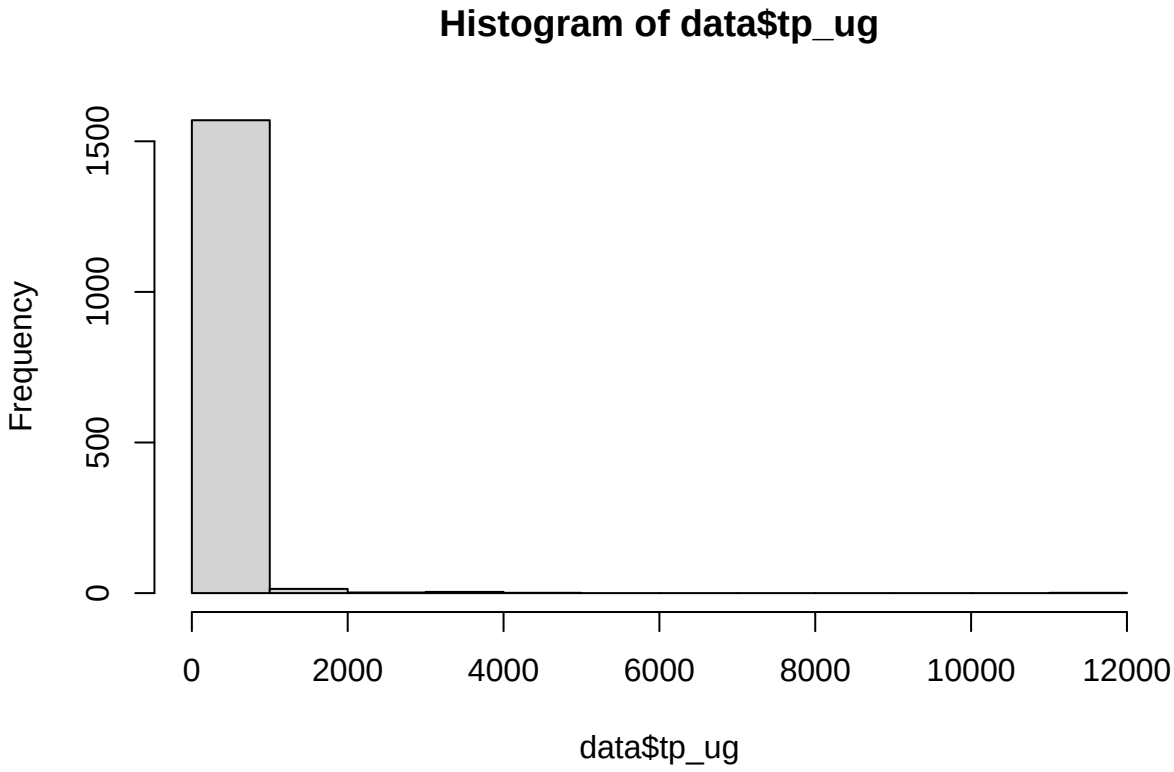
GEO Class models

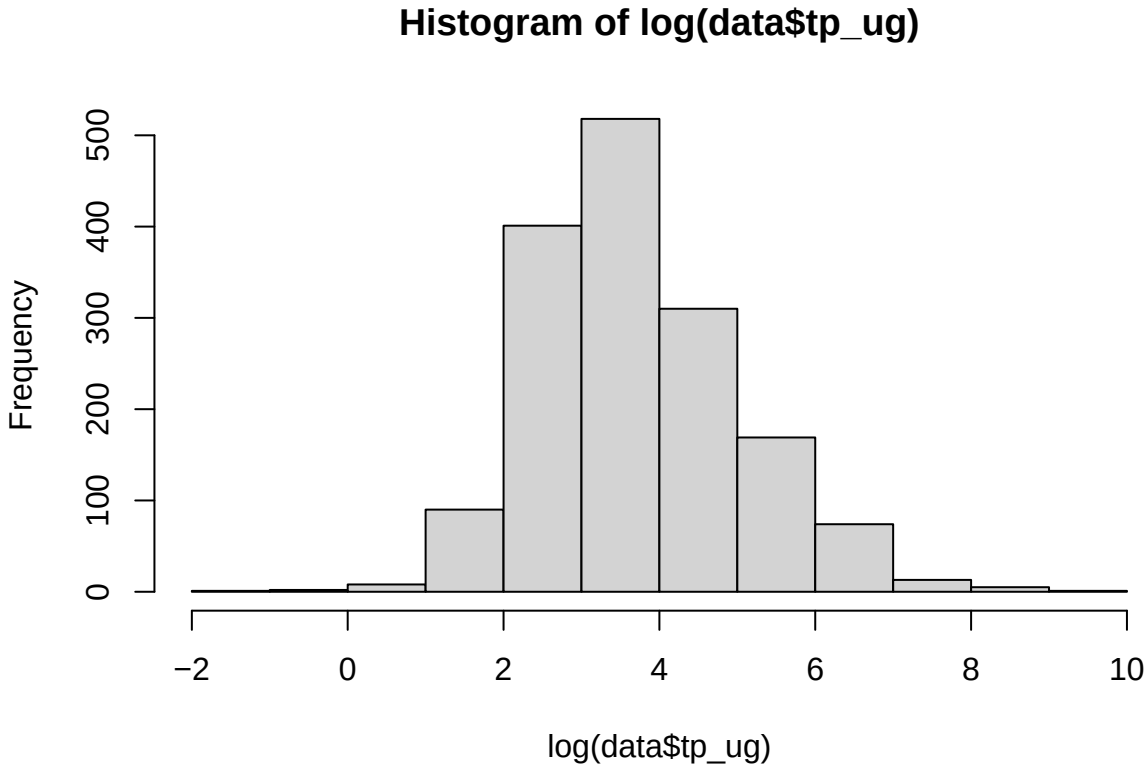
```
##      lake_climate8110norm_ppt_mmperyr lake_climate8110norm_tmean_degc
## [1,]                          1014.4612                        12.667676
## [2,]                          1352.5294                        22.050747
## [3,]                           356.7877                         5.211880
## [4,]                          1542.9588                        19.790745
## [5,]                           818.1258                         6.806020
## [6,]                          1573.0031                         4.331956
## [7,]                           259.8651                         7.757644
##      ws_soil_kffact ws_soil_depthtobedrock_cm ws_soil_sand_pct ws_soil_silt_pct
## [1,]     0.37614340                 3.355516         25.58247        52.283109
## [2,]     0.08554742                 2.583093         87.91728         8.991113
## [3,]     0.31323216                 3.775530         33.21197        38.140647
## [4,]     0.47610411                 3.279830         11.20137        65.372980
## [5,]     0.10039301                 3.485569         66.51206        22.894704
## [6,]     0.23044797                 2.843953         54.12616        39.795097
## [7,]     0.27335221                 3.189607         51.24208        28.861086
##      hu12_baseflowindex_pct hu12_runoff_inperyr ws_lake_arearatio
## [1,]               24.80337          11.8476391         3.3039491
## [2,]               40.77829          12.7027326         0.8544751
## [3,]               32.04031           0.5300966         0.7726166
## [4,]               16.16385          20.6229107        -0.5391557
## [5,]               80.71824          14.2022267         1.3130543
## [6,]               70.38442          43.5632515         0.8319672
## [7,]               54.92286           0.5108218         2.4573008
##      lake_elevation_m ws_nlcd16_totfor_pct ws_nlcd16_totwetl_pct
## [1,]         2.460466            -1.667168             -4.161225
## [2,]         2.016779            -1.785667             -3.068301
## [3,]         2.993445            -4.558116             -4.572404
## [4,]         1.956773            -4.536390             -1.854694
## [5,]         2.538599            -2.648372              2.506625
## [6,]         3.200891             4.071658             -4.525694
## [7,]         3.269668            -4.520580             -4.509537
##      ws_nlcd16_shrub_pct ws_landform_notgentle_pct ws_streams_all_mperha
## [1,]          -4.418235                -4.196914             1.6669242
## [2,]          -3.756547                -4.563691            -0.7481135
## [3,]          -4.582865                -4.582963            -0.9747965
## [4,]          -4.526579                -4.575825            -0.9778994
## [5,]          -4.568419                -4.575160            -0.1915795
## [6,]          -4.557666                 4.231427            -0.4913738
## [7,]           4.157319                -1.928576             1.0261469
```

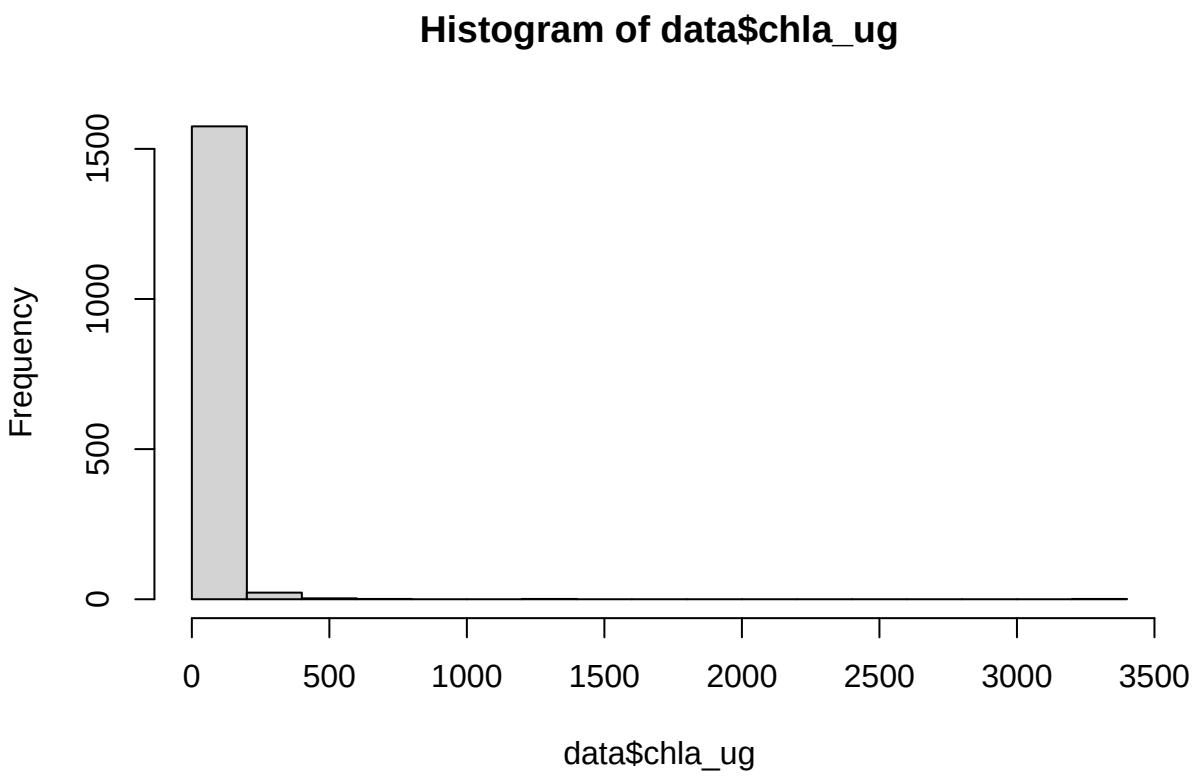
```
##  [1] "X"                         "site_id"
##  [3] "uid"                       "comid"
##  [5] "date_col"                  "ag_eco9"
##  [7] "lat_dd83"                  "lon_dd83"
##  [9] "area_ha"                   "tp_ug"
```

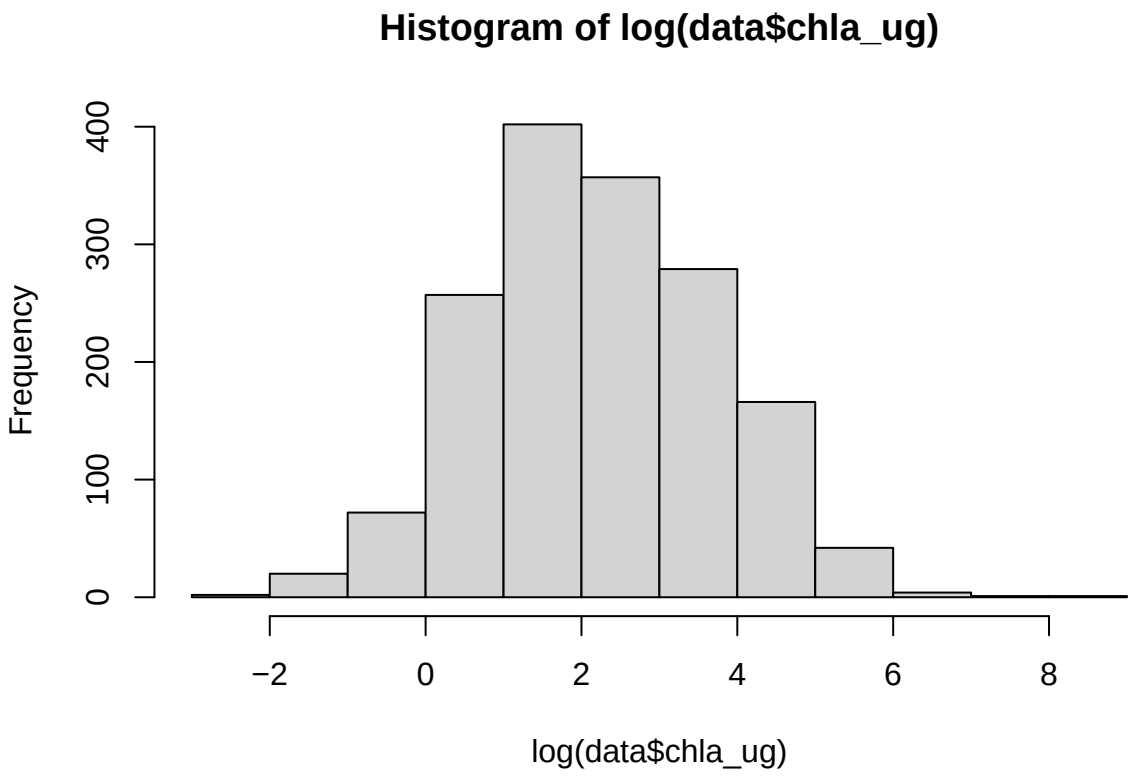
```
## [11] "nitrate_mg"                "nitrate_nitrite_mg"
## [13] "nitrite_mg"                "ammonia_mg"
## [15] "tn_ug"                     "doc_mg"
## [17] "toc_mg"                    "site_depth"
## [19] "chla_ug"                   "secchi_m"
## [21] "lake_nhdid"                "lagoslakeid"
## [23] "year"                      "lake_connectivity_permanent"
## [25] "lake_maxdepth_m"           "w.arch1"
## [27] "w.arch2"                   "w.arch3"
## [29] "w.arch4"                   "w.arch5"
## [31] "w.arch6"                   "w.arch7"
## [33] "max.arch"                  "w.max.arch"
```

