# Mysis modeling brainstorm:

Variables:

| | | |
|---|---|---|
| Time | = | $t$ |
| Average solar radiation | = | $a$ |
| Thermocline's distance from surface | = | $d$ |
| Calories ($c$) | = | if migrating: $+\omega$ |
| | | else: $-\epsilon$ |

Migrate Desire Model equations:

| | | |
|---|---|---|
| Mysis engrained desire to migrate: | $M(t) =$ | $C_1$ (assuming resolution of a single day) |
| Pressure not to migrate from light levels: | $L(a) =$ | $C_2 \log(a)$ |
| Pressure " " from thermocline depth: | $D(d) =$ | $C_3(d)$ |
| Hunger: | $H(c) =$ | $c_4 e^c$ |

Total Mysis model:

| | | |
|---|---|---|
| Migrate or Not | = | $MoN(t,a,d,c) = M(t) - L(a) - D(d) + H(c)$ |
| If ($MoN(t,a,d,c) > \alpha$ for day) | = | migrate |

A large number of Mysis will be initialized with randomly permuted starting conditions and run through an arbitrary amount of time (say a year). Their migration patterns will be visualized, from this visualizations patterns in migration will be come apparent.

## Light Intensity Equation

$$I_x = I_o e^{-kx}$$

$$I_{x,o} = \text{intensity at depth x and surface respectively (in lux)}$$

$$k = \text{ extinction coefficient (or water clarity)}$$

So to solve for distance to threshold we find..

$$\begin{aligned} \tfrac{I_x}{I_o} &= e^{-kx} \\ ln(\tfrac{I_x}{I_o}) &= -kx \\ ln(I_x) - ln(I_o) &= -kx \\ ln(I_o) - ln(I_x) &= kx \\ \tfrac{1}{k}(ln(I_o) - ln(I_x)) &= x \end{aligned}$$

We set the threshold ($I_x$) to be $10^{-2}$ lux (per Boscarino 2007) and the extinction coefficient ($k$) to be 0.15 (per Jenson 2006). This turns the function into one of current light level at surface ($I_o$) in the form of:

Distance of light threshold: $f(I_o) = \frac{1}{k}(ln(I_o) - ln(I_x))$
or
$f(I_o) = \frac{1}{0.15}(ln(I_o) + 6.9)$

**Note:** make sure to plot the different parameter values for this equation later. Maybe make an interactive visualization of it.

For nightime light intensity I am currently going off of a fishing website's un-cited figure. This will need to be updated to a more legitimate source when I am on the UVM network.