Seminoff EPac green turtle Stable Isotope Data Analysis-models only doc

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## Setup

## Load Required Libraries

## Read in data

Key background info: d15N is typically used as a measure of trophic position (positive correlation btwn d15N and trophic position); other papers have focused on developing mixing models for all of these different food webs, etc.; this paper is focused on broad scale comparisons across the entire range of the Eastern Pacific green turtle.

# Goals of statistical analyses:

1. At what locations does delta 15N differ? Specifically, particularly interested in differences between sites within each Region-so could just run seperate a priori ANOVAs for each region, but seems better to have one model. So in this model, trying to just build simple linear model to test for differences among sites, but that takes into accounts regional differences (biologically, this is due to a confluence of oceanographic and anthropogenic factors shifting the baseline of the food webs (i.e., nothing to do necessarily with trophic differences in the turtles-i.e. nitrification 'tongue' in Gulf of California, eutrophication in urbanized Southern California estuaries ) -(also, same question for d13C, though d15N is more interesting for this study)
2. Does the variance of d15N between regions differ? (aka, biologically, do turtles in different regions have a wider or narrower trophic niche width? This hypothesis is related to species-area/fundamental ecology concepts-if turtles are generalists then those inhabiting foraging areas with broad coastal shelves will have wider trophic niches bc there are more different thigns to eat, while those on islands with narrow photic zones, etc. will have narrower trophic niches) -So I am trying to get at this, roughly, by modeling with different variance structures with the rationale that the better fit is for the one that allows variance to differ among regions -Secondarily, the simple LMM has some fanning/heteroscadacity among treatments so this also attempts to fix that violation of linear model assumption

#### Hierarchical models

#just nitrogen for now-run also for carbon once get syntax, etc set  
M0<-lme(d15N~1,random = ~1 | Region, data=data\_new2)  
M1<-lme(d15N~Ordered\_SITE,random = ~1 | Region, data=data\_new2)  
M2<-lme(d15N~Ordered\_SITE,random = ~1 | Region,   
 weights=varIdent(form=~1|Ordered\_SITE),  
 data=data\_new2)  
summary(M0)#AIC 2874.685

## Linear mixed-effects model fit by REML  
## Data: data\_new2   
## AIC BIC logLik  
## 2874.685 2888.084 -1434.343  
##   
## Random effects:  
## Formula: ~1 | Region  
## (Intercept) Residual  
## StdDev: 1.634606 2.21767  
##   
## Fixed effects: d15N ~ 1   
## Value Std.Error DF t-value p-value  
## (Intercept) 14.36126 0.8224859 640 17.4608 0  
##   
## Standardized Within-Group Residuals:  
## Min Q1 Med Q3 Max   
## -3.8297211 -0.4492887 0.1001904 0.5878360 3.5785478   
##   
## Number of Observations: 644  
## Number of Groups: 4