Models and plots






Histogram of data$chla_ug
Frequency
0
500
1000
1500
0
500
1000
1500
2000
2500
3000
3500
data$chla_ug



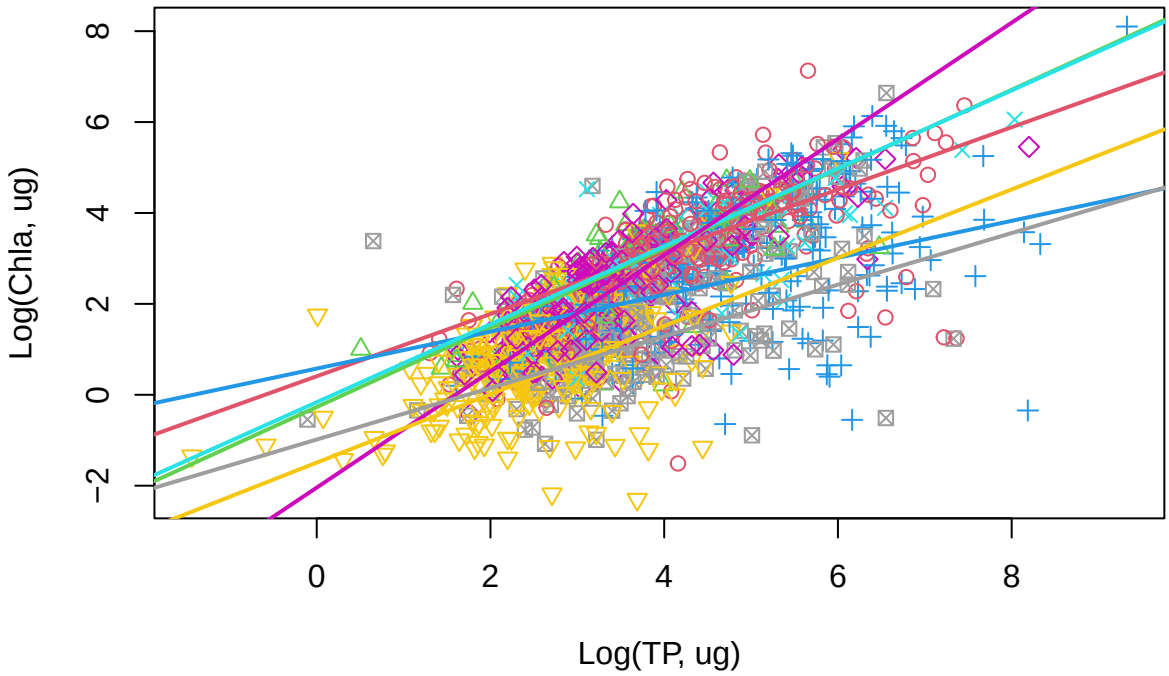

```
##
## Call:
## lm(formula = log(chla_ug) ~ 0 + w.arch1 + w.arch2 + w.arch3 +
##     w.arch4 + w.arch5 + w.arch6 + w.arch7 + log(tp_ug):w.arch1 +
##     log(tp_ug):w.arch2 + log(tp_ug):w.arch3 + log(tp_ug):w.arch4 +
##     log(tp_ug):w.arch5 + log(tp_ug):w.arch6 + log(tp_ug):w.arch7,
##     data = data)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -4.7172 -0.5269  0.0690  0.5933  3.6866
##
## Coefficients:
##                     Estimate Std. Error t value Pr(>|t|)
## w.arch1              0.40765    0.34193   1.192  0.23336
## w.arch2             -0.26944    0.55056  -0.489  0.62464
## w.arch3              0.57633    0.33168   1.738  0.08248 .
## w.arch4             -0.16356    0.58488  -0.280  0.77978
## w.arch5             -2.04203    0.42686  -4.784 1.88e-06 ***
## w.arch6             -1.49190    0.27630  -5.400 7.70e-08 ***
## w.arch7             -0.98438    0.36779  -2.676  0.00752 **
## w.arch1:log(tp_ug)  0.68493    0.07941   8.625  < 2e-16 ***
## w.arch2:log(tp_ug)  0.87246    0.14558   5.993 2.55e-09 ***
## w.arch3:log(tp_ug)  0.40629    0.06772   6.000 2.44e-09 ***
## w.arch4:log(tp_ug)  0.85755    0.13637   6.289 4.14e-10 ***
## w.arch5:log(tp_ug)  1.27855    0.11464  11.153  < 2e-16 ***
```

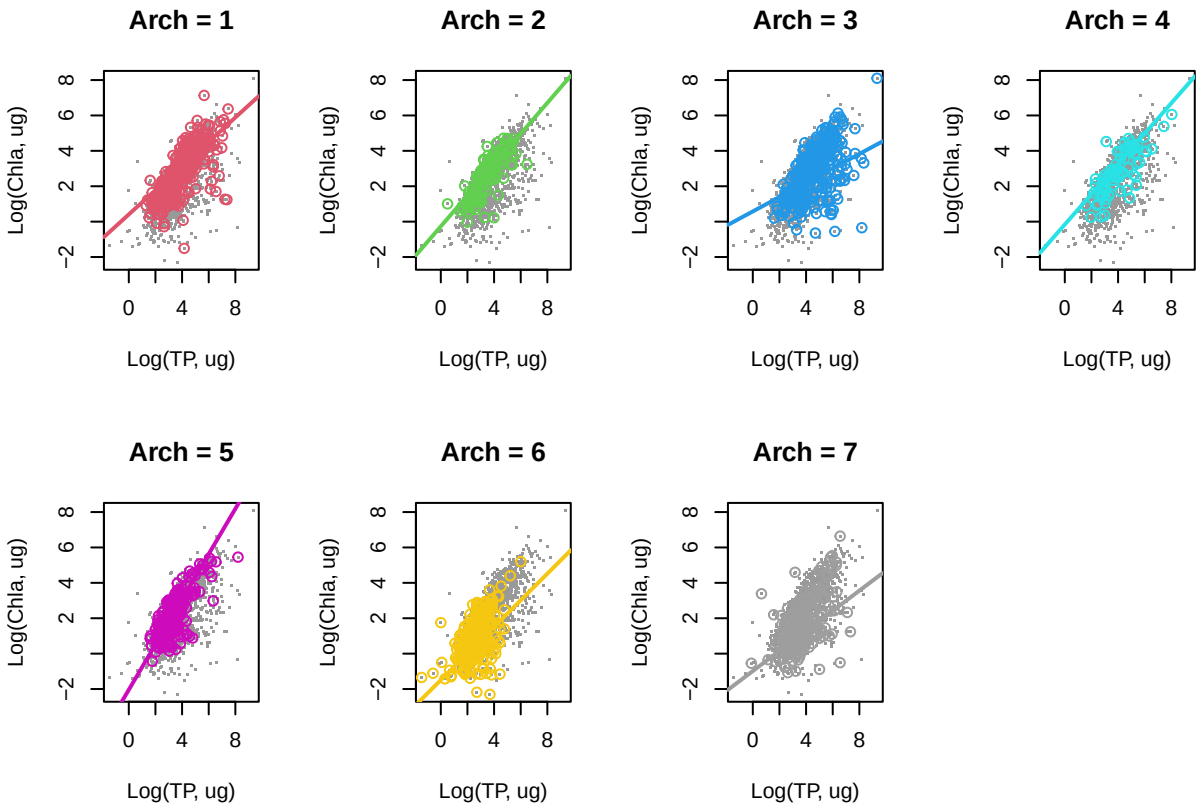
```
## w.arch6:log(tp_ug)  0.75128    0.09316   8.064 1.44e-15 ***
## w.arch7:log(tp_ug)  0.56785    0.09268   6.127 1.13e-09 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.9483 on 1578 degrees of freedom
##   (11 observations deleted due to missingness)
## Multiple R-squared:  0.8743, Adjusted R-squared:  0.8732
## F-statistic: 783.9 on 14 and 1578 DF,  p-value: < 2.2e-16
```

```
##
## Call:
## lm(formula = log(chla_ug) ~ log(tp_ug) * max.arch, data = data)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -5.8993 -0.5558  0.0792  0.6621  3.8313
##
## Coefficients:
##                       Estimate Std. Error t value Pr(>|t|)
## (Intercept)           0.113845   0.178737   0.637 0.524255
## log(tp_ug)            0.735065   0.042955  17.113  < 2e-16 ***
## max.arch             -0.144920   0.038102  -3.803 0.000148 ***
## log(tp_ug):max.arch -0.005794   0.009841  -0.589 0.556112
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1.007 on 1588 degrees of freedom
##   (11 observations deleted due to missingness)
## Multiple R-squared:  0.5376, Adjusted R-squared:  0.5367
## F-statistic: 615.5 on 3 and 1588 DF,  p-value: < 2.2e-16
```

```
##
## Call:
## lm(formula = log(chla_ug) ~ log(tp_ug) * ag_eco9, data = data)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -4.7682 -0.4974  0.0771  0.5554  3.7220
##
## Coefficients:
##                        Estimate Std. Error t value Pr(>|t|)
## (Intercept)           -0.43168    0.27542  -1.567  0.11723
## log(tp_ug)             0.84305    0.06657  12.664  < 2e-16 ***
## ag_eco9NAP            -1.02437    0.38067  -2.691  0.00720 **
## ag_eco9NPL             0.14374    0.45161   0.318  0.75031
## ag_eco9SAP            -0.30074    0.37147  -0.810  0.41829
## ag_eco9SPL             0.20176    0.40317   0.500  0.61685
## ag_eco9TPL             0.10026    0.36077   0.278  0.78113
## ag_eco9UMW            -0.94821    0.37103  -2.556  0.01069 *
## ag_eco9WMT            -0.96976    0.32441  -2.989  0.00284 **
## ag_eco9XER            -0.33176    0.37589  -0.883  0.37759
## log(tp_ug):ag_eco9NAP  0.28604    0.11209   2.552  0.01081 *
## log(tp_ug):ag_eco9NPL -0.26757    0.09587  -2.791  0.00532 **
```

```
## log(tp_ug):ag_eco9SAP  0.09008    0.09866   0.913  0.36134
## log(tp_ug):ag_eco9SPL -0.16837    0.09255  -1.819  0.06908 .
## log(tp_ug):ag_eco9TPL -0.07161    0.08367  -0.856  0.39220
## log(tp_ug):ag_eco9UMW  0.21875    0.09938   2.201  0.02787 *
## log(tp_ug):ag_eco9WMT -0.05881    0.08451  -0.696  0.48659
## log(tp_ug):ag_eco9XER -0.19138    0.09004  -2.126  0.03370 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.9507 on 1574 degrees of freedom
##   (11 observations deleted due to missingness)
## Multiple R-squared:  0.5916, Adjusted R-squared:  0.5872
## F-statistic: 134.1 on 17 and 1574 DF,  p-value: < 2.2e-16
```






```
aa.r.sq
```

```
## [1] 0.8731691
```

```
max.arch.r.sq
```

```
## [1] 0.5367407
```

```
ecoreg.r.sq
```

```
## [1] 0.5871549
```

```
aa.AIC
```

