Summary

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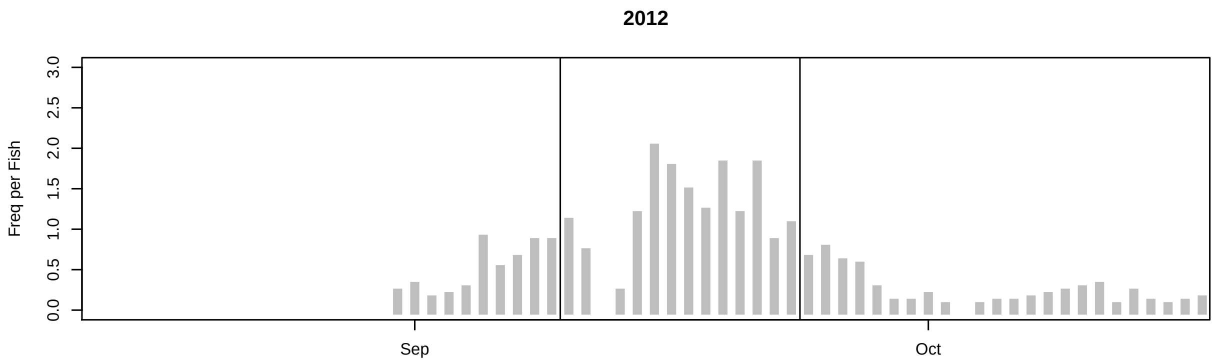
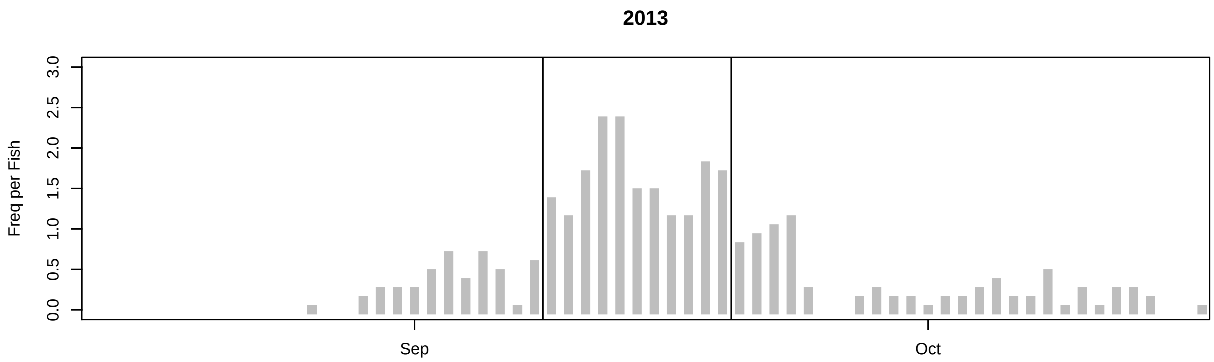
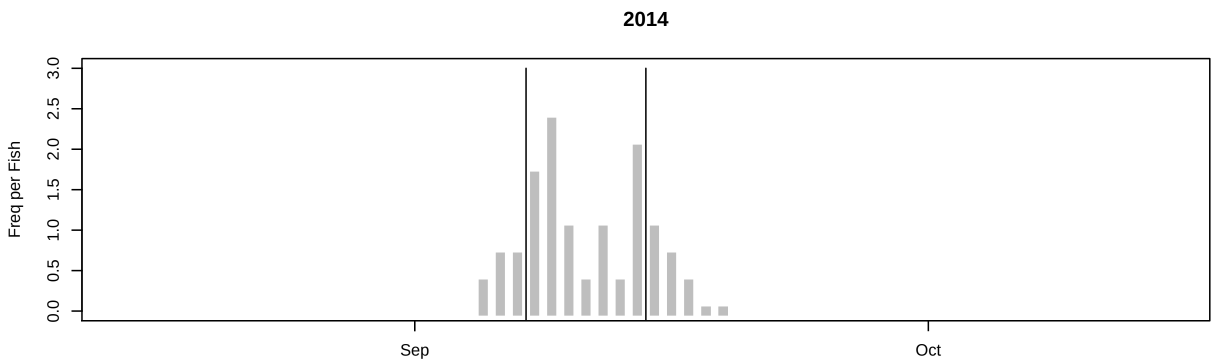
Cluster Frequency Over Time

I created a frequency per individual plot of spawning clusters which nicely scaled the data among years. Each year has a nice spawning bump in the middle of September.