summary(M1)#AIC 2351.805

## Linear mixed-effects model fit by REML  
## Data: data\_new2   
## AIC BIC logLik  
## 2351.805 2427.355 -1158.903  
##   
## Random effects:  
## Formula: ~1 | Region  
## (Intercept) Residual  
## StdDev: 0.3073738 1.462551  
##   
## Fixed effects: d15N ~ Ordered\_SITE   
## Value Std.Error DF t-value p-value  
## (Intercept) 16.700000 0.4243123 626 39.35780 0.0000  
## Ordered\_SITE3-SDB 0.836782 0.3318872 626 2.52128 0.0119  
## Ordered\_SITE4-NGU -5.131579 0.4451339 626 -11.52817 0.0000  
## Ordered\_SITE6-BMA -6.460000 0.4136720 626 -15.61624 0.0000  
## Ordered\_SITE9-BLA -0.945283 0.5611409 626 -1.68457 0.0926  
## Ordered\_SITE11-CIN -0.592857 0.5923803 626 -1.00080 0.3173  
## Ordered\_SITE12-NAV -0.334848 0.5825285 626 -0.57482 0.5656  
## Ordered\_SITE13-DUL -4.222973 0.5508410 626 -7.66641 0.0000  
## Ordered\_SITE14-PAR -3.580952 0.6134977 626 -5.83695 0.0000  
## Ordered\_SITE15-MEJ -0.614286 0.6134977 626 -1.00128 0.3171  
## Ordered\_SITE17-COC -3.619403 0.5535755 626 -6.53823 0.0000  
## Ordered\_SITE18-GOR -2.971053 0.5501500 626 -5.40044 0.0000  
## Ordered\_SITE19-IGP -4.595122 0.5715695 626 -8.03948 0.0000  
## Ordered\_SITE20-IGE -5.089189 0.5764824 626 -8.82800 0.0000  
## Ordered\_SITE21-IGD -5.162162 0.5764824 626 -8.95459 0.0000  
## Correlation:   
## (Intr) O\_SITE3 O\_SITE4 O\_SITE6 O\_SITE9 O\_SITE11  
## Ordered\_SITE3-SDB -0.608   
## Ordered\_SITE4-NGU -0.453 0.579   
## Ordered\_SITE6-BMA -0.487 0.623 0.465   
## Ordered\_SITE9-BLA -0.756 0.459 0.343 0.369   
## Ordered\_SITE11-CIN -0.716 0.435 0.324 0.349 0.826   
## Ordered\_SITE12-NAV -0.728 0.443 0.330 0.355 0.840 0.796   
## Ordered\_SITE13-DUL -0.770 0.468 0.349 0.375 0.582 0.552   
## Ordered\_SITE14-PAR -0.692 0.420 0.313 0.337 0.523 0.495   
## Ordered\_SITE15-MEJ -0.692 0.420 0.313 0.337 0.523 0.495   
## Ordered\_SITE17-COC -0.766 0.466 0.347 0.374 0.580 0.549   
## Ordered\_SITE18-GOR -0.771 0.469 0.349 0.376 0.583 0.552   
## Ordered\_SITE19-IGP -0.742 0.451 0.336 0.362 0.561 0.532   
## Ordered\_SITE20-IGE -0.736 0.447 0.333 0.359 0.557 0.527   
## Ordered\_SITE21-IGD -0.736 0.447 0.333 0.359 0.557 0.527   
## O\_SITE12 O\_SITE13 O\_SITE14 O\_SITE15 O\_SITE17 O\_SITE18  
## Ordered\_SITE3-SDB   
## Ordered\_SITE4-NGU   
## Ordered\_SITE6-BMA   
## Ordered\_SITE9-BLA   
## Ordered\_SITE11-CIN   
## Ordered\_SITE12-NAV   
## Ordered\_SITE13-DUL 0.561   
## Ordered\_SITE14-PAR 0.504 0.812   
## Ordered\_SITE15-MEJ 0.504 0.812 0.729   
## Ordered\_SITE17-COC 0.558 0.590 0.530 0.530   
## Ordered\_SITE18-GOR 0.562 0.594 0.533 0.533 0.901   
## Ordered\_SITE19-IGP 0.541 0.572 0.513 0.513 0.868 0.873   
## Ordered\_SITE20-IGE 0.536 0.567 0.509 0.509 0.860 0.866   
## Ordered\_SITE21-IGD 0.536 0.567 0.509 0.509 0.860 0.866   
## O\_SITE19 O\_SITE20  
## Ordered\_SITE3-SDB   
## Ordered\_SITE4-NGU   
## Ordered\_SITE6-BMA   
## Ordered\_SITE9-BLA   
## Ordered\_SITE11-CIN   
## Ordered\_SITE12-NAV   
## Ordered\_SITE13-DUL   
## Ordered\_SITE14-PAR   
## Ordered\_SITE15-MEJ   
## Ordered\_SITE17-COC   
## Ordered\_SITE18-GOR   
## Ordered\_SITE19-IGP   
## Ordered\_SITE20-IGE 0.833   
## Ordered\_SITE21-IGD 0.833 0.826   
##   
## Standardized Within-Group Residuals:  
## Min Q1 Med Q3 Max   
## -3.74728544 -0.51602772 0.04322474 0.56025591 4.69043392   
##   
## Number of Observations: 644  
## Number of Groups: 4