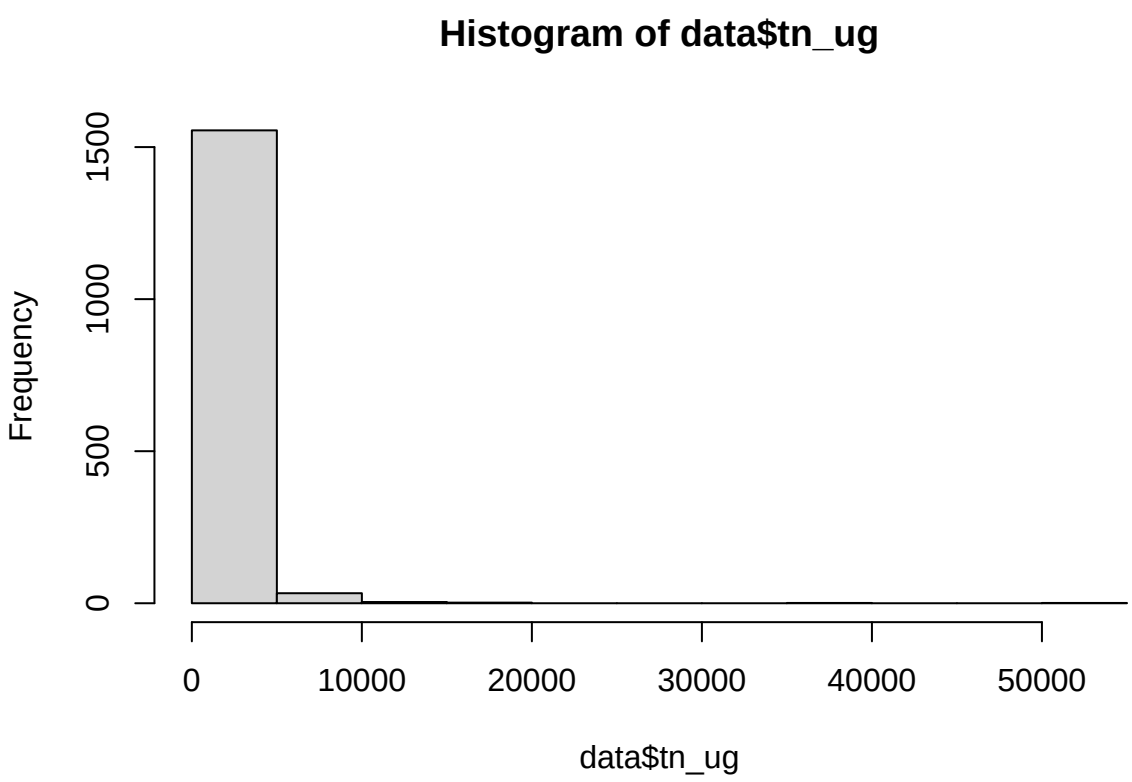
```
## [1] 4364.763
```

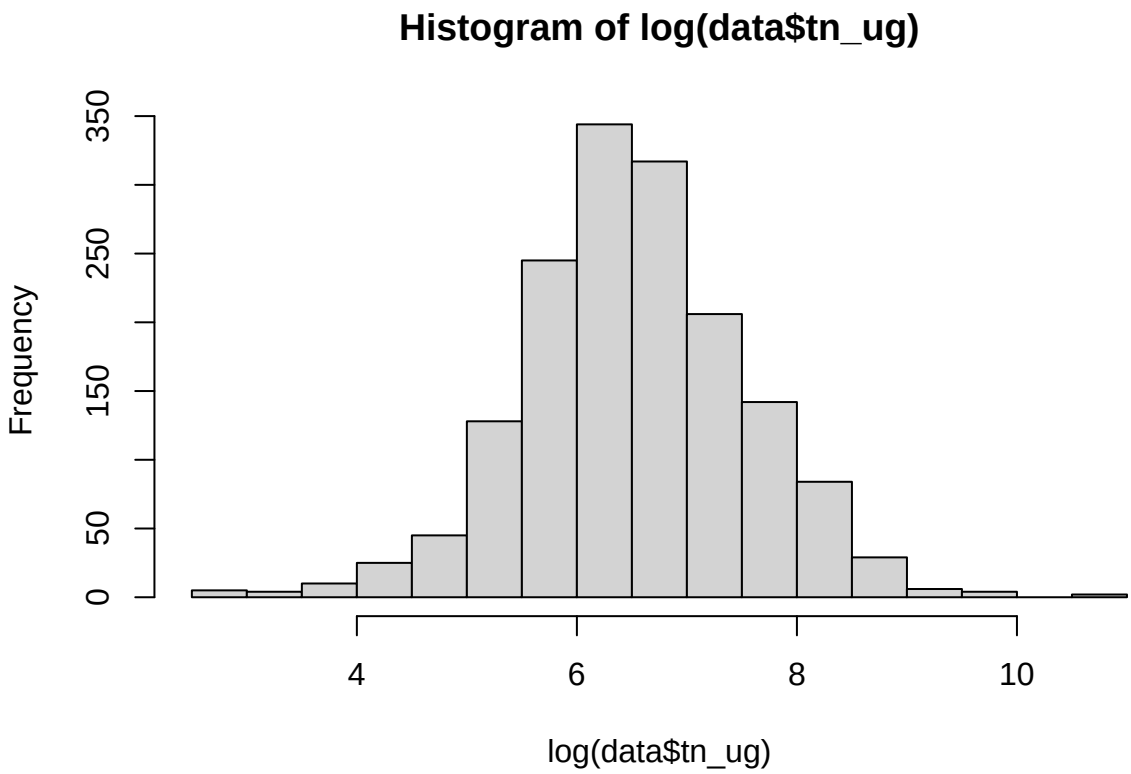
```
max.arch.AIC
```

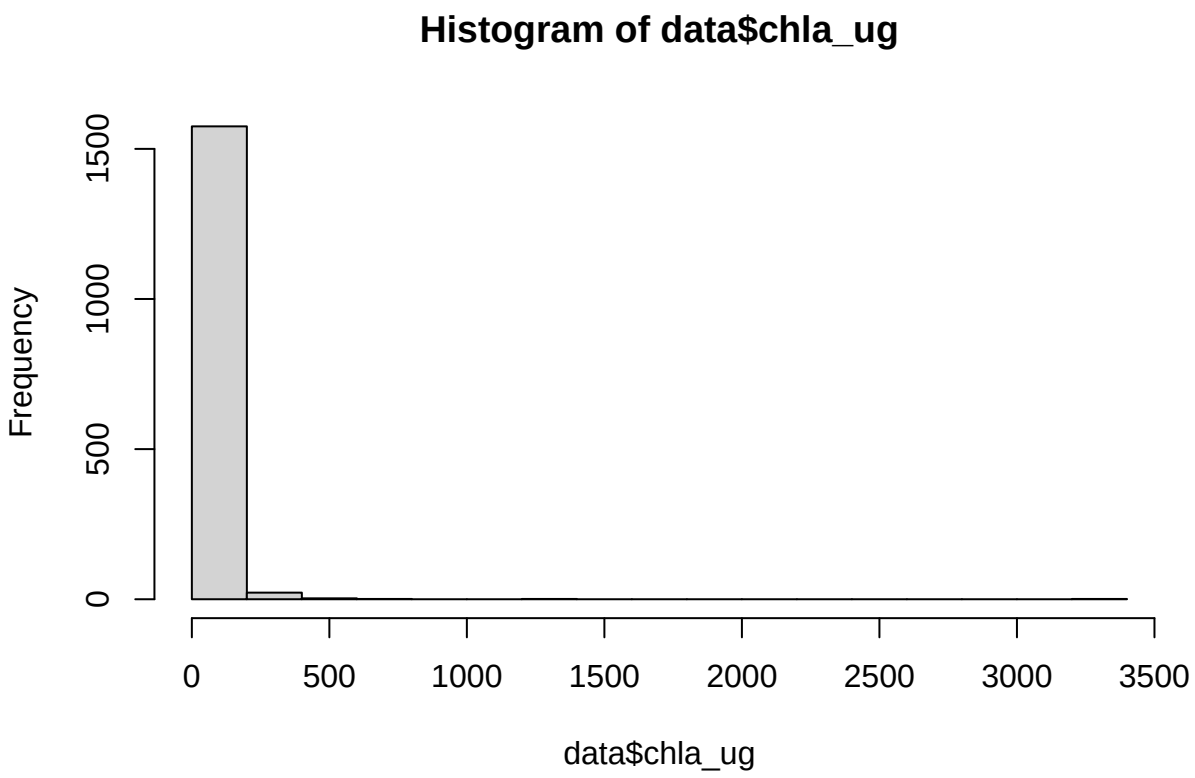
```
## [1] 4546.447
```

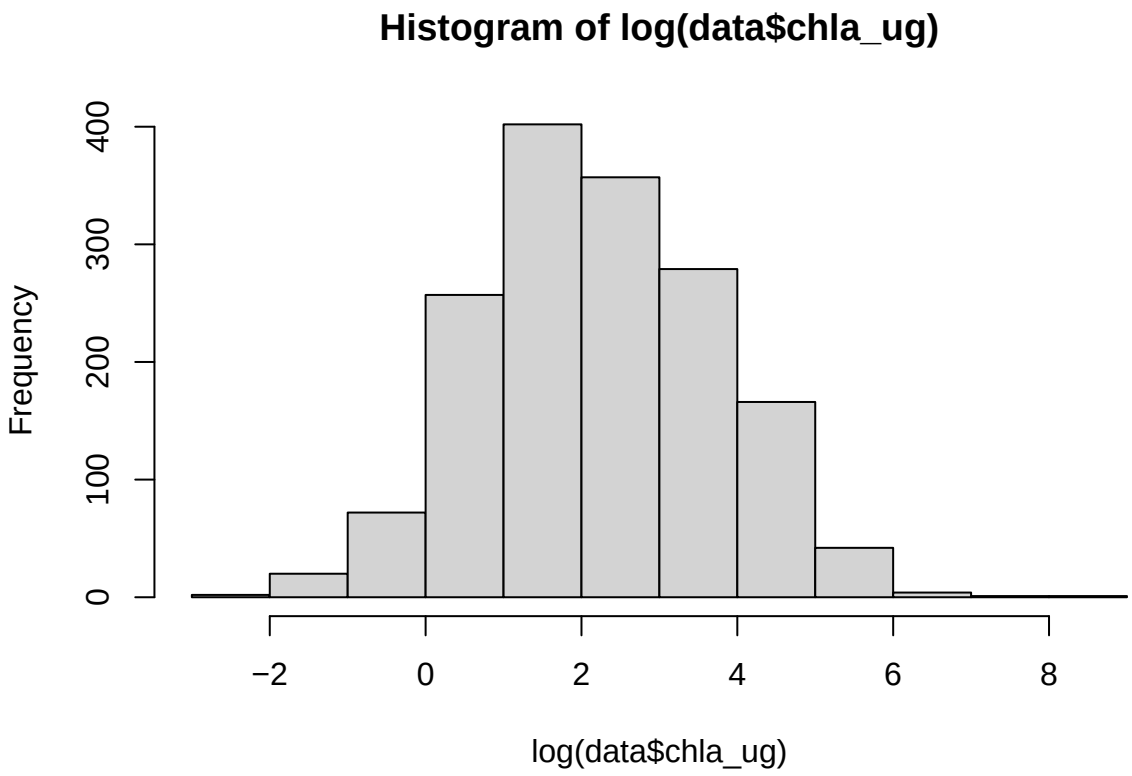
```
ecoreg.AIC
```

```
## [1] 4376.928
```


Histogram of data$tn_ug
Frequency
0
500
1000
1500
0
10000
20000
30000
40000
50000
data$tn_ug


Histogram of log(data$tn_ug)
Frequency
0
50
150
250
350
4
6
8
10
log(data$tn_ug)


Histogram of data$chla_ug
Frequency
0
500
1000
1500
0
500
1000
1500
2000
2500
3000
3500
data$chla_ug



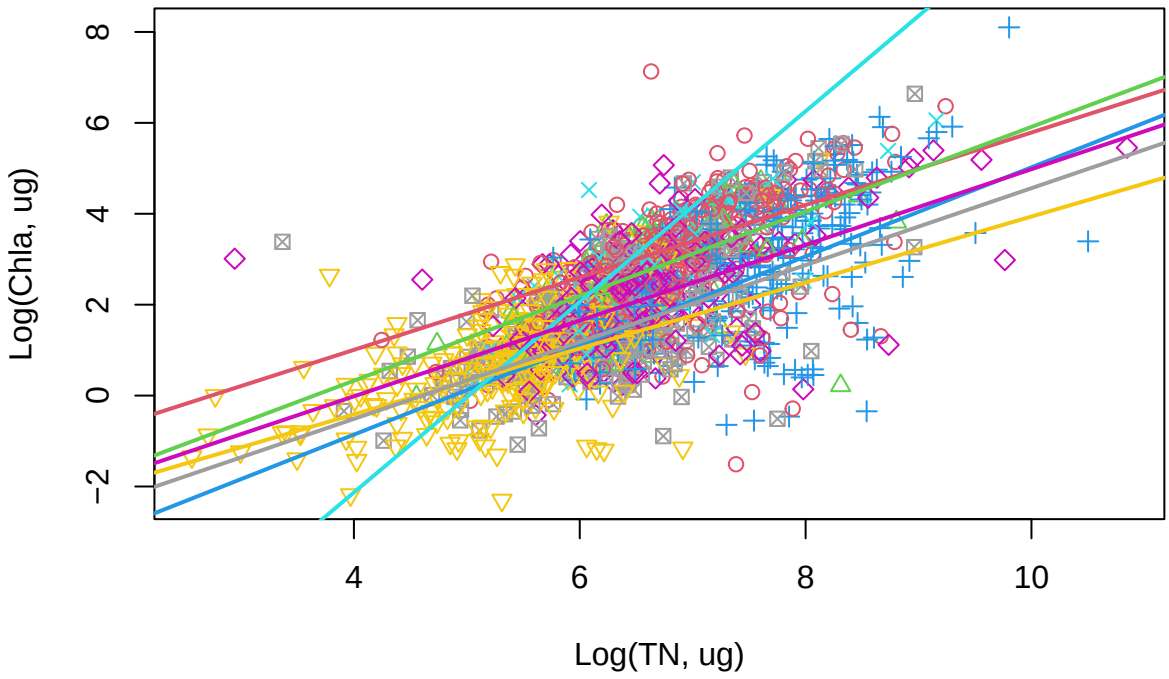

```
##
## Call:
## lm(formula = log(chla_ug) ~ 0 + w.arch1 + w.arch2 + w.arch3 +
##     w.arch4 + w.arch5 + w.arch6 + w.arch7 + log(tn_ug):w.arch1 +
##     log(tn_ug):w.arch2 + log(tn_ug):w.arch3 + log(tn_ug):w.arch4 +
##     log(tn_ug):w.arch5 + log(tn_ug):w.arch6 + log(tn_ug):w.arch7,
##     data = data)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -5.5612 -0.5751  0.0663  0.6423  4.7257
##
## Coefficients:
##                     Estimate Std. Error t value Pr(>|t|)
## w.arch1              -2.1819     0.8145  -2.679 0.007468 **
## w.arch2              -3.3951     1.4095  -2.409 0.016125 *
## w.arch3              -4.7799     0.8049  -5.939 3.52e-09 ***
## w.arch4             -10.5189     1.5639  -6.726 2.42e-11 ***
## w.arch5              -3.3486     0.9956  -3.364 0.000788 ***
## w.arch6              -3.3149     0.5991  -5.534 3.67e-08 ***
## w.arch7              -3.8974     0.7875  -4.949 8.25e-07 ***
## w.arch1:log(tn_ug)    0.7969     0.1186   6.721 2.52e-11 ***
## w.arch2:log(tn_ug)    0.9307     0.2117   4.396 1.17e-05 ***
## w.arch3:log(tn_ug)    0.9802     0.1073   9.135  < 2e-16 ***
## w.arch4:log(tn_ug)    2.0968     0.2321   9.033  < 2e-16 ***
## w.arch5:log(tn_ug)    0.8330     0.1480   5.627 2.16e-08 ***
```