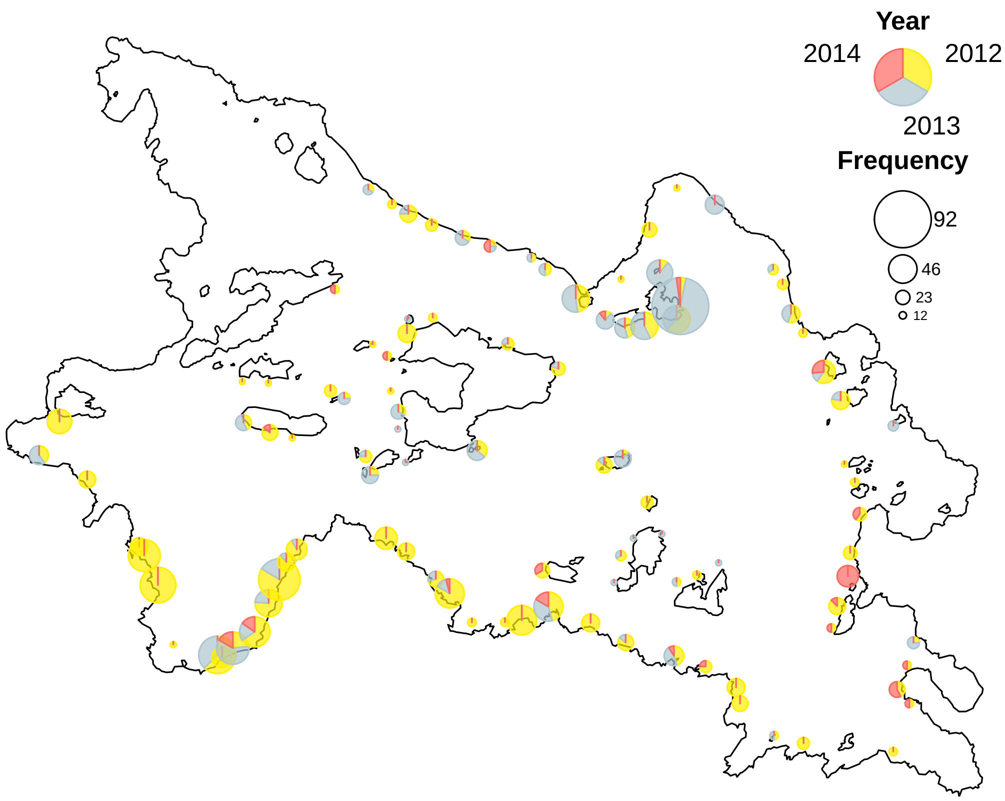




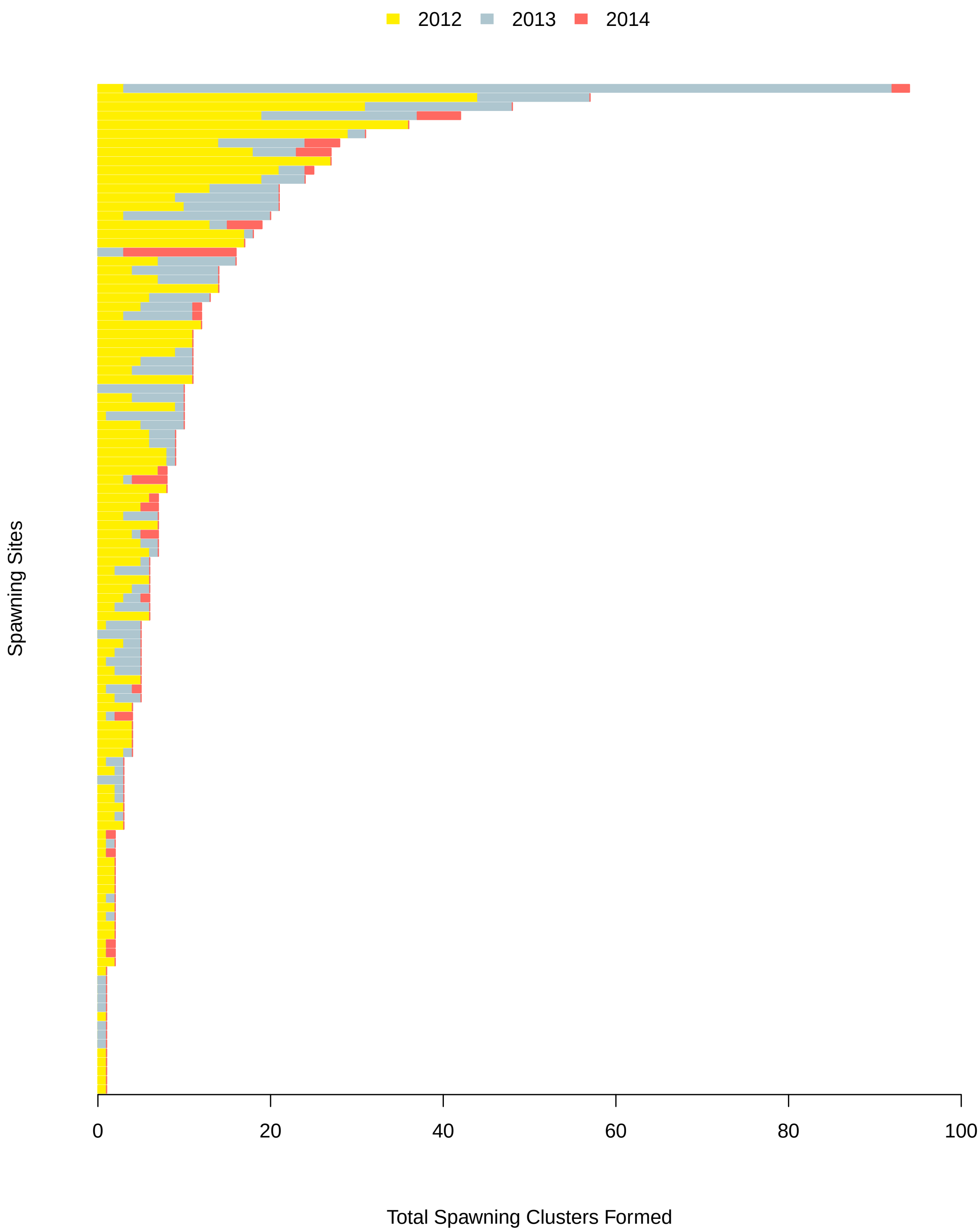


Spawning Shoal Use

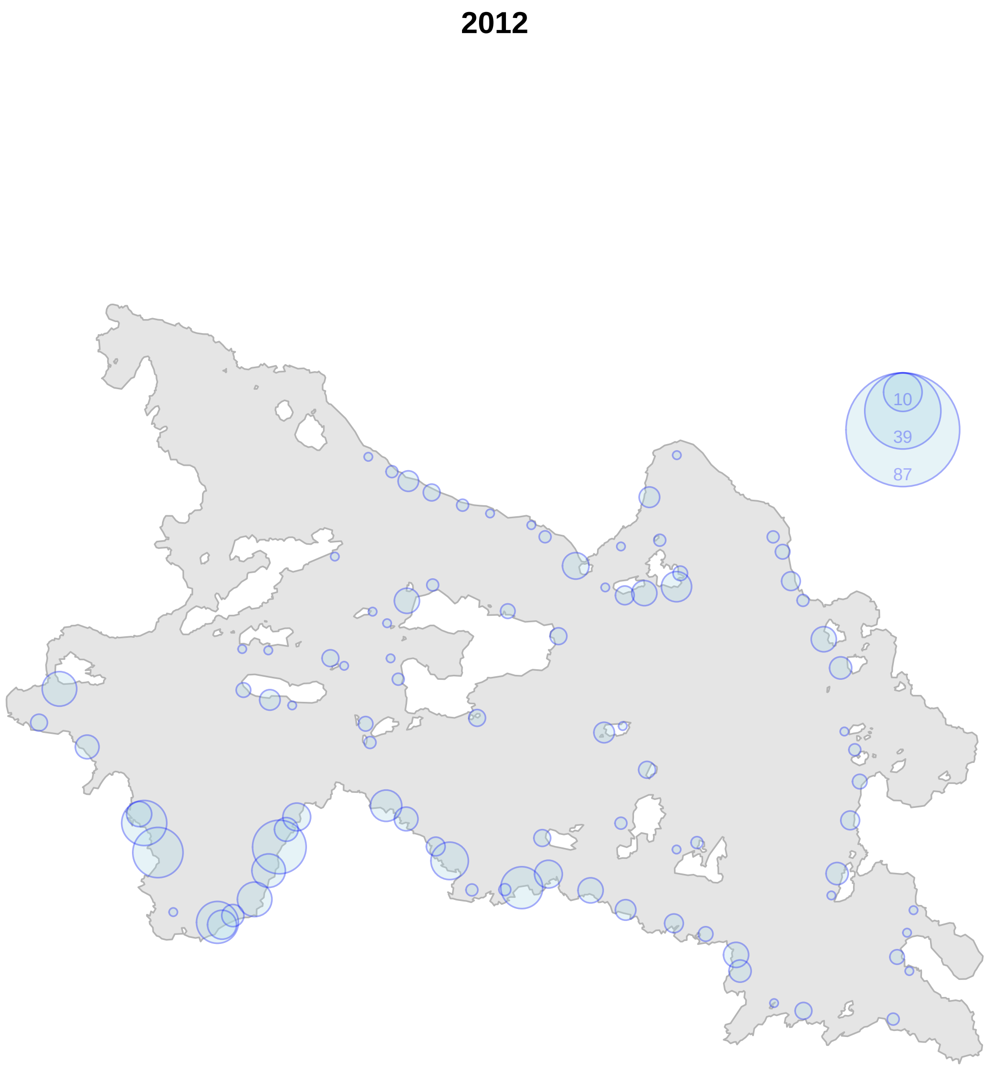
Below is a bubble pie plot showing cumulative frequency of use for all years (bubble size) and relative use