summary(M2)#AIC 2238.23

## Linear mixed-effects model fit by REML  
## Data: data\_new2   
## AIC BIC logLik  
## 2238.23 2375.998 -1088.115  
##   
## Random effects:  
## Formula: ~1 | Region  
## (Intercept) Residual  
## StdDev: 0.3590934 1.708654  
##   
## Variance function:  
## Structure: Different standard deviations per stratum  
## Formula: ~1 | Ordered\_SITE   
## Parameter estimates:  
## 13-DUL 14-PAR 15-MEJ 17-COC 18-GOR 19-IGP 20-IGE   
## 1.0000000 0.8676050 1.4549622 0.9237081 0.4647625 0.4567143 0.5961751   
## 21-IGD 9-BLA 11-CIN 12-NAV 1-SGR\_SBN 3-SDB 4-NGU   
## 0.8652599 0.6544929 0.6511168 0.7094473 0.6785350 0.8182455 1.2737548   
## 6-BMA   
## 1.6098118   
## Fixed effects: d15N ~ Ordered\_SITE   
## Value Std.Error DF t-value p-value  
## (Intercept) 16.700000 0.4274514 626 39.06877 0.0000  
## Ordered\_SITE3-SDB 0.836782 0.2761054 626 3.03066 0.0025  
## Ordered\_SITE4-NGU -5.131579 0.5505170 626 -9.32138 0.0000  
## Ordered\_SITE6-BMA -6.460000 0.5969935 626 -10.82089 0.0000  
## Ordered\_SITE9-BLA -0.945283 0.5790156 626 -1.63257 0.1031  
## Ordered\_SITE11-CIN -0.592857 0.5965463 626 -0.99382 0.3207  
## Ordered\_SITE12-NAV -0.334848 0.5968173 626 -0.56106 0.5750  
## Ordered\_SITE13-DUL -4.222973 0.5925500 626 -7.12678 0.0000  
## Ordered\_SITE14-PAR -3.580952 0.6452219 626 -5.54995 0.0000  
## Ordered\_SITE15-MEJ -0.614286 0.7784371 626 -0.78913 0.4303  
## Ordered\_SITE17-COC -3.619403 0.5906287 626 -6.12805 0.0000  
## Ordered\_SITE18-GOR -2.971053 0.5656505 626 -5.25245 0.0000  
## Ordered\_SITE19-IGP -4.595122 0.5714156 626 -8.04165 0.0000  
## Ordered\_SITE20-IGE -5.089189 0.5828445 626 -8.73164 0.0000  
## Ordered\_SITE21-IGD -5.162162 0.6088820 626 -8.47810 0.0000  
## Correlation:   
## (Intr) O\_SITE3 O\_SITE4 O\_SITE6 O\_SITE9 O\_SITE11  
## Ordered\_SITE3-SDB -0.456   
## Ordered\_SITE4-NGU -0.228 0.354   
## Ordered\_SITE6-BMA -0.211 0.326 0.164   
## Ordered\_SITE9-BLA -0.738 0.336 0.169 0.156   
## Ordered\_SITE11-CIN -0.717 0.326 0.164 0.151 0.902   
## Ordered\_SITE12-NAV -0.716 0.326 0.164 0.151 0.902 0.875   
## Ordered\_SITE13-DUL -0.721 0.329 0.165 0.152 0.533 0.517   
## Ordered\_SITE14-PAR -0.662 0.302 0.151 0.140 0.489 0.475   
## Ordered\_SITE15-MEJ -0.549 0.250 0.125 0.116 0.405 0.393   
## Ordered\_SITE17-COC -0.724 0.330 0.165 0.152 0.534 0.519   
## Ordered\_SITE18-GOR -0.756 0.344 0.173 0.159 0.558 0.541   
## Ordered\_SITE19-IGP -0.748 0.341 0.171 0.158 0.552 0.536   
## Ordered\_SITE20-IGE -0.733 0.334 0.168 0.155 0.541 0.526   
## Ordered\_SITE21-IGD -0.702 0.320 0.160 0.148 0.518 0.503   
## O\_SITE12 O\_SITE13 O\_SITE14 O\_SITE15 O\_SITE17 O\_SITE18  
## Ordered\_SITE3-SDB   
## Ordered\_SITE4-NGU   
## Ordered\_SITE6-BMA   
## Ordered\_SITE9-BLA   
## Ordered\_SITE11-CIN   
## Ordered\_SITE12-NAV   
## Ordered\_SITE13-DUL 0.517   
## Ordered\_SITE14-PAR 0.474 0.815   
## Ordered\_SITE15-MEJ 0.393 0.676 0.621   
## Ordered\_SITE17-COC 0.518 0.522 0.479 0.397   
## Ordered\_SITE18-GOR 0.541 0.545 0.501 0.415 0.933   
## Ordered\_SITE19-IGP 0.536 0.540 0.496 0.411 0.923 0.964   
## Ordered\_SITE20-IGE 0.525 0.529 0.486 0.403 0.905 0.945   
## Ordered\_SITE21-IGD 0.503 0.506 0.465 0.385 0.867 0.905   
## O\_SITE19 O\_SITE20  
## Ordered\_SITE3-SDB   
## Ordered\_SITE4-NGU   
## Ordered\_SITE6-BMA   
## Ordered\_SITE9-BLA   
## Ordered\_SITE11-CIN   
## Ordered\_SITE12-NAV   
## Ordered\_SITE13-DUL   
## Ordered\_SITE14-PAR   
## Ordered\_SITE15-MEJ   
## Ordered\_SITE17-COC   
## Ordered\_SITE18-GOR   
## Ordered\_SITE19-IGP   
## Ordered\_SITE20-IGE 0.936   
## Ordered\_SITE21-IGD 0.896 0.878   
##   
## Standardized Within-Group Residuals:  
## Min Q1 Med Q3 Max   
## -3.81422698 -0.58864503 0.04521741 0.61876090 3.37034192   
##   
## Number of Observations: 644  
## Number of Groups: 4