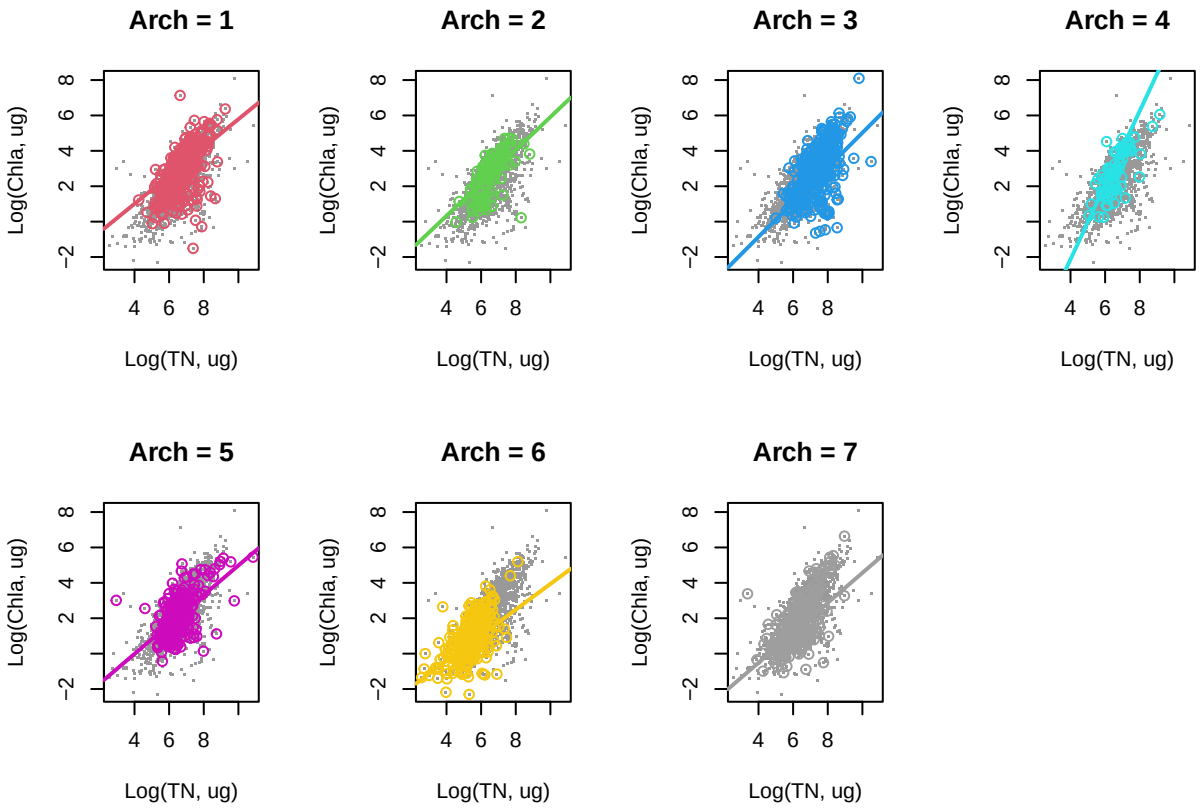
```
## w.arch6:log(tn_ug)   0.7254     0.1084   6.694 3.01e-11 ***
## w.arch7:log(tn_ug)   0.8460     0.1238   6.836 1.16e-11 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.9993 on 1582 degrees of freedom
##   (7 observations deleted due to missingness)
## Multiple R-squared:  0.8602, Adjusted R-squared:  0.859
## F-statistic: 695.4 on 14 and 1582 DF,  p-value: < 2.2e-16
```

```
##
## Call:
## lm(formula = log(chla_ug) ~ log(tn_ug) * max.arch, data = data)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -4.9154 -0.6246  0.0604  0.7104  4.4403
##
## Coefficients:
##                     Estimate Std. Error t value Pr(>|t|)
## (Intercept)         -3.57376    0.43635  -8.190  5.3e-16 ***
## log(tn_ug)           0.96522    0.06431  15.010  < 2e-16 ***
## max.arch            -0.03151    0.08960  -0.352    0.725
## log(tn_ug):max.arch -0.01590    0.01376  -1.156    0.248
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1.038 on 1592 degrees of freedom
##   (7 observations deleted due to missingness)
## Multiple R-squared:  0.5085, Adjusted R-squared:  0.5076
## F-statistic: 549.1 on 3 and 1592 DF,  p-value: < 2.2e-16
```

```
##
## Call:
## lm(formula = log(chla_ug) ~ log(tn_ug) * ag_eco9, data = data)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -4.8132 -0.5837  0.0670  0.6501  4.6638
##
## Coefficients:
##                          Estimate Std. Error t value Pr(>|t|)
## (Intercept)            -3.185785   0.705193  -4.518 6.72e-06 ***
## log(tn_ug)              0.909789   0.104188   8.732  < 2e-16 ***
## ag_eco9NAP             -4.083888   1.115814  -3.660 0.000261 ***
## ag_eco9NPL             -1.896096   1.081472  -1.753 0.079752 .
## ag_eco9SAP             -1.638042   0.984349  -1.664 0.096294 .
## ag_eco9SPL             -1.347213   0.993524  -1.356 0.175295
## ag_eco9TPL             -1.712215   0.937920  -1.826 0.068108 .
## ag_eco9UMW             -0.417405   0.947333  -0.441 0.659555
## ag_eco9WMT             -0.876969   0.786405  -1.115 0.264951
## ag_eco9XER             -0.908502   0.914717  -0.993 0.320762
## log(tn_ug):ag_eco9NAP   0.597203   0.178343   3.349 0.000831 ***
## log(tn_ug):ag_eco9NPL   0.094901   0.148977   0.637 0.524203
```

```
## log(tn_ug):ag_eco9SAP  0.252038   0.152331   1.655 0.098216 .
## log(tn_ug):ag_eco9SPL  0.124669   0.143595   0.868 0.385415
## log(tn_ug):ag_eco9TPL  0.200756   0.134768   1.490 0.136518
## log(tn_ug):ag_eco9UMW -0.040052   0.141770  -0.283 0.777584
## log(tn_ug):ag_eco9WMT -0.003408   0.120760  -0.028 0.977489
## log(tn_ug):ag_eco9XER  0.018101   0.137646   0.132 0.895394
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1.015 on 1578 degrees of freedom
##   (7 observations deleted due to missingness)
## Multiple R-squared:  0.534,  Adjusted R-squared:  0.529
## F-statistic: 106.4 on 17 and 1578 DF,  p-value: < 2.2e-16

## [1] 0.85898

## [1] 0.5076073

## [1] 0.529019

## [1] 4542.842

## [1] 4653.962

## [1] 4596.908
```






```
aa.r.sq
```

```
## [1] 0.85898
```

```
max.arch.r.sq
```

```
## [1] 0.5076073
```

```
ecoreg.r.sq
```

```
## [1] 0.529019
```

```
aa.AIC
```

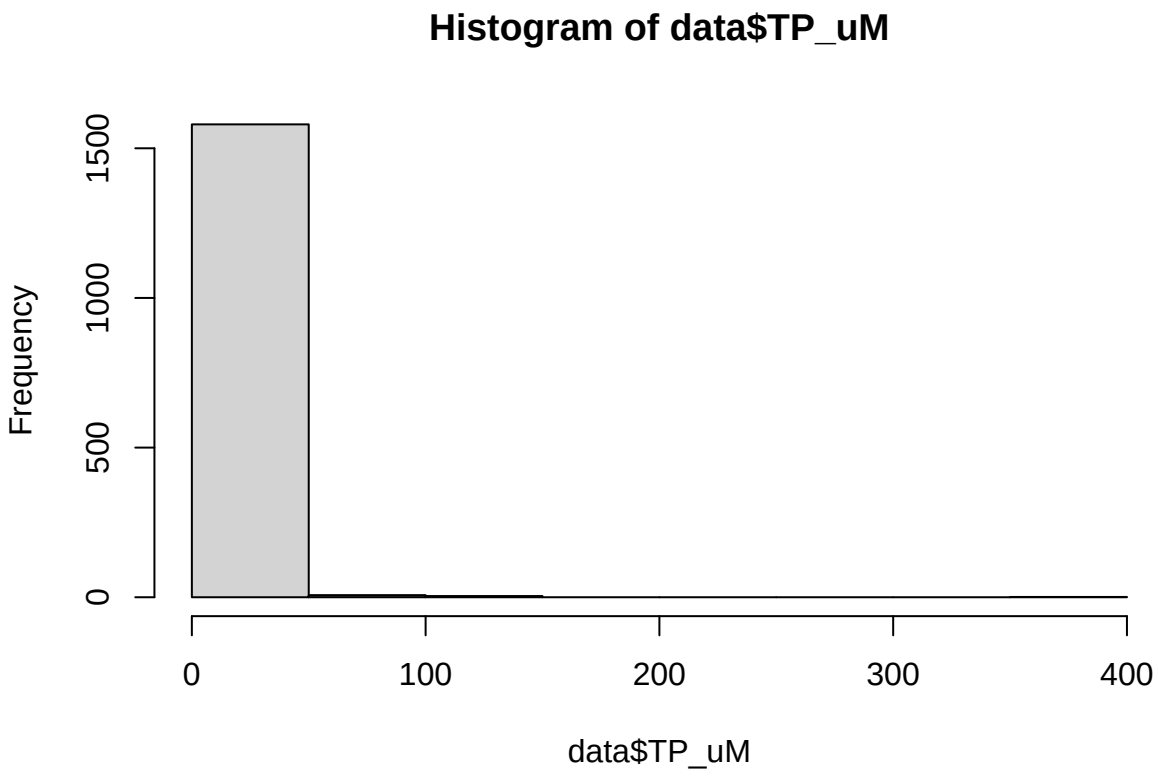
```
## [1] 4542.842
```

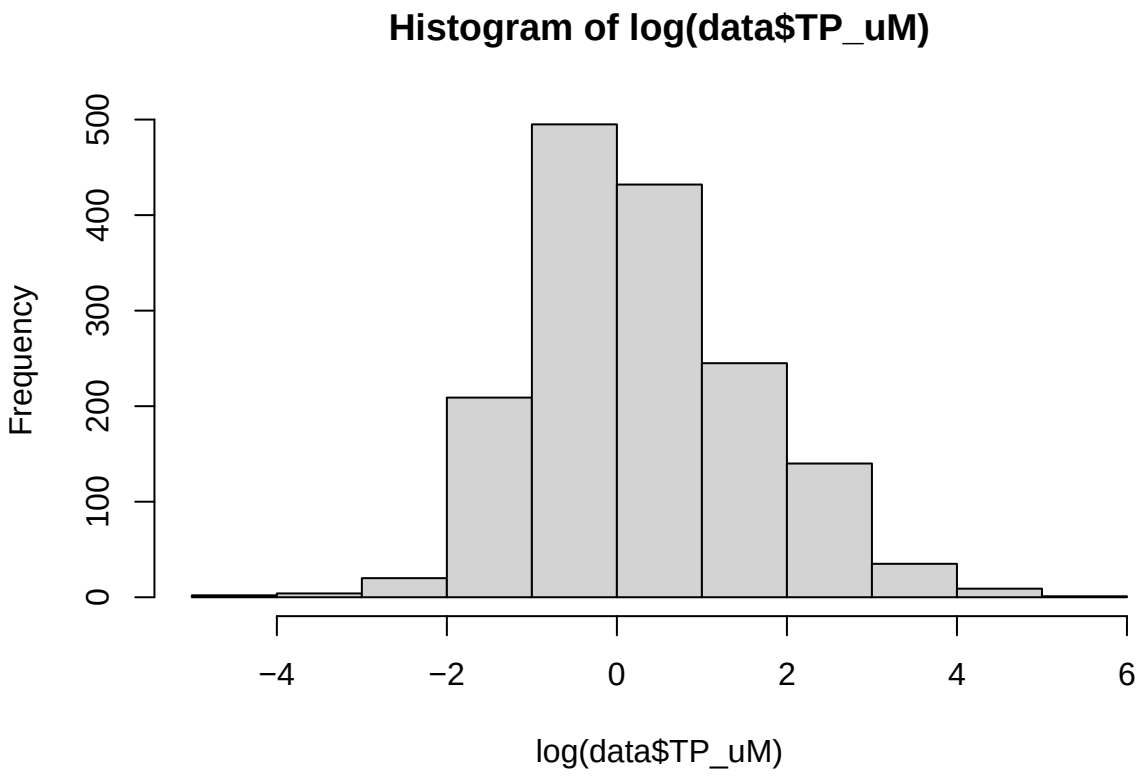
```
max.arch.AIC
```

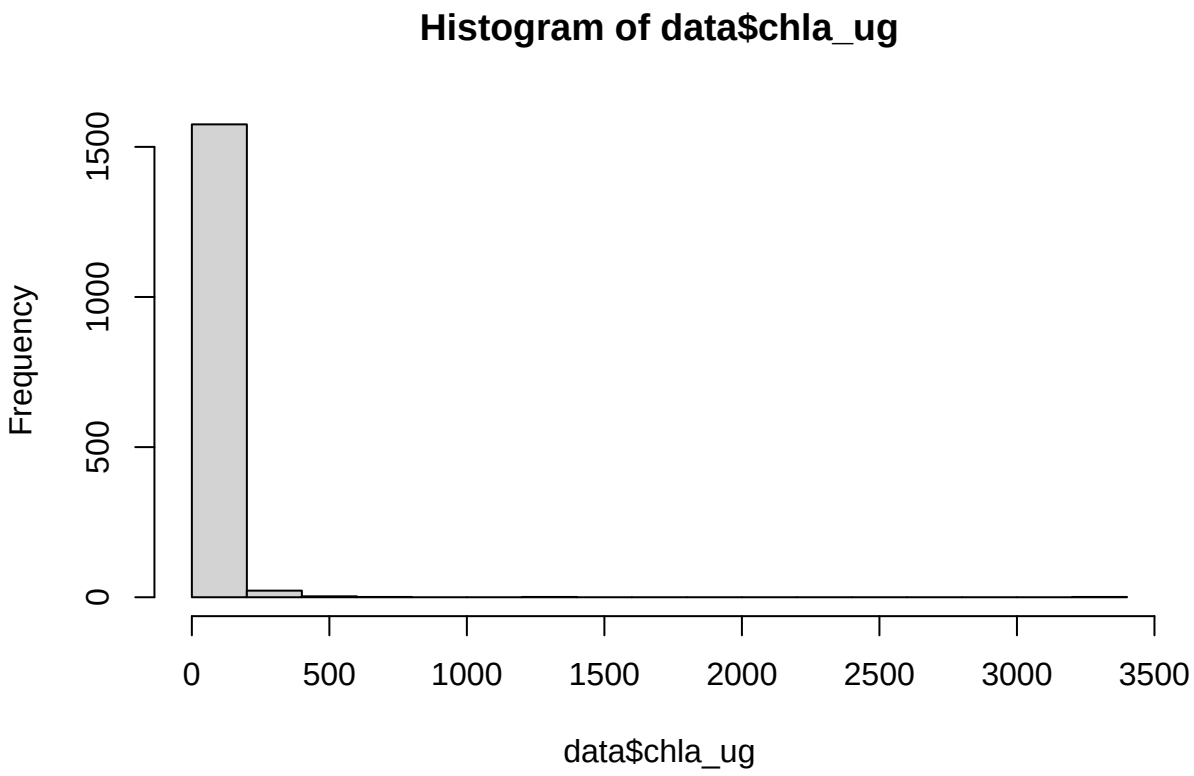
```
## [1] 4653.962
```

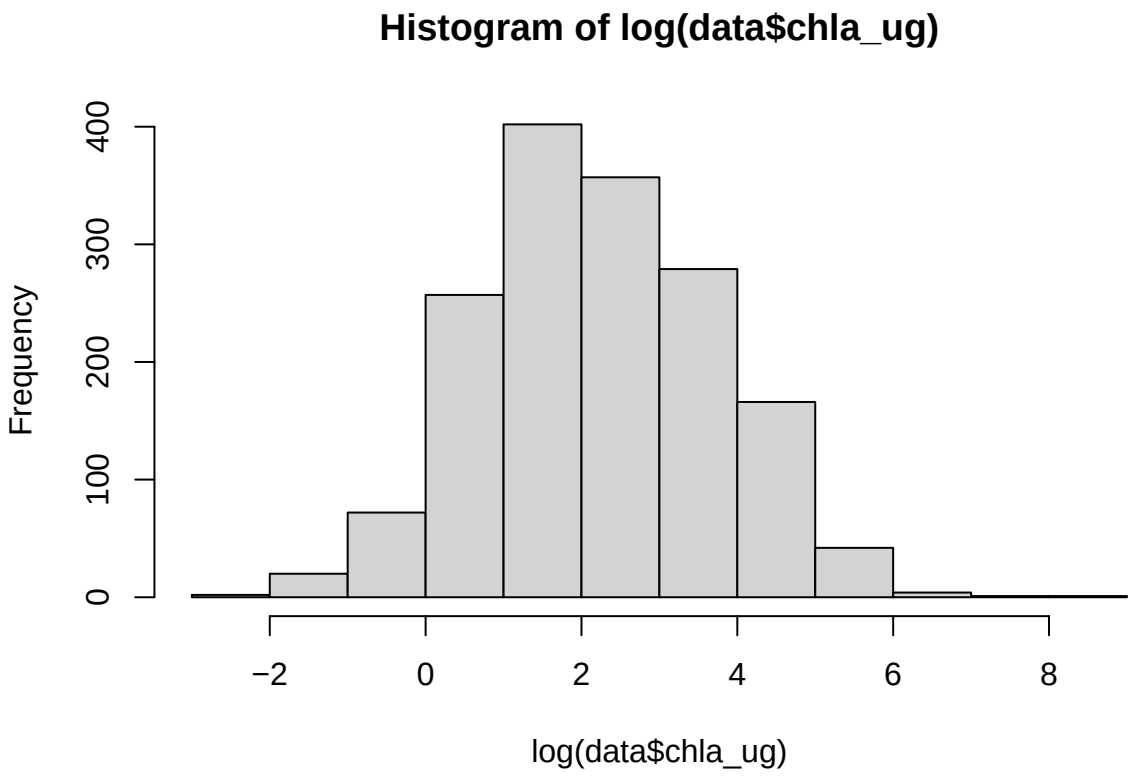
```
ecoreg.AIC
```

```
## [1] 4596.908
```