among years (pie slices). It's a bit messy but fun to look at!



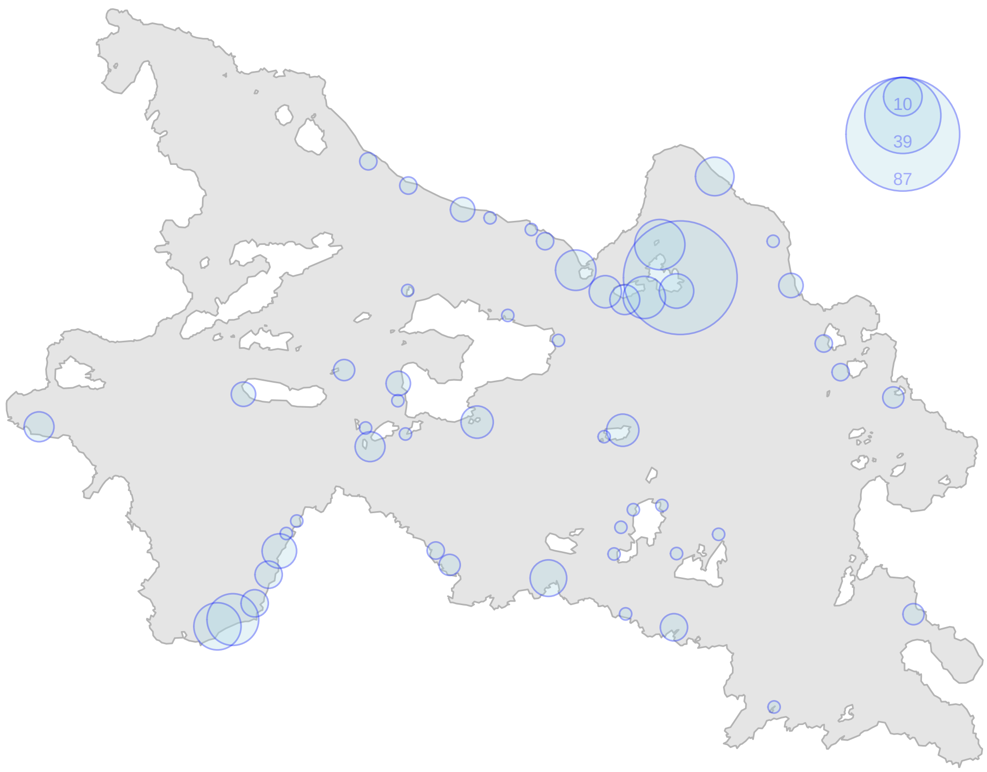
Next I plotted the data from the bubble pie graph and created a sorted horizontal frequency distribution to get a better idea of use among sites.