#### Linear Models (now just anovas bc took out turtle body size due to missing data from some sites)

summary(data)

## SITE\_No SITE\_CODE Ordered\_SITE  
## Min. : 1.00 SDB : 87 3-SDB : 87   
## 1st Qu.: 9.00 GOR : 76 18-GOR : 76   
## Median :14.00 DUL : 74 13-DUL : 74   
## Mean :13.73 PPE : 74 24-PPE : 74   
## 3rd Qu.:19.00 COC : 67 17-COC : 67   
## Max. :24.00 BLA : 53 9-BLA : 53   
## (Other):287 (Other):287   
## Location\_Label Habitat\_Type  
## San Diego Bay, USA : 87 coastal:386   
## Isla Gorgona, Colombia : 76 insular:258   
## Golfo Dulce, Costa Rica : 74 oceanic: 74   
## Oceanic Waters, Peru (Longline): 74   
## Cocos Island, Costa Rica : 67   
## Bahia de los Angeles, GoC, MX : 53   
## (Other) :287   
## Region   
## Cen-SoAm Pac Coast:116   
## EPac Islands :258   
## Gulf of Cal :114   
## Oceanic : 74   
## SC-BC Pac Coast :156   
##   
##   
## Location LABID   
## San Diego Bay, United States : 87 : 33   
## Isla Gorgona, Colombia : 76 101 : 1   
## Golfo Dulce, Costa Rica : 74 102 : 1   
## Oceanic Waters, Peru (Longline) : 74 103 : 1   
## Cocos Island, Costa Rica : 67 104 : 1   
## Bahia de los Angeles, Gulf of California, Mexico: 53 105087 : 1   
## (Other) :287 (Other):680   
## Collect\_Date Run\_Date   
## Min. :0000-03-23 00:00:00 Min. :0003-01-17 00:00:00   
## 1st Qu.:0004-11-15 06:00:00 1st Qu.:0005-01-26 18:00:00   
## Median :0008-09-23 12:00:00 Median :0007-06-07 00:00:00   
## Mean :0009-09-08 08:34:18 Mean :0007-07-31 14:45:00   
## 3rd Qu.:0011-03-08 18:00:00 3rd Qu.:0007-08-09 00:00:00   
## Max. :0099-02-04 00:00:00 Max. :0014-02-10 00:00:00   
## NA's :32 NA's :430   
## Percent\_N Percent\_C d15N d13C   
## Min. : 5.30 Min. :18.7 Min. : 7.0 Min. :-25.50   
## 1st Qu.:11.70 1st Qu.:38.2 1st Qu.:11.9 1st Qu.:-16.80   
## Median :13.40 Median :42.5 Median :13.6 Median :-15.98   
## Mean :12.98 Mean :41.1 Mean :13.8 Mean :-15.84   
## 3rd Qu.:14.70 3rd Qu.:45.2 3rd Qu.:15.7 3rd Qu.:-14.90   
## Max. :17.00 Max. :65.0 Max. :21.2 Max. : -8.80   
## NA's :87 NA's :87   
## COLOR SCL CCL\_calc\_fromSCL CCL\_empirical   
## :642 Min. : 39.70 Min. : 43.39 Min. : 42.70   
## BLACK : 29 1st Qu.: 56.80 1st Qu.: 61.11 1st Qu.: 65.67   
## YELLOW: 47 Median : 65.10 Median : 69.71 Median : 75.00   
## Mean : 67.97 Mean : 72.69 Mean : 75.28   
## 3rd Qu.: 74.88 3rd Qu.: 79.84 3rd Qu.: 82.30   
## Max. :110.40 Max. :116.65 Max. :116.50   
## NA's :368 NA's :368 NA's :328   
## CCL\_combined Alt.ID   
## Min. : 42.70 :594   
## 1st Qu.: 62.00 Alt ID : 24   
## Median : 71.68 : 4   
## Mean : 72.68 100 : 1   
## 3rd Qu.: 80.00 105 : 1   
## Max. :116.50 106 : 1   
## NA's :197 (Other): 93   
## Notes   
## :709   
## : 8   
## no measurements taken, confirmed in SDB Binder: 1   
##   
##   
##   
##