Histogram of data$TP_uM
Frequency
0
500
1000
1500
0
100
200
300
400
data$TP_uM


Histogram of log(data$TP_uM)
Frequency
0
100
200
300
400
500
−4
−2
0
2
4
6
log(data$TP_uM)


Histogram of data$chla_ug
Frequency
0
500
1000
1500
0
500
1000
1500
2000
2500
3000
3500
data$chla_ug




```
##
## Call:
## lm(formula = log(chla_ug) ~ 0 + w.arch1 + w.arch2 + w.arch3 +
##     w.arch4 + w.arch5 + w.arch6 + w.arch7 + log(TP_uM):w.arch1 +
##     log(TP_uM):w.arch2 + log(TP_uM):w.arch3 + log(TP_uM):w.arch4 +
##     log(TP_uM):w.arch5 + log(TP_uM):w.arch6 + log(TP_uM):w.arch7,
##     data = data)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -4.7172 -0.5269  0.0690  0.5933  3.6866
##
## Coefficients:
##                     Estimate Std. Error t value Pr(>|t|)
## w.arch1              2.75902    0.11621  23.743  < 2e-16 ***
## w.arch2              2.72575    0.16341  16.680  < 2e-16 ***
## w.arch3              1.97112    0.12776  15.428  < 2e-16 ***
## w.arch4              2.78042    0.20380  13.643  < 2e-16 ***
## w.arch5              2.34725    0.12940  18.139  < 2e-16 ***
## w.arch6              1.08726    0.13035   8.341  < 2e-16 ***
## w.arch7              0.96505    0.12186   7.919 4.46e-15 ***
## w.arch1:log(TP_uM)  0.68493    0.07941   8.625  < 2e-16 ***
## w.arch2:log(TP_uM)  0.87246    0.14558   5.993 2.55e-09 ***
## w.arch3:log(TP_uM)  0.40629    0.06772   6.000 2.44e-09 ***
## w.arch4:log(TP_uM)  0.85755    0.13637   6.289 4.14e-10 ***
## w.arch5:log(TP_uM)  1.27855    0.11464  11.153  < 2e-16 ***
```

```
## w.arch6:log(TP_uM)  0.75128    0.09316   8.064 1.44e-15 ***
## w.arch7:log(TP_uM)  0.56785    0.09268   6.127 1.13e-09 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.9483 on 1578 degrees of freedom
##   (11 observations deleted due to missingness)
## Multiple R-squared:  0.8743, Adjusted R-squared:  0.8732
## F-statistic: 783.9 on 14 and 1578 DF,  p-value: < 2.2e-16
```

```
##
## Call:
## lm(formula = log(chla_ug) ~ log(TP_uM) * max.arch, data = data)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -5.8993 -0.5558  0.0792  0.6621  3.8313
##
## Coefficients:
##                       Estimate Std. Error t value Pr(>|t|)
## (Intercept)           2.637337   0.057246  46.070   <2e-16 ***
## log(TP_uM)            0.735065   0.042955  17.113   <2e-16 ***
## max.arch             -0.164810   0.012400 -13.291   <2e-16 ***
## log(TP_uM):max.arch -0.005794   0.009841  -0.589    0.556
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1.007 on 1588 degrees of freedom
##   (11 observations deleted due to missingness)
## Multiple R-squared:  0.5376, Adjusted R-squared:  0.5367
## F-statistic: 615.5 on 3 and 1588 DF,  p-value: < 2.2e-16
```

```
##
## Call:
## lm(formula = log(chla_ug) ~ log(TP_uM) * ag_eco9, data = data)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -4.7682 -0.4974  0.0771  0.5554  3.7220
##
## Coefficients:
##                         Estimate Std. Error t value Pr(>|t|)
## (Intercept)             2.462540   0.080993  30.404  < 2e-16 ***
## log(TP_uM)              0.843055   0.066569  12.664  < 2e-16 ***
## ag_eco9NAP             -0.042385   0.125237  -0.338  0.73508
## ag_eco9NPL             -0.774830   0.163532  -4.738 2.35e-06 ***
## ag_eco9SAP              0.008519   0.112764   0.076  0.93979
## ag_eco9SPL             -0.376252   0.131260  -2.866  0.00421 **
## ag_eco9TPL             -0.145579   0.113495  -1.283  0.19979
## ag_eco9UMW             -0.197227   0.101977  -1.934  0.05329 .
## ag_eco9WMT             -1.171675   0.102273 -11.456  < 2e-16 ***
## ag_eco9XER             -0.988757   0.121617  -8.130 8.60e-16 ***
## log(TP_uM):ag_eco9NAP   0.286042   0.112094   2.552  0.01081 *
## log(TP_uM):ag_eco9NPL -0.267570   0.095870  -2.791  0.00532 **
```

```
## log(TP_uM):ag_eco9SAP  0.090085   0.098660   0.913  0.36134
## log(TP_uM):ag_eco9SPL -0.168367   0.092553  -1.819  0.06908 .
## log(TP_uM):ag_eco9TPL -0.071610   0.083669  -0.856  0.39220
## log(TP_uM):ag_eco9UMW  0.218752   0.099382   2.201  0.02787 *
## log(TP_uM):ag_eco9WMT -0.058815   0.084515  -0.696  0.48659
## log(TP_uM):ag_eco9XER -0.191376   0.090038  -2.126  0.03370 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.9507 on 1574 degrees of freedom
##   (11 observations deleted due to missingness)
## Multiple R-squared:  0.5916, Adjusted R-squared:  0.5872
## F-statistic: 134.1 on 17 and 1574 DF,  p-value: < 2.2e-16
```

```
## [1] 0.8731691
```

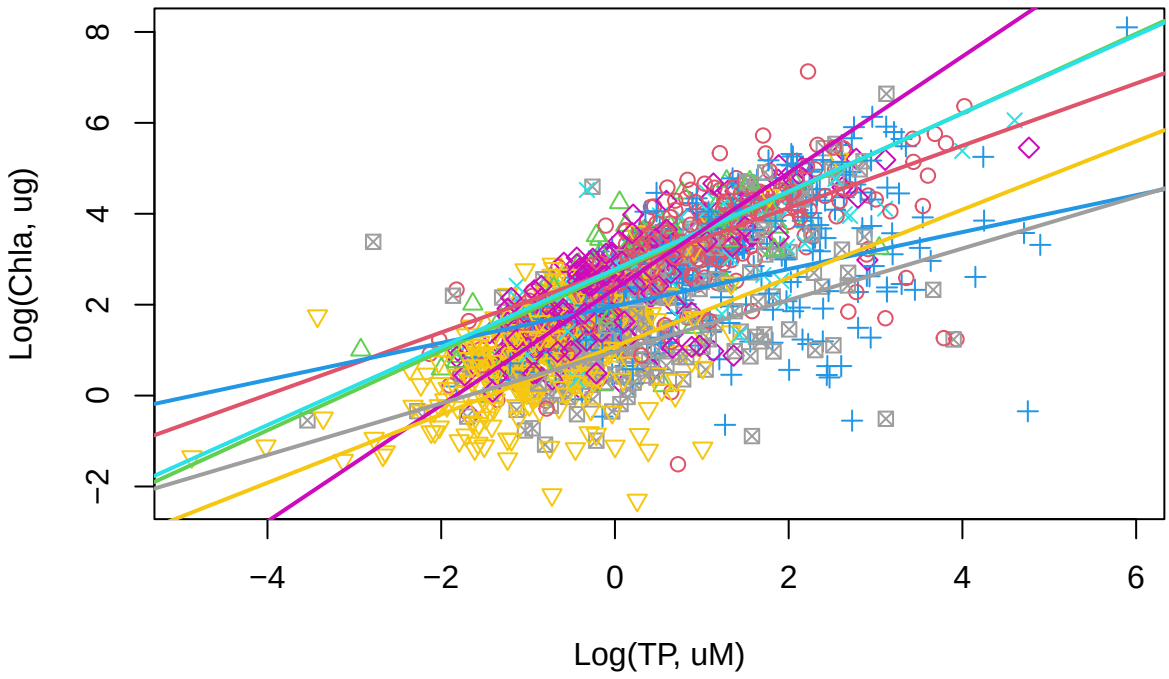
```
## [1] 0.5367407
```

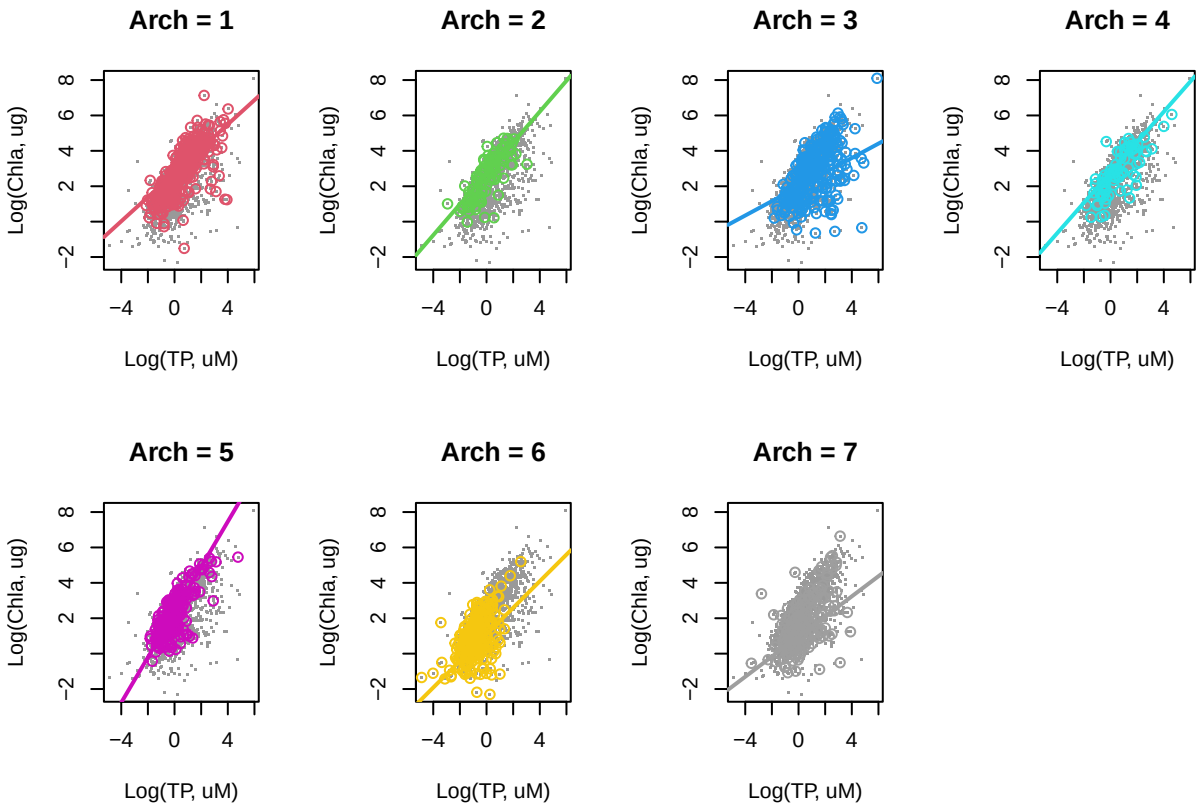
```
## [1] 0.5871549
```

```
## [1] 4364.763
```

```
## [1] 4546.447
```

```
## [1] 4376.928
```






```
aa.r.sq
```

```
## [1] 0.8731691
```

```
max.arch.r.sq
```

```
## [1] 0.5367407
```

```
ecoreg.r.sq
```

```
## [1] 0.5871549
```

```
aa.AIC
```