Next I created a series of bubble plots for each year where the bubble size represents frequency of use in that year.

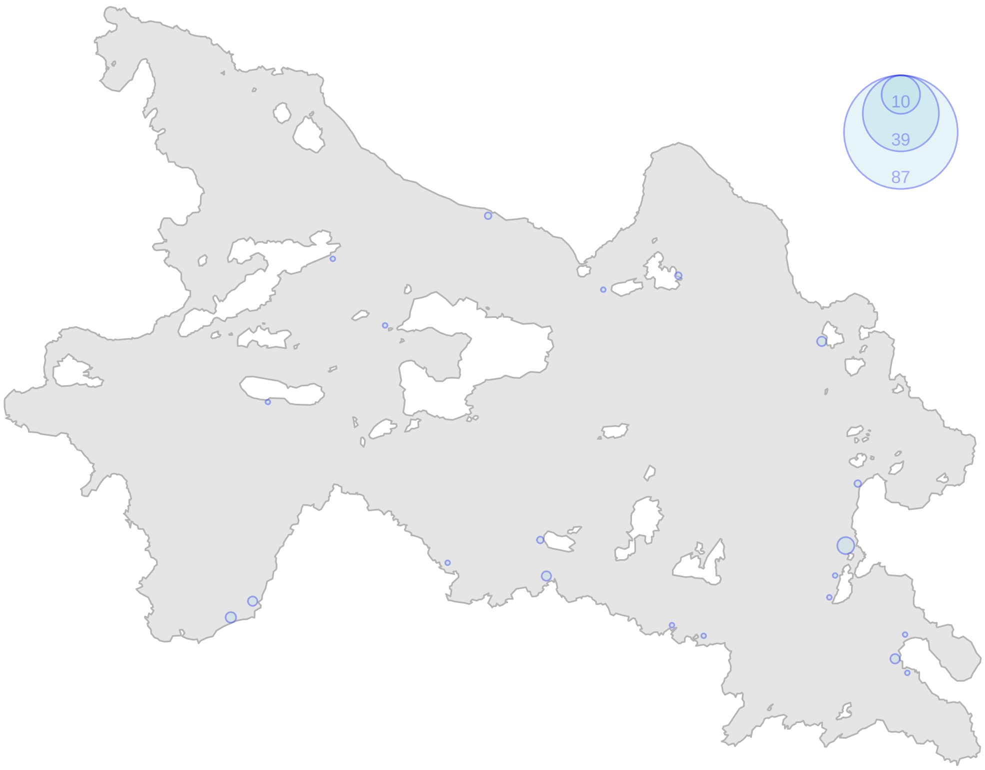


2013



It is a tough to see the frequency bubbles in 2014, but I wanted to maintain the same scale as the previous years.