data$Ordered\_SITE<-factor(data$Ordered\_SITE)  
table(data$Ordered\_SITE)

##   
## 1-SGR\_SBN 3-SDB 4-NGU 6-BMA 9-BLA 11-CIN 12-NAV   
## 25 87 19 25 53 28 33   
## 13-DUL 14-PAR 15-MEJ 17-COC 18-GOR 19-IGP 20-IGE   
## 74 21 21 67 76 41 37   
## 21-IGD 24-PPE   
## 37 74

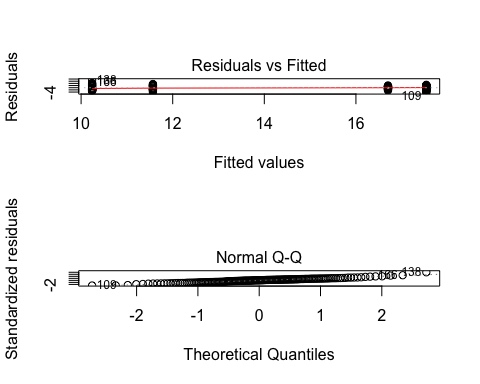
#Linear models-For each region seperately  
summary(data\_new2$Region)

## Cen-SoAm Pac Coast EPac Islands Gulf of Cal   
## 116 258 114   
## Oceanic SC-BC Pac Coast   
## 0 156

SC<-subset(data\_new2, Region=="SC-BC Pac Coast")   
GC<-subset(data\_new2, Region=="Gulf of Cal")  
CSC<-subset(data\_new2, Region== "Cen-SoAm Pac Coast")   
EPI<- subset(data\_new2, Region== "EPac Islands")  
  
SC\_Nm2<-aov(data=SC, d15N~Ordered\_SITE)  
GC\_Nm2<-aov(data=GC, d15N~Ordered\_SITE)  
CSC\_Nm2<-aov(data=CSC, d15N~Ordered\_SITE)  
EPI\_Nm2<-aov(data=EPI, d15N~Ordered\_SITE)  
  
summary(SC\_Nm2)

## Df Sum Sq Mean Sq F value Pr(>F)   
## Ordered\_SITE 3 1382.3 460.8 149.9 <2e-16 \*\*\*  
## Residuals 152 467.2 3.1   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

par(mfrow=c(2, 1))  
plot(SC\_Nm2, which=1:2)



dev.off()

## null device   
## 1

SC$Nresid = resid(SC\_Nm2)  
ggplot(SC,aes(x=Ordered\_SITE,y=Nresid))+geom\_boxplot()+geom\_point()  
  
summary(GC\_Nm2)