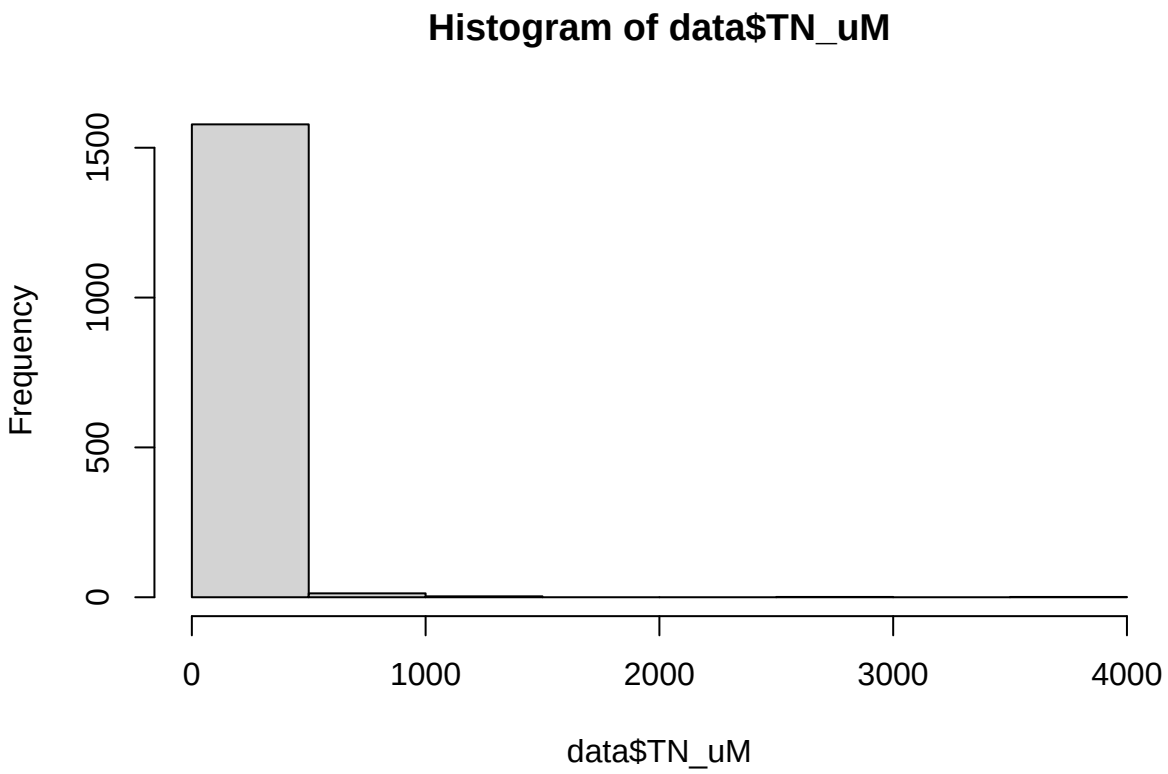
```
## [1] 4364.763
```

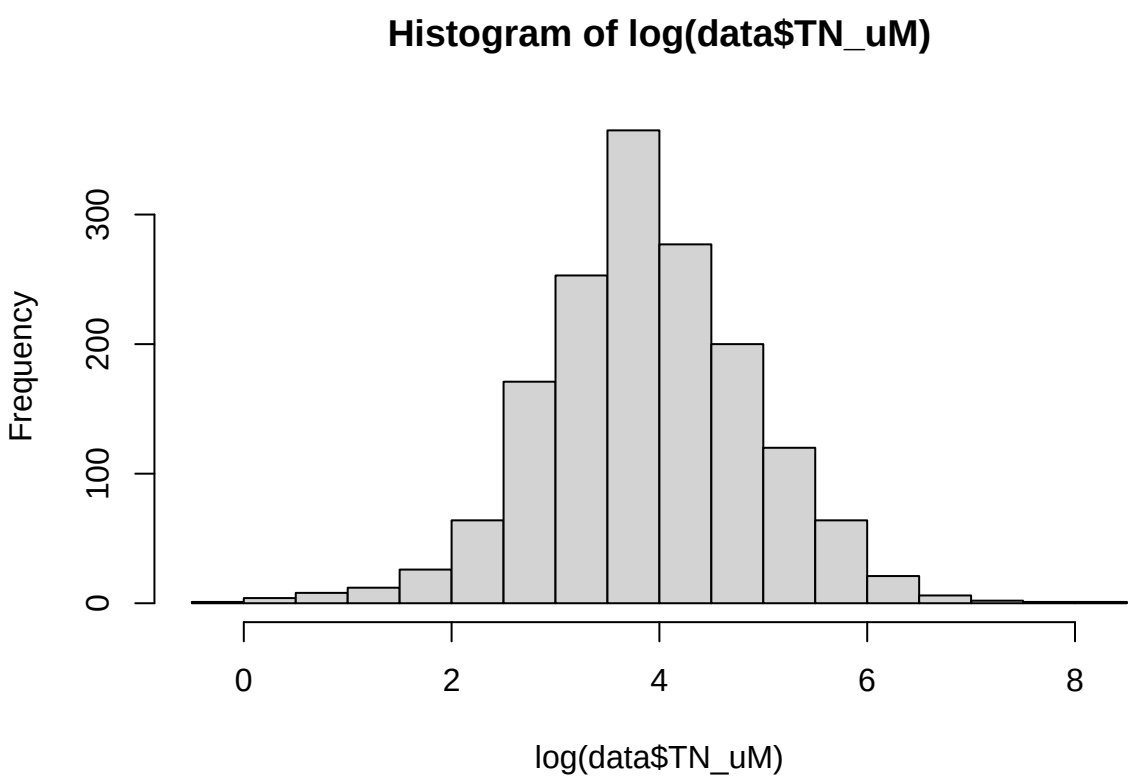
```
max.arch.AIC
```

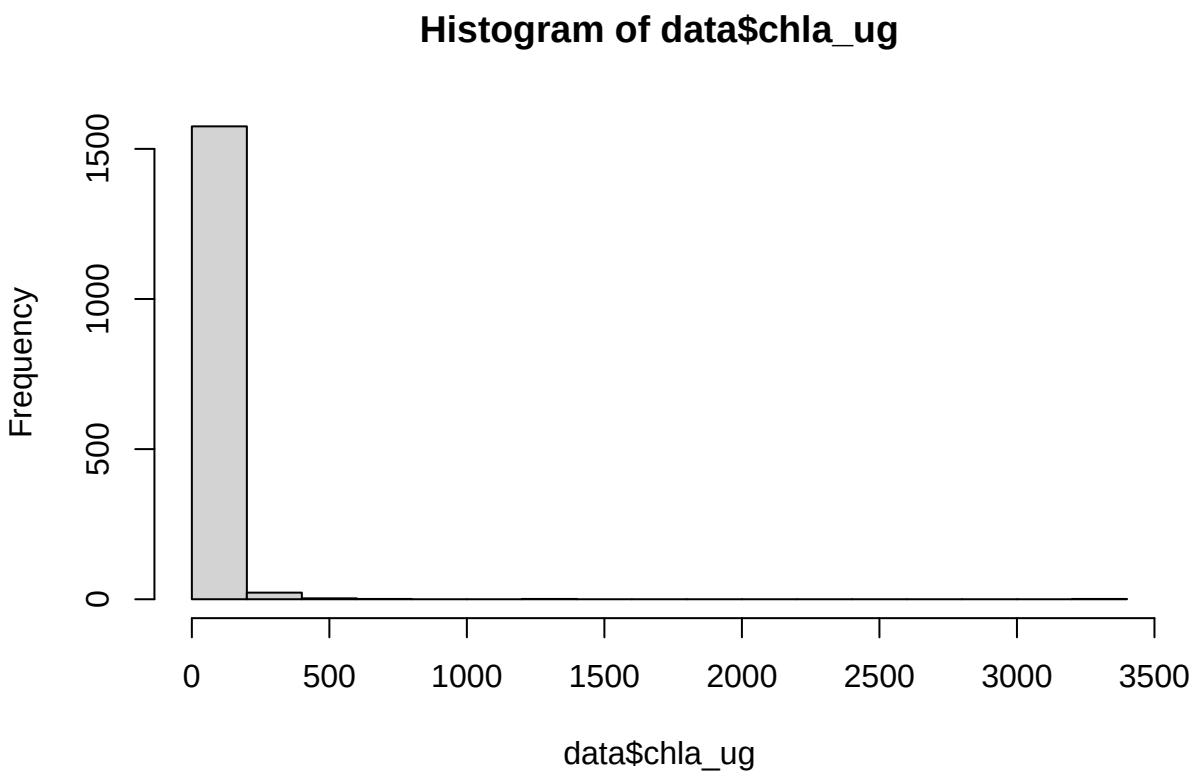
```
## [1] 4546.447
```

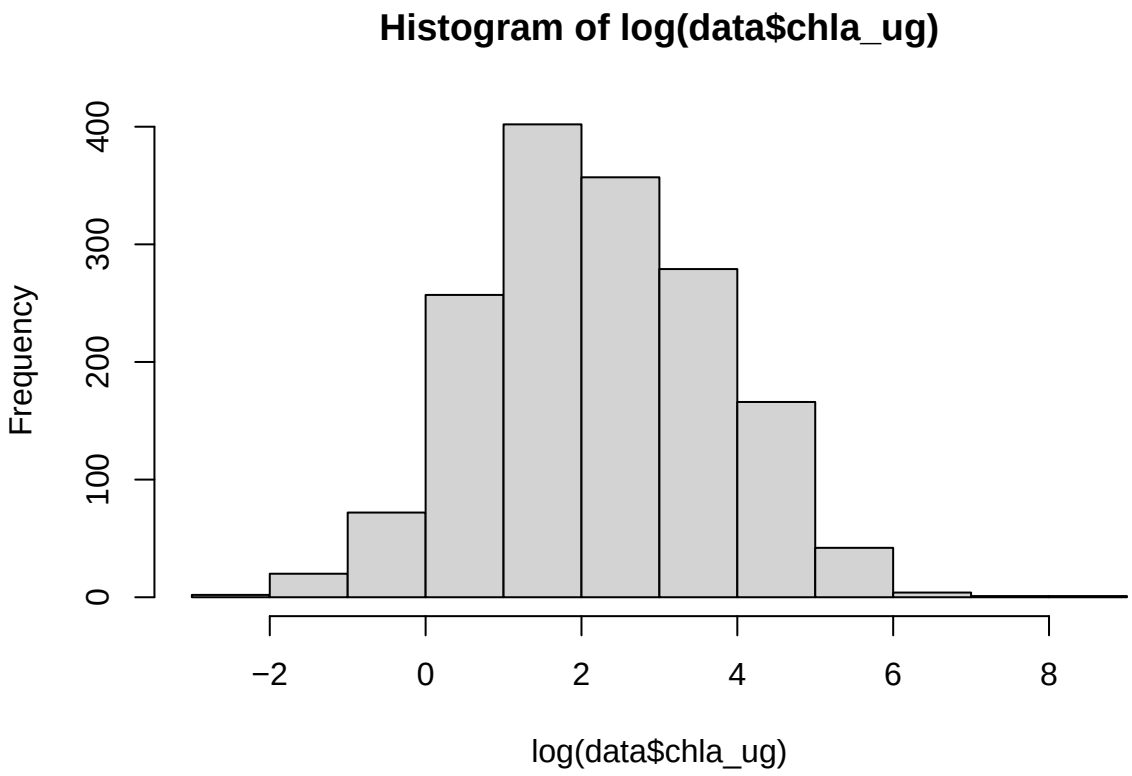
```
ecoreg.AIC
```

```
## [1] 4376.928
```


Histogram of data$TN_uM
Frequency
0
500
1000
1500
0
1000
2000
3000
4000
data$TN_uM


Histogram of log(data$TN_uM)
Frequency
0
100
200
300
0
2
4
6
8
log(data$TN_uM)


Histogram of data$chla_ug
Frequency
0
500
1000
1500
0
500
1000
1500
2000
2500
3000
3500
data$chla_ug



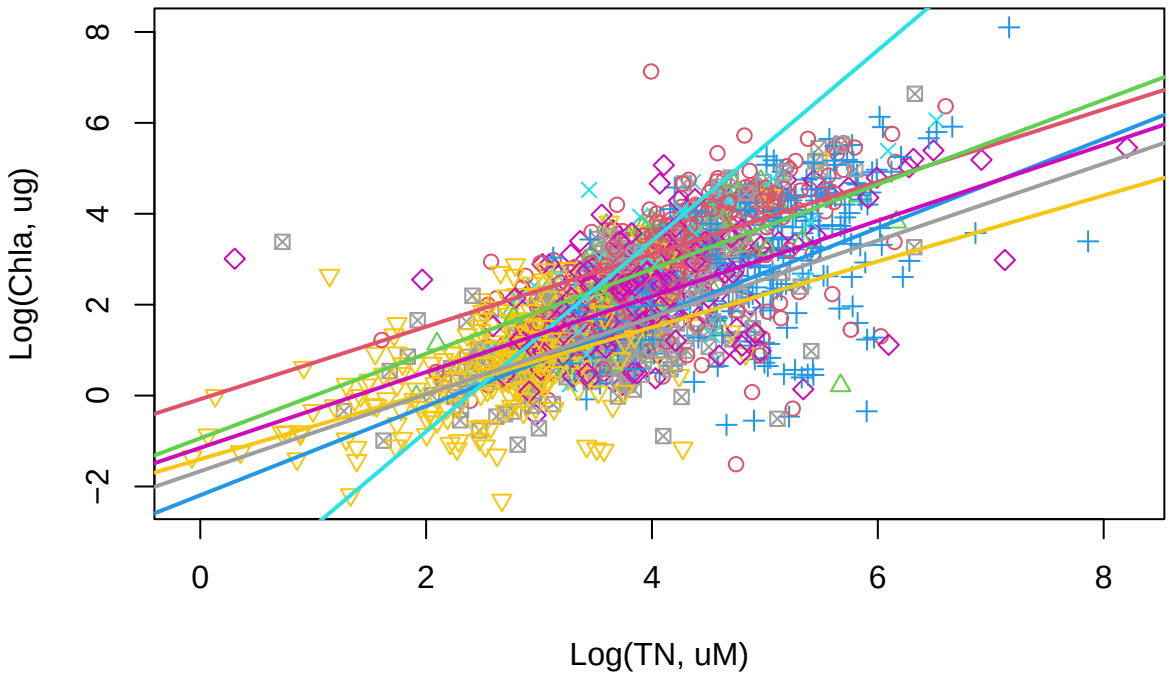

```
##
## Call:
## lm(formula = log(chla_ug) ~ 0 + w.arch1 + w.arch2 + w.arch3 +
##     w.arch4 + w.arch5 + w.arch6 + w.arch7 + log(TN_uM):w.arch1 +
##     log(TN_uM):w.arch2 + log(TN_uM):w.arch3 + log(TN_uM):w.arch4 +
##     log(TN_uM):w.arch5 + log(TN_uM):w.arch6 + log(TN_uM):w.arch7,
##     data = data)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -5.5612 -0.5751  0.0663  0.6423  4.7257
##
## Coefficients:
##                     Estimate Std. Error t value Pr(>|t|)
## w.arch1            -0.07841    0.50605  -0.155 0.876887
## w.arch2            -0.93861    0.85748  -1.095 0.273852
## w.arch3            -2.19261    0.52500  -4.176 3.12e-05 ***
## w.arch4            -4.98422    0.95888  -5.198 2.28e-07 ***
## w.arch5            -1.14998    0.61068  -1.883 0.059870 .
## w.arch6            -1.40028    0.32401  -4.322 1.64e-05 ***
## w.arch7            -1.66428    0.46767  -3.559 0.000384 ***
## w.arch1:log(TN_uM)  0.79692    0.11858   6.721 2.52e-11 ***
## w.arch2:log(TN_uM)  0.93065    0.21169   4.396 1.17e-05 ***
## w.arch3:log(TN_uM)  0.98020    0.10730   9.135  < 2e-16 ***
## w.arch4:log(TN_uM)  2.09683    0.23213   9.033  < 2e-16 ***
## w.arch5:log(TN_uM)  0.83296    0.14803   5.627 2.16e-08 ***
```