2014



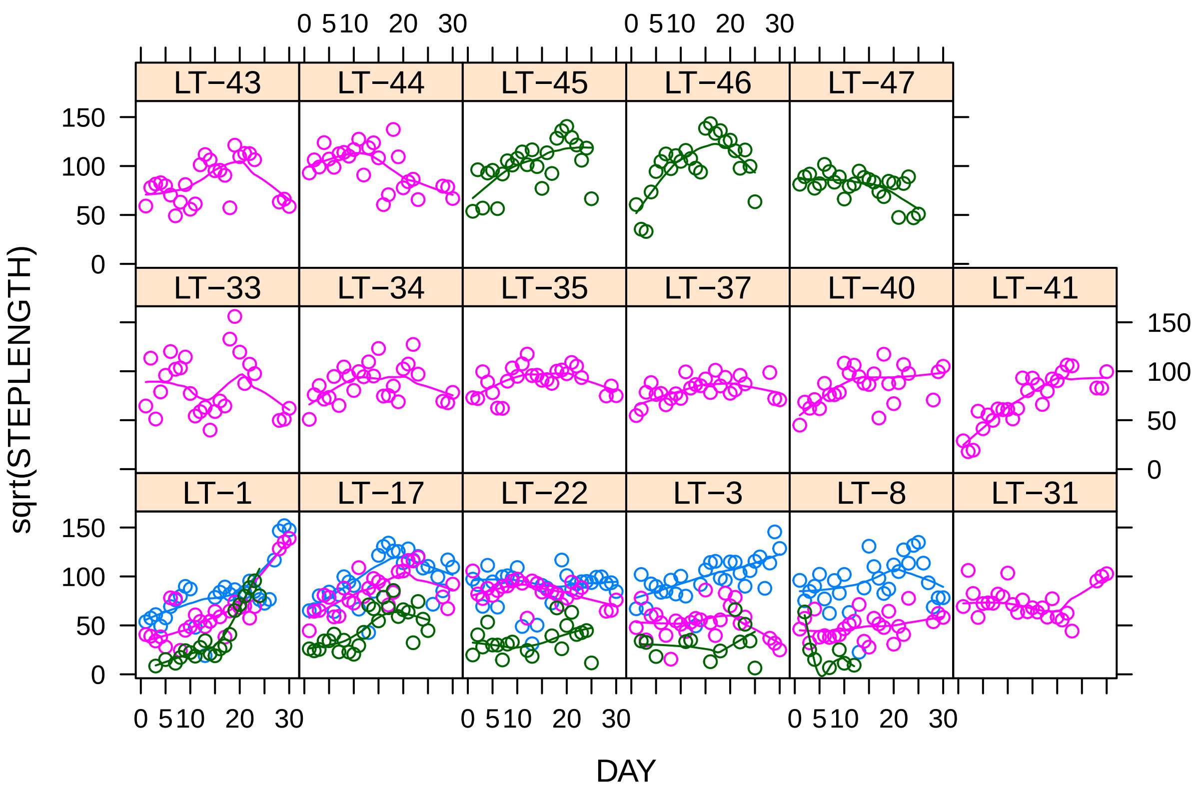
Basic Lake Trout Movement Analysis

Below is a summary of mean daily displacement, persistence index (closer to 1 means straight line, closer to -1 is circles), mean daily acceleration and thier associated standard deviations for male, female and unkown lake trout over 3 years (2012-2014).

Year	Sex	n	Daily Displacement	Std. Dev.	Persistence Index	Std. Dev.	Accel	Std. Dev.
2012	F	1	10025.49	4622.31	0.21	0.14	NaN	NaN
2012	M	4	8731.34	4387.93	0.09	0.21	NaN	NaN
2012	U	23	8833.05	4600.00	0.17	0.18	NaN	NaN
2013	F	6	8498.93	3922.81	0.18	0.17	0.38	0.18
2013	M	9	5955.44	3772.56	0.05	0.21	0.50	0.28
2013	U	14	5325.44	4423.99	0.06	0.32	NaN	NaN
2014	F	3	6773.38	4905.83	0.11	0.20	0.33	0.10
2014	M	5	4348.52	5143.83	-0.12	0.36	0.57	0.24
2014	U	10	2877.50	2954.17	-0.07	0.33	NaN	NaN

Daily Displacement

Here I show square root transformed daily displacement data (sqrt(STEPLENGTH)) for each lake trout over the course of Septmeber. The different colours represent different years. The trend lines generally show a curvelinear relationship for daily displacement over time.



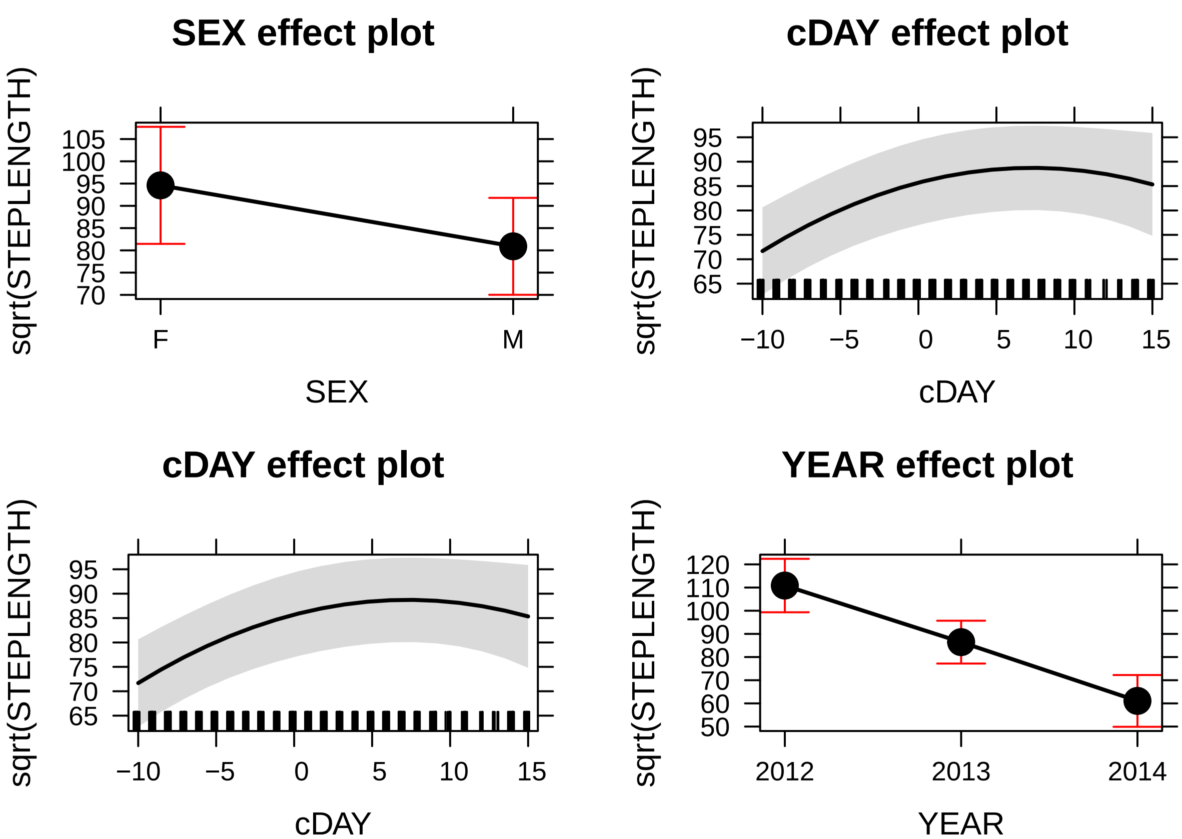
Next I will run a linear mixed effects model to determine if daily displacment differs between sexes. The model uses individuals nested in year as random intercepts to address repeated measures and AR1 correlation structure to address independence.