## Df Sum Sq Mean Sq F value Pr(>F)   
## Ordered\_SITE 2 7.87 3.937 3.004 0.0536 .  
## Residuals 111 145.47 1.311   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

par(mfrow=c(2, 1))  
plot(GC\_Nm2, which=1:2)  
dev.off()

## null device   
## 1

GC$Nresid = resid(GC\_Nm2)  
ggplot(GC,aes(x=Ordered\_SITE,y=Nresid))+geom\_boxplot()+geom\_point()  
  
summary(CSC\_Nm2)

## Df Sum Sq Mean Sq F value Pr(>F)   
## Ordered\_SITE 2 213.4 106.72 31.68 1.2e-11 \*\*\*  
## Residuals 113 380.7 3.37   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

par(mfrow=c(2, 1))  
plot(CSC\_Nm2, which=1:2)  
dev.off()

## null device   
## 1

CSC$Nresid = resid(CSC\_Nm2)  
ggplot(CSC,aes(x=Ordered\_SITE,y=Nresid))+geom\_boxplot()+geom\_point()  
  
summary(EPI\_Nm2)

## Df Sum Sq Mean Sq F value Pr(>F)   
## Ordered\_SITE 4 198.5 49.62 35.66 <2e-16 \*\*\*  
## Residuals 253 352.1 1.39   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

par(mfrow=c(2, 1))  
plot(EPI\_Nm2, which=1:2)  
dev.off()

## null device   
## 1

EPI$Nresid = resid(EPI\_Nm2)  
ggplot(EPI,aes(x=Ordered\_SITE,y=Nresid))+geom\_boxplot()+geom\_point()  
  
#-------  
 #Carbon   
  
SC\_Cm2<-aov(data=SC, d13C~Ordered\_SITE)  
GC\_Cm2<-aov(data=GC, d13C~Ordered\_SITE)  
CSC\_Cm2<-aov(data=CSC, d13C~Ordered\_SITE)  
EPI\_Cm2<-aov(data=EPI, d13C~Ordered\_SITE)  
  
  
summary(SC\_Cm2)

## Df Sum Sq Mean Sq F value Pr(>F)   
## Ordered\_SITE 3 53.3 17.768 3.631 0.0144 \*  
## Residuals 152 743.9 4.894   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

par(mfrow=c(2, 1))  
plot(SC\_Cm2, which=1:2)  
dev.off()

## null device   
## 1

SC$Cresid = resid(SC\_Cm2)  
ggplot(SC,aes(x=Ordered\_SITE,y=Cresid))+geom\_boxplot()+geom\_point()  
  
summary(GC\_Cm2)

## Df Sum Sq Mean Sq F value Pr(>F)   
## Ordered\_SITE 2 24.18 12.091 13.19 7.26e-06 \*\*\*  
## Residuals 111 101.76 0.917   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

par(mfrow=c(2, 1))  
plot(GC\_Cm2, which=1:2)  
dev.off()

## null device   
## 1

GC$Cresid = resid(GC\_Cm2)  
ggplot(GC,aes(x=Ordered\_SITE,y=Cresid))+geom\_boxplot()+geom\_point()  
  
summary(CSC\_Cm2)

## Df Sum Sq Mean Sq F value Pr(>F)   
## Ordered\_SITE 2 4.4 2.198 2.573 0.0807 .  
## Residuals 113 96.5 0.854   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

par(mfrow=c(2, 1))  
plot(CSC\_Cm2, which=1:2)  
dev.off()

## null device   
## 1

CSC$Cresid = resid(CSC\_Cm2)  
ggplot(CSC,aes(x=Ordered\_SITE,y=Cresid))+geom\_boxplot()+geom\_point() #moderate fanning, be aware-come back to  
  
summary(EPI\_Cm2)

## Df Sum Sq Mean Sq F value Pr(>F)   
## Ordered\_SITE 4 845.0 211.25 65.29 <2e-16 \*\*\*  
## Residuals 253 818.6 3.24   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

par(mfrow=c(2, 1))  
plot(EPI\_Cm2, which=1:2)  
dev.off()

## null device   
## 1

EPI$Cresid = resid(EPI\_Cm2)  
ggplot(EPI,aes(x=Ordered\_SITE,y=Cresid))+geom\_boxplot()+geom\_point()