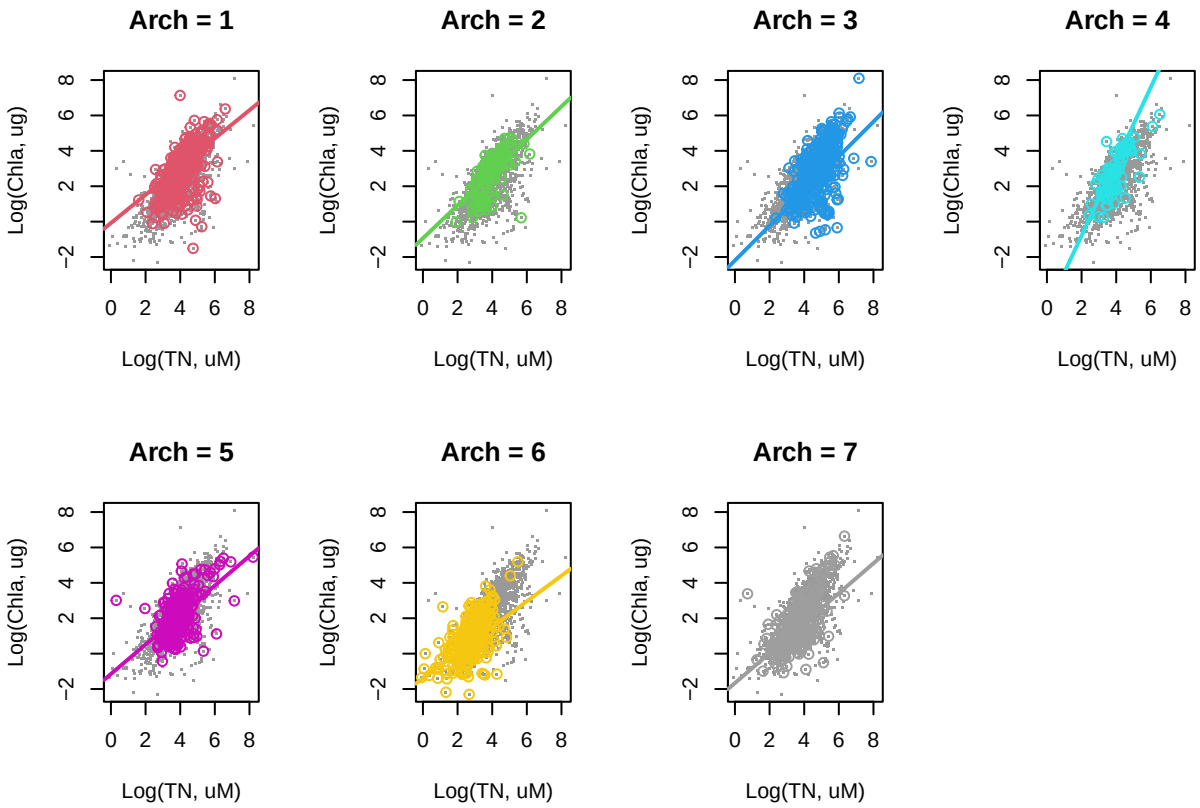
```
## w.arch6:log(TN_uM)  0.72537    0.10836   6.694 3.01e-11 ***
## w.arch7:log(TN_uM)  0.84604    0.12376   6.836 1.16e-11 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.9993 on 1582 degrees of freedom
##   (7 observations deleted due to missingness)
## Multiple R-squared:  0.8602, Adjusted R-squared:  0.859
## F-statistic: 695.4 on 14 and 1582 DF,  p-value: < 2.2e-16
```

```
##
## Call:
## lm(formula = log(chla_ug) ~ log(TN_uM) * max.arch, data = data)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -4.9154 -0.6246  0.0604  0.7104  4.4403
##
## Coefficients:
##                     Estimate Std. Error t value Pr(>|t|)
## (Intercept)         -1.02601    0.26878  -3.817  0.00014 ***
## log(TN_uM)           0.96522    0.06431  15.010  < 2e-16 ***
## max.arch            -0.07349    0.05392  -1.363  0.17312
## log(TN_uM):max.arch -0.01590    0.01376  -1.156  0.24776
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1.038 on 1592 degrees of freedom
##   (7 observations deleted due to missingness)
## Multiple R-squared:  0.5085, Adjusted R-squared:  0.5076
## F-statistic: 549.1 on 3 and 1592 DF,  p-value: < 2.2e-16
```

```
##
## Call:
## lm(formula = log(chla_ug) ~ log(TN_uM) * ag_eco9, data = data)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -4.8132 -0.5837  0.0670  0.6501  4.6638
##
## Coefficients:
##                        Estimate Std. Error t value Pr(>|t|)
## (Intercept)           -0.784346   0.432850  -1.812 0.070169 .
## log(TN_uM)             0.909789   0.104188   8.732  < 2e-16 ***
## ag_eco9NAP            -2.507537   0.650558  -3.854 0.000121 ***
## ag_eco9NPL            -1.645599   0.693506  -2.373 0.017770 *
## ag_eco9SAP            -0.972773   0.587432  -1.656 0.097926 .
## ag_eco9SPL            -1.018141   0.618890  -1.645 0.100147
## ag_eco9TPL            -1.182309   0.585807  -2.018 0.043734 *
## ag_eco9UMW            -0.523126   0.576658  -0.907 0.364456
## ag_eco9WMT            -0.885965   0.473462  -1.871 0.061495 .
## ag_eco9XER            -0.860724   0.556592  -1.546 0.122204
## log(TN_uM):ag_eco9NAP  0.597203   0.178343   3.349 0.000831 ***
## log(TN_uM):ag_eco9NPL  0.094901   0.148977   0.637 0.524203
```

```
## log(TN_uM):ag_eco9SAP  0.252038   0.152331   1.655 0.098216 .
## log(TN_uM):ag_eco9SPL  0.124669   0.143595   0.868 0.385415
## log(TN_uM):ag_eco9TPL  0.200756   0.134768   1.490 0.136518
## log(TN_uM):ag_eco9UMW -0.040052   0.141770  -0.283 0.777584
## log(TN_uM):ag_eco9WMT -0.003408   0.120760  -0.028 0.977489
## log(TN_uM):ag_eco9XER  0.018101   0.137646   0.132 0.895394
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1.015 on 1578 degrees of freedom
##   (7 observations deleted due to missingness)
## Multiple R-squared:  0.534,  Adjusted R-squared:  0.529
## F-statistic: 106.4 on 17 and 1578 DF,  p-value: < 2.2e-16

## [1] 0.85898

## [1] 0.5076073

## [1] 0.529019

## [1] 4542.842

## [1] 4653.962

## [1] 4596.908
```






```
aa.r.sq
```

```
## [1] 0.85898
```

```
max.arch.r.sq
```

```
## [1] 0.5076073
```

```
ecoreg.r.sq
```

```
## [1] 0.529019
```

```
aa.AIC
```

