean depth = foraging at depth

→ can be explained by 3 environmental factors: light, temperature at depth, oxygen concentration at depth

→ the combination of those 3 factors can be converted spatially to produce maps of daytime mean depth
  → daytime longline sets targeting swordfish to reduce by-catch ??

→ in absence of basking, swordfish seem to roughly follow an isolume

→ lower limit of oxygen tolerance around 0.2mL/L