The full model is as follows:

$$\sqrt{DailyDisplacement} \sim Sex + Day + Day^2 + Year + random(1|Transmitter : Year)$$

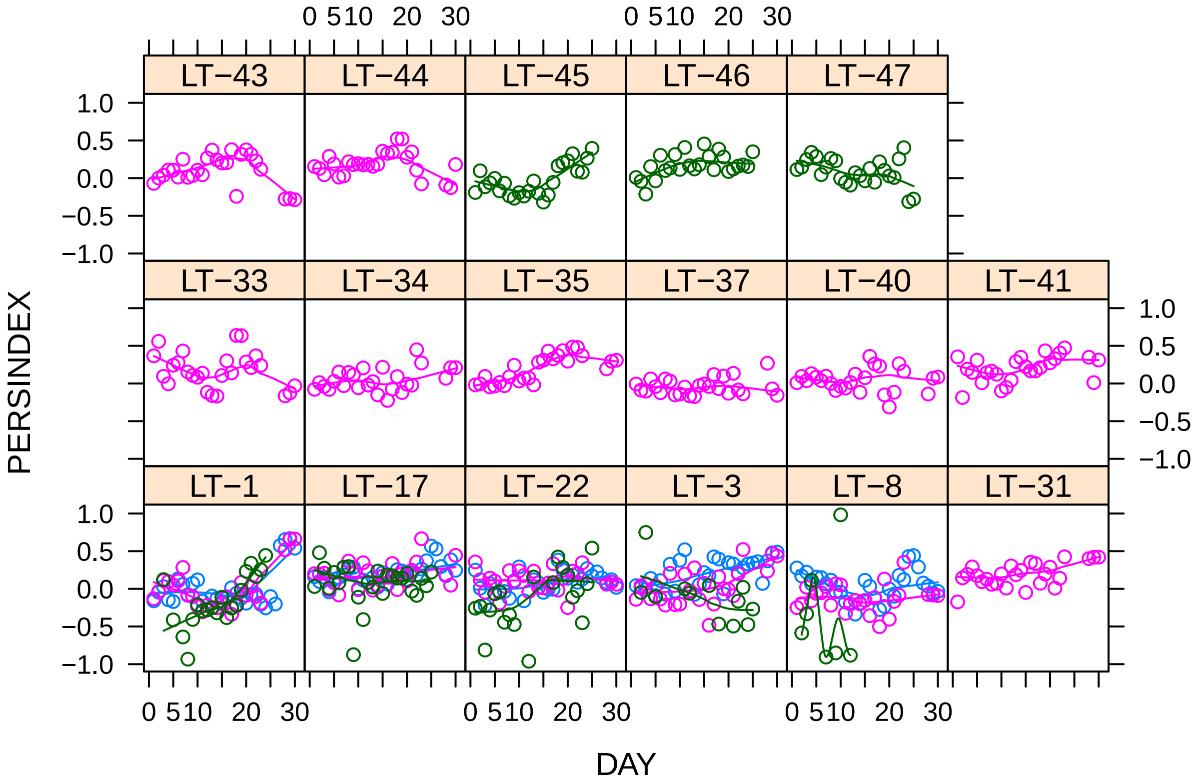
Model results shown below indicate no significant difference in daily displacement between sexes but that thier is a significant curvelinear relationship with days as well as among years. The figure indicates how these effects relate to daily displacement—note that it is square root transformed to meet parametric assumptions).

	Chisq	Df	Pr(>Chisq)
SEX	2.651570	1	0.1034477
cDAY	21.963218	1	0.0000028
I(cDAYˆ2)	8.987048	1	0.0027190
YEAR	84.035349	2	0.0000000



