Yellow highlight = update in code.

~~Crossed out~~ - = not useful from Myctophid standpoint

## Otolith Sampling

### Otolith Prep.

* Sagittal otoliths used.
* Otoliths removed from package and placed in petri dish filled with tap water for approx. 1 minute.
* Tissue and stuck packaging carefully removed while in water with tweezers and edge of a mounted needle.
  + Washed away.
  + Water changed between washes.
* ~~Spray of canned air used to blow off excess water/~~ blotted if small.
* Otoliths left to air dry completely at room temperature before sampling.

### ~~Dremelling~~

* ~~Large otoliths sampled using dremel rotary tool.~~
* ~~Otoliths mounted onto glass slide with Blu Tac.~~
  + ~~Slide held with custom built Lego holder.~~
* ~~Either engraving or diamond bit on lowest speed setting as possible.~~
* ~~No more than 1mm depth taken.~~
  + ~~Outer edge.~~
  + ~~If bands can be seen, go where bands are thickest to integrate as little time as possible.~~
* ~~Powder tapped onto black card, wrapped in foil and secured upright.~~
* ~~Wipe with Blu Roll, and air duster used to remove excess powder and prevent cross-contamination.~~

## Isotope Analysis

* Expressed permil (%o).
* Standard for C and O is Vienna Pee Dee Belemnite.
* dX = ((Ratio\_sample – Ratio\_standard)/Ratio\_Standard) \* 1000
* Analysed using Thermo Scientific Kiel IV Carbonate device coupled with a MAT253 isotope ratio mass spectrometer.

## Data from Literature

1. Search: otolith AND carbon\* AND isotop\* - WoS
2. Otolith d13C
3. Modern marine species
4. Wild adults
5. With data (d13C, body mass, location).

## Model for M

Components:

* D13C\_oto
* D13C\_DIC
* D13C\_diet
* E

### D13C\_DIC

* DIC maps from Tagliabue & Bopp 2008.
* Figure 2a – Average d13C\_DIC in 1990.
  + Colour match used for base DIC.
  + Stan dev = 0.202 🡪 from PICSES-A (Table 2).
* Need to account for Suess effect.
  + Anthropogenic CO2 is depleted in d13C.
  + Changes the DIC due to ocean absorption of CO2.
* Figure 9 – Surface ocean Suess effect between 1970-2000 during PICSCES-A.
  + Colour match again.
  + Add/minus from base d13C\_DIC in 1990.
  + Stan dev = 0.202 🡪 from PICSCES-A (Table 2).
* Pre 1970.
  + -0.07%o per decade.
  + Add value from map up to 1970, then use 0.07%o value.
  + Stan dev = 0.202 🡪 from PICSES-A (Table 2).

### D13C\_diet

* Made up of d13C\_phyto, trophic level and trophic enrichment factor.
* Test estimates against muscle from Ming-Tsung.

#### D13C\_Phyto

* Map from Magozzi et al. 2017.
* Figure 1 – Modelled annually averaged surface water phytoplankton, from 2001-2010.
  + Colour matched for base d13C\_Phyto.
* Need to account for Suess again.
  + -0.17 per decade.
  + Stan dev = 0.202 🡪 from PISCES-A (Table 2).

#### Trophic Level

* From FishBase.
  + Use the trophic level from diet composition where possible.
  + Standard error also from FishBase.
* Phytoplankton have a trophic level of 1.
  + To get to phytoplankton, do TL – 1.

#### Trophic Enrichment Factor

* 0.8%o according to DeNiro & Epstein, 1978.
  + Standard deviation of 1.1%o.

### E

* Isotopic fractionation factor.
  + Fractionation from DIC🡪 blood 🡪 endolymph 🡪 otolith.
  + Set to 0 in previous work.
* -1.8%o according to Solomon et al. 2006.
  + Standard deviation is 1.8%o.

## Model for Temperature

## Model for Body Mass

### Getting Total Length

* Total length = (length measurement / length percent)\*100
* Morphometrics from FishBase or measured using ImageJ.
  + From morphometric photographs where possible.
  + From drawings if needs be, or from closely related species.
* Checked against ecology table sources for plausibility.

### Getting Weight

* Used length-weight relationships from FishBase and Godbold et al. 2013.
  + Where many – use mean of a and b and add sd.
* Used closely-related species where none were available.

## ~~Ecology Data~~

* ~~Categories dictated by FishBase.~~
  + ~~Body shape – eel-like/elongated/fusiform/short~~
  + ~~Depth min/max.~~
  + ~~Caudal aspect ratio.~~
  + ~~Benthic/benthopelagic/pelagic.~~
  + ~~Migratory/non-migratory.~~
  + ~~Schooling/shoaling.~~
* ~~Compared against references and selected those that matched up the most/were most reliable (i.e. FAO).~~