Persistence Index

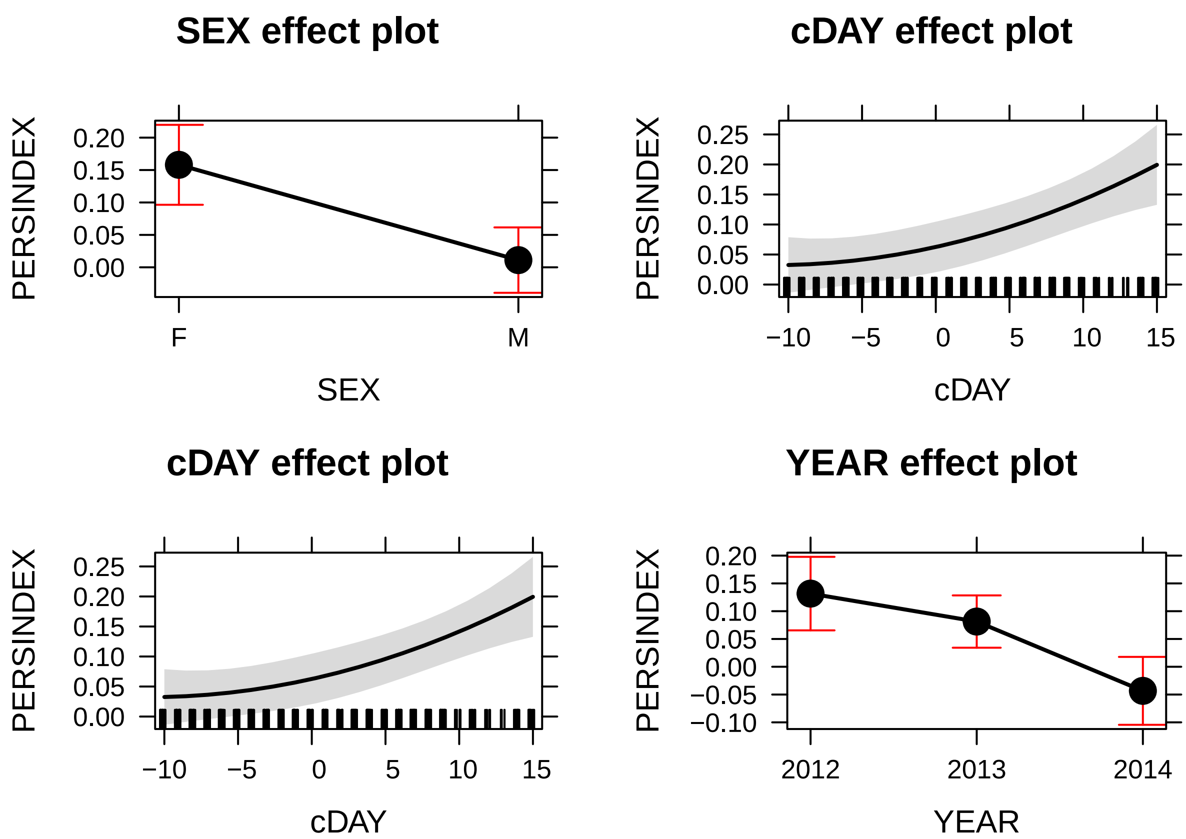
Here is the same plot as before but for persistence index. No transformation was required.



I also ran the same mixed model parameters for persitence index. The results show that there is a significant difference between sexes in terms of persistence index with significant changes among days (note days^2 is not significant indicating a linear day relationship) and years.

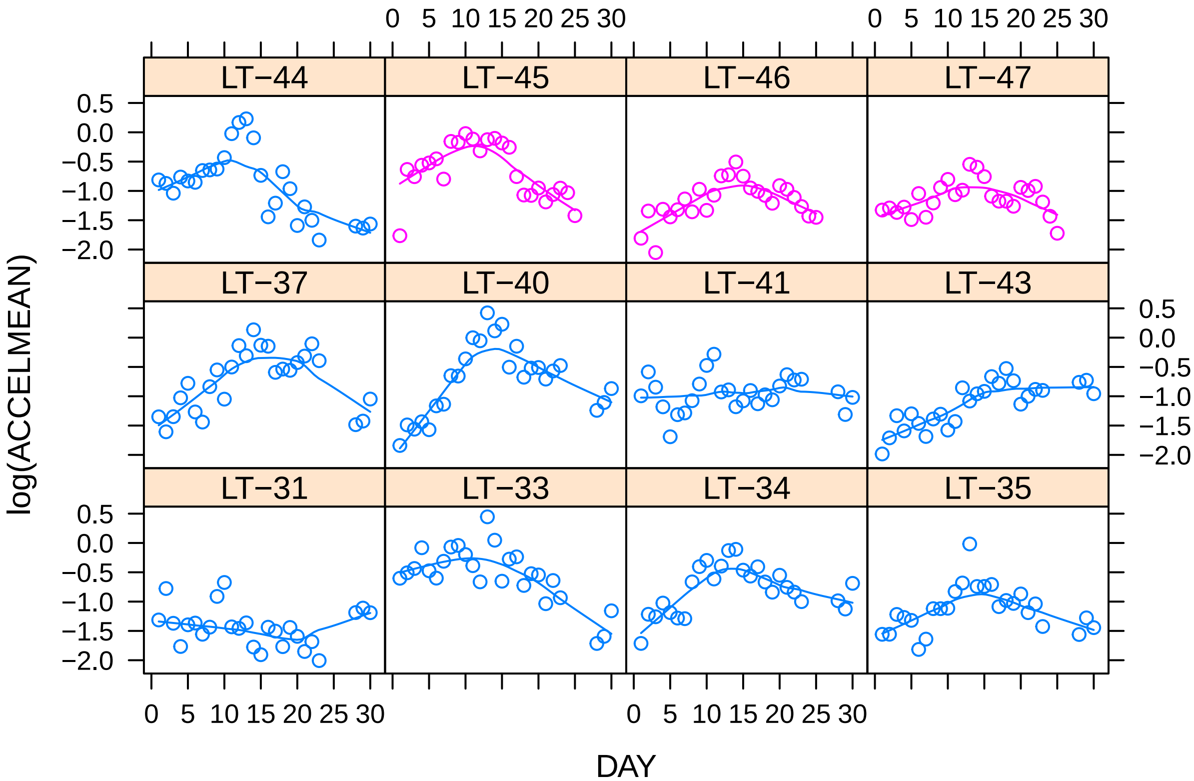
	Chisq	Df	Pr(>Chisq)
SEX	15.57477	1	0.0000793
cDAY	16.03111	1	0.0000623
I(cDAY^2)	2.36845	1	0.1238099
YEAR	23.99317	2	0.0000062

The figure below illustrates the relationships between parameters and persistence index.



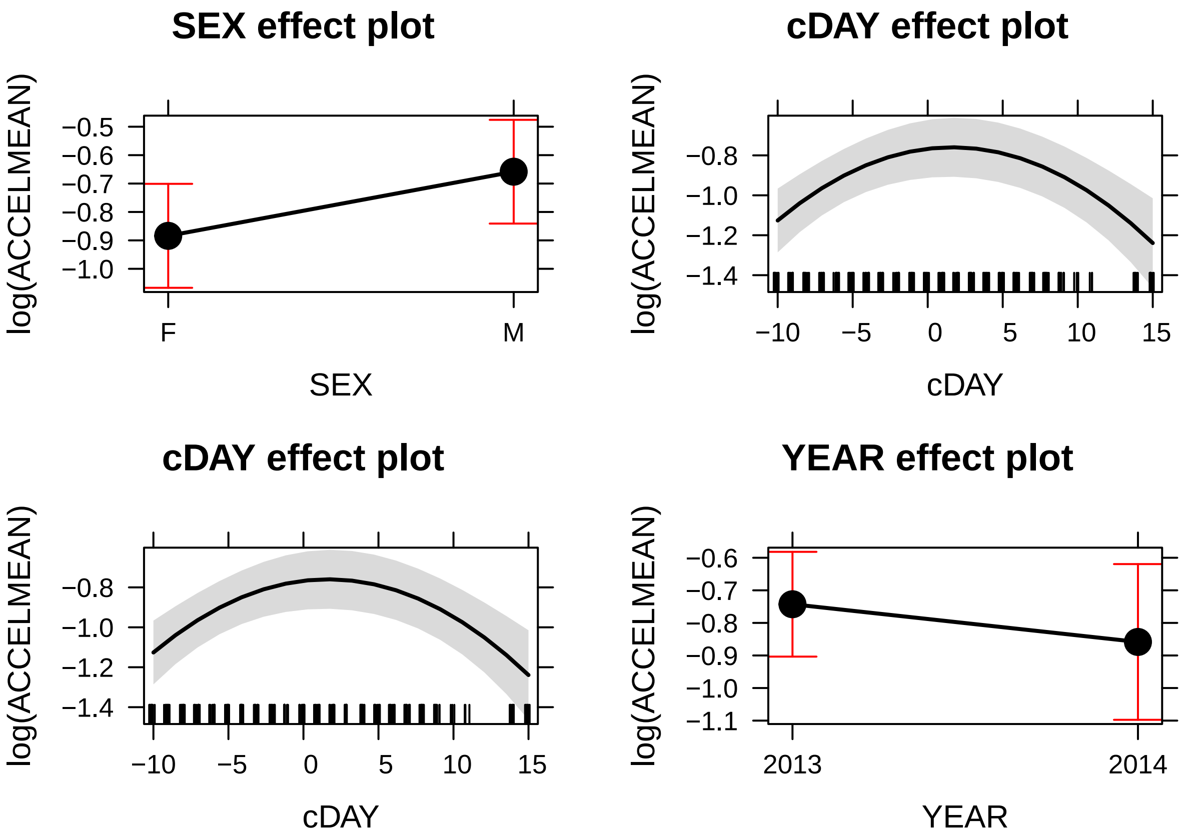
Daily Mean Acceleration

Here is the same plot from previously but for daily mean acceleration. This was log trasnformed to meet parametric assumptions. Notice the strong horseshoe relationship—looks to be occuring during peak spawn.



I also ran the same mixed model parameters for daily mean acceleration but need to adjust the random component to transmitter since we only had two years of accelerometer data. The results show that there is a significant difference (although not very convincing…) between sexes in terms of acceration with significant changes among days^2 but not days or years.

	Chisq	Df	Pr(>Chisq)
SEX	3.9062208	1	0.0481077
cDAY	2.4116034	1	0.1204390
I(cDAY^2)	24.7085688	1	0.0000007
YEAR	0.7516694	1	0.3859482


SEX effect plot
log(ACCELMEAN)
−0.5
−0.6
−0.7
−0.8
−0.9
−1.0
F
M
SEX
cDAY effect plot
log(ACCELMEAN)
−0.8
−1.0
−1.2
−1.4
−10
−5
0
5
10
15
cDAY
cDAY effect plot
log(ACCELMEAN)
−0.8
−1.0
−1.2
−1.4
−10
−5
0
5
10
15
cDAY
YEAR effect plot
log(ACCELMEAN)
−0.6
−0.7
−0.8
−0.9
−1.0
−1.1
2013
2014
YEAR

A summary of all best models (insignificant predictors dropped) and coefficients is shown below. Note these coefficients have not been back-transformed!

Table 5:

	Dependent variable:		
	sqrt(STEPLENGTH)	PERSINDEX	log(ACCELMEAN)
	(1)	(2)	(3)
SEXM		-0.147^{***}	0.245^{*}
		(0.037)	(0.116)
cDAY	0.832^{***}	0.006^{***}	
	(0.178)	(0.001)	
I(cDAY^2)	-0.057^{***}		-0.002^{***}
	(0.019)		(0.001)
YEAR2013	-24.266^{***}	-0.052	
	(4.838)	(0.033)	
YEAR2014	-49.946^{***}	-0.180^{***}	
	(5.466)	(0.037)	
Constant	111.651^{***}	0.246^{***}	-0.915^{***}
	(6.147)	(0.041)	(0.094)
Observations	668	668	309
Log Likelihood	−2,889.275	107.961	−63.892
Akaike Inf. Crit.	5,794.551	−199.921	139.783
Bayesian Inf. Crit.	5,830.585	−163.887	162.183
Note:			*p<0.1; **p<0.05; ***p<0.01