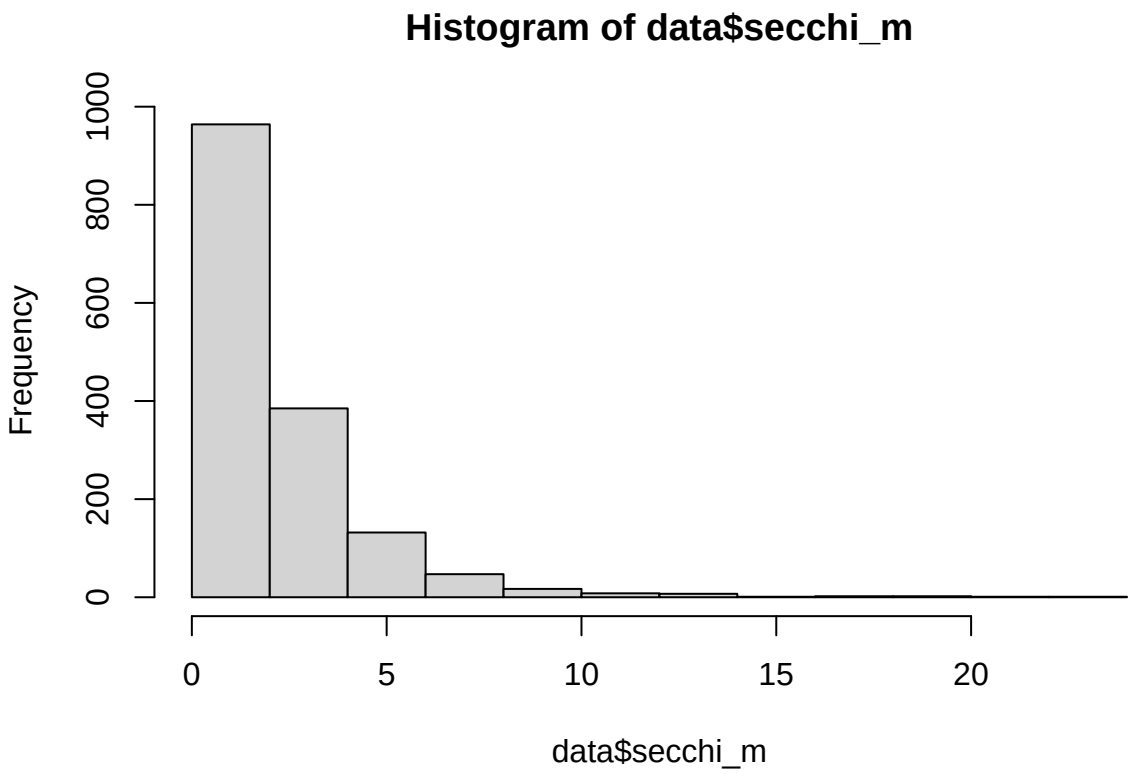
```
## [1] 4542.842
```

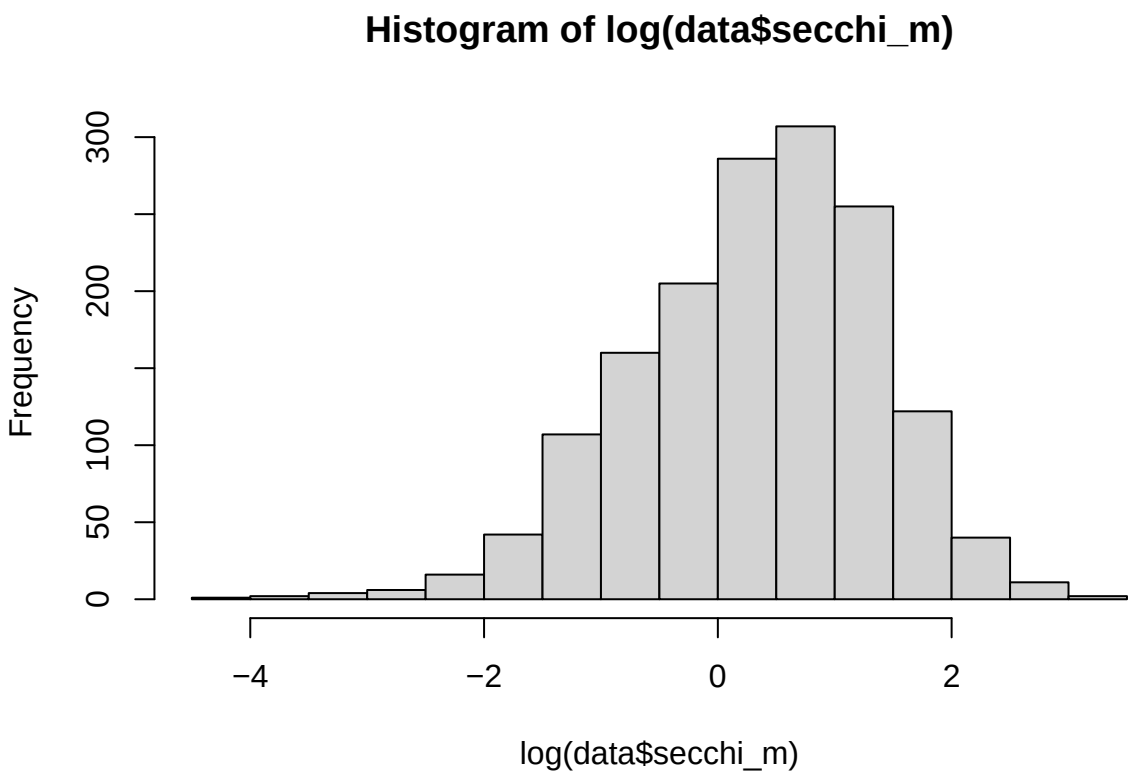
```
max.arch.AIC
```

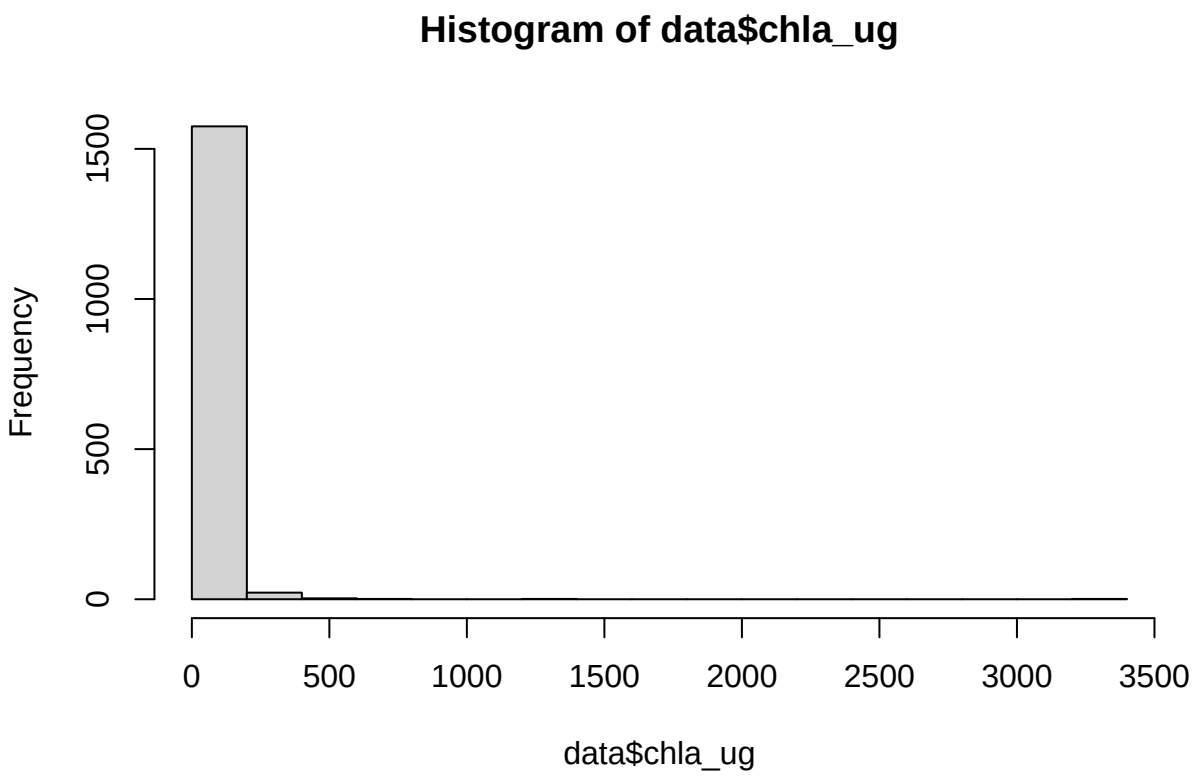
```
## [1] 4653.962
```

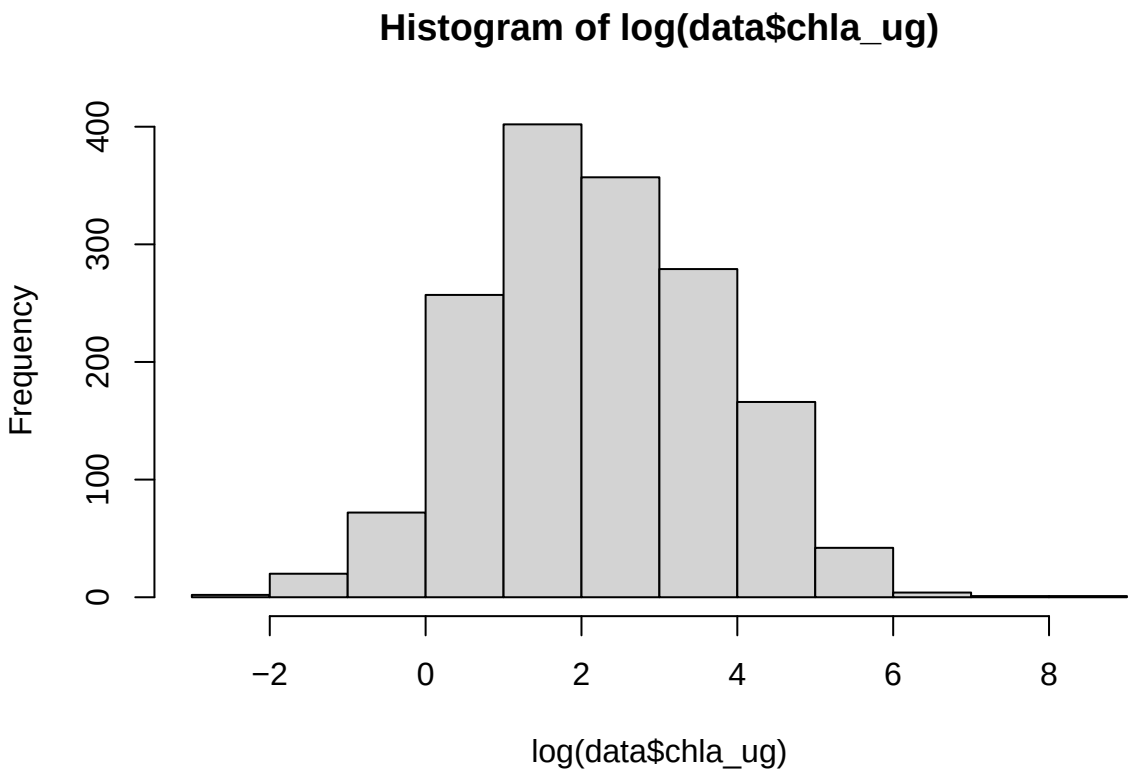
```
ecoreg.AIC
```

```
## [1] 4596.908
```


Histogram of data$secchi_m
Frequency
0
200
400
600
800
1000
0
5
10
15
20
data$secchi_m


Histogram of log(data$secchi_m)
Frequency
0
50
100
200
300
−4
−2
0
2
log(data$secchi_m)


Histogram of data$chla_ug
Frequency
0
500
1000
1500
0
500
1000
1500
2000
2500
3000
3500
data$chla_ug



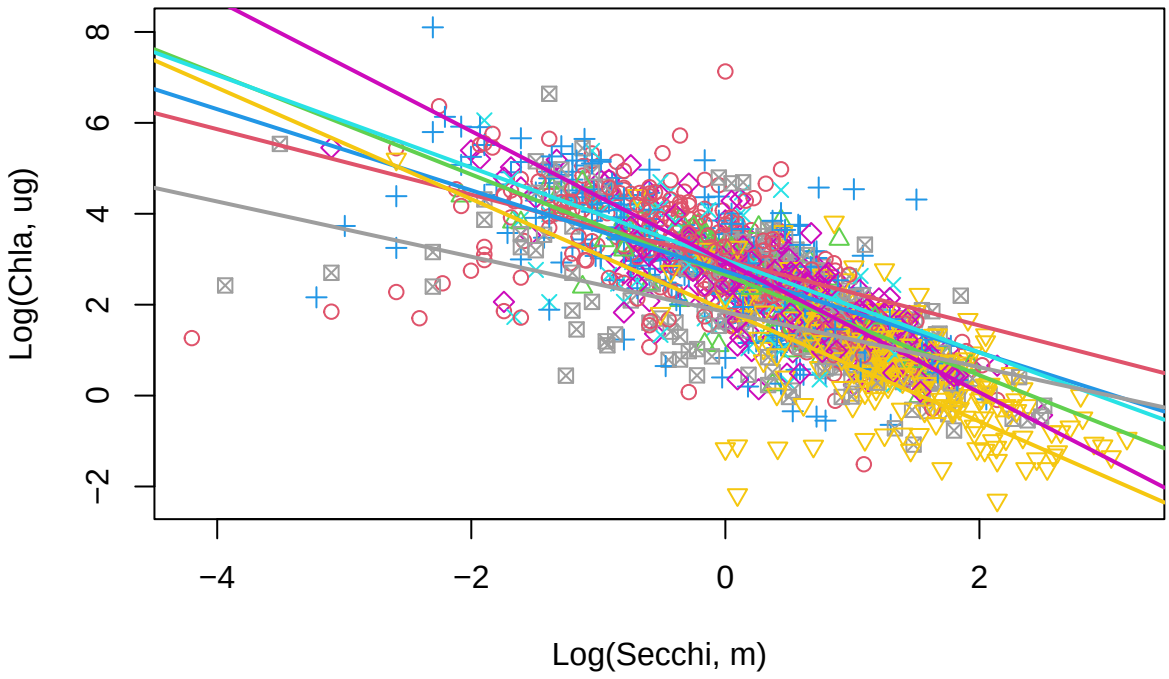

```
##
## Call:
## lm(formula = log(chla_ug) ~ 0 + w.arch1 + w.arch2 + w.arch3 +
##     w.arch4 + w.arch5 + w.arch6 + w.arch7 + log(secchi_m):w.arch1 +
##     log(secchi_m):w.arch2 + log(secchi_m):w.arch3 + log(secchi_m):w.arch4 +
##     log(secchi_m):w.arch5 + log(secchi_m):w.arch6 + log(secchi_m):w.arch7,
##     data = data)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -5.0552 -0.4539  0.0231  0.5212  4.3254
##
## Coefficients:
##                       Estimate Std. Error t value Pr(>|t|)
## w.arch1                2.98203    0.09920  30.061  < 2e-16 ***
## w.arch2                2.65607    0.15378  17.272  < 2e-16 ***
## w.arch3                2.73252    0.08868  30.813  < 2e-16 ***
## w.arch4                2.98228    0.17555  16.989  < 2e-16 ***
## w.arch5                2.94302    0.13190  22.312  < 2e-16 ***
## w.arch6                1.87690    0.17017  11.030  < 2e-16 ***
## w.arch7                1.83942    0.12130  15.164  < 2e-16 ***
## w.arch1:log(secchi_m) -0.71979    0.10241  -7.029 3.11e-12 ***
## w.arch2:log(secchi_m) -1.10408    0.17015  -6.489 1.16e-10 ***
## w.arch3:log(secchi_m) -0.89207    0.09164  -9.734  < 2e-16 ***
## w.arch4:log(secchi_m) -1.01673    0.19091  -5.326 1.15e-07 ***
## w.arch5:log(secchi_m) -1.43694    0.13544 -10.610  < 2e-16 ***
```

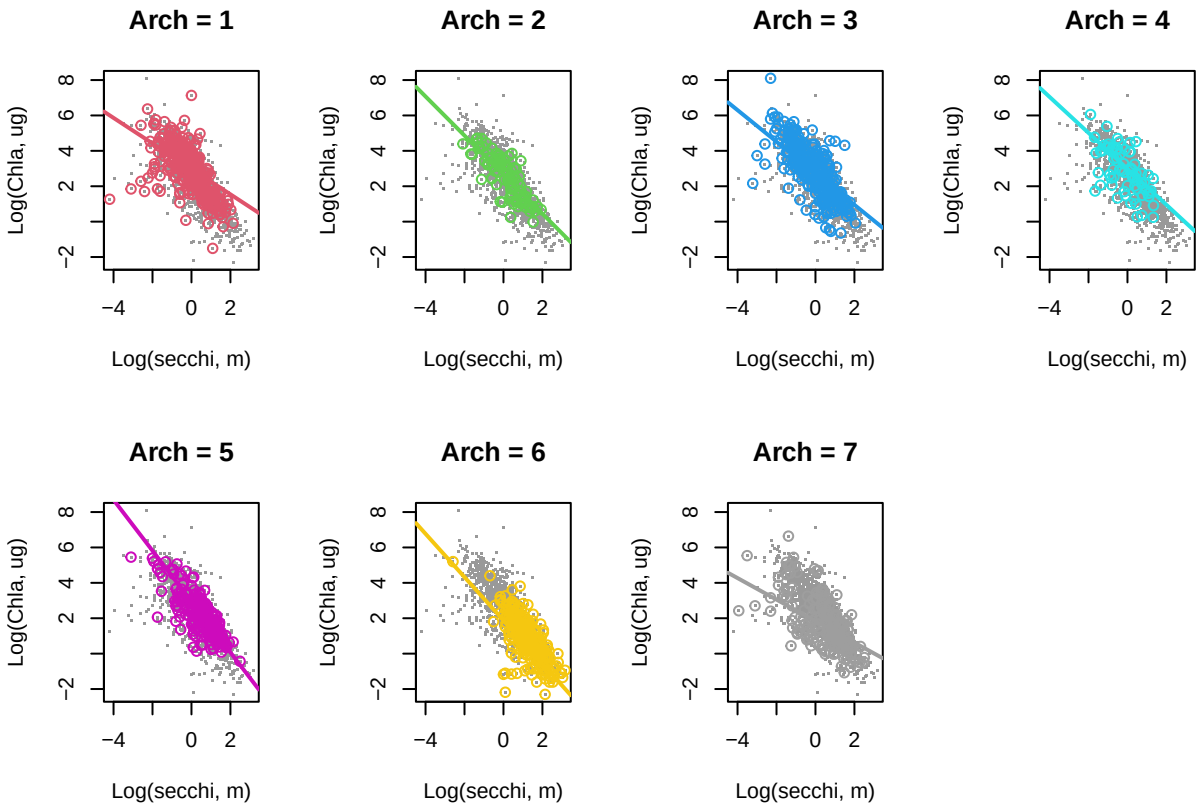
```
## w.arch6:log(secchi_m) -1.22362    0.10821 -11.308  < 2e-16 ***
## w.arch7:log(secchi_m) -0.60769    0.09895  -6.142 1.04e-09 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.8955 on 1552 degrees of freedom
##   (36 observations deleted due to missingness)
## Multiple R-squared:  0.8889, Adjusted R-squared:  0.8879
## F-statistic: 886.8 on 14 and 1552 DF,  p-value: < 2.2e-16
```

```
##
## Call:
## lm(formula = log(chla_ug) ~ log(secchi_m) * max.arch, data = data)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -5.8390 -0.4736  0.0348  0.5544  4.2890
##
## Coefficients:
##                          Estimate Std. Error t value Pr(>|t|)
## (Intercept)              2.941445   0.048242  60.973  < 2e-16 ***
## log(secchi_m)           -1.007273   0.050450 -19.966  < 2e-16 ***
## max.arch                -0.099535   0.012073  -8.244 3.48e-16 ***
## log(secchi_m):max.arch -0.007364   0.010968  -0.671    0.502
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.9206 on 1562 degrees of freedom
##   (36 observations deleted due to missingness)
## Multiple R-squared:  0.6175, Adjusted R-squared:  0.6168
## F-statistic: 840.6 on 3 and 1562 DF,  p-value: < 2.2e-16
```

```
##
## Call:
## lm(formula = log(chla_ug) ~ log(secchi_m) * ag_eco9, data = data)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -4.3854 -0.4509  0.0386  0.5095  4.2593
##
## Coefficients:
##                            Estimate Std. Error t value Pr(>|t|)
## (Intercept)                2.795098   0.070467  39.665  < 2e-16 ***
## log(secchi_m)             -1.091707   0.089901 -12.143  < 2e-16 ***
## ag_eco9NAP                -0.054675   0.134445  -0.407 0.684308
## ag_eco9NPL                -0.297968   0.112551  -2.647 0.008194 **
## ag_eco9SAP                -0.032791   0.107193  -0.306 0.759718
## ag_eco9SPL                -0.396453   0.110215  -3.597 0.000332 ***
## ag_eco9TPL                 0.076544   0.092270   0.830 0.406912
## ag_eco9UMW                 0.002192   0.102083   0.021 0.982869
## ag_eco9WMT                -0.482759   0.116079  -4.159 3.37e-05 ***
## ag_eco9XER                -0.602062   0.109832  -5.482 4.91e-08 ***
## log(secchi_m):ag_eco9NAP -0.208670   0.142390  -1.465 0.142992
## log(secchi_m):ag_eco9NPL -0.067610   0.126726  -0.534 0.593754
```

```
## log(secchi_m):ag_eco9SAP -0.245346   0.133500  -1.838 0.066283 .
## log(secchi_m):ag_eco9SPL  0.337571   0.114691   2.943 0.003296 **
## log(secchi_m):ag_eco9TPL  0.024634   0.109658   0.225 0.822283
## log(secchi_m):ag_eco9UMW -0.071210   0.117584  -0.606 0.544860
## log(secchi_m):ag_eco9WMT -0.063866   0.109739  -0.582 0.560662
## log(secchi_m):ag_eco9XER  0.259507   0.113074   2.295 0.021866 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.9022 on 1548 degrees of freedom
##   (36 observations deleted due to missingness)
## Multiple R-squared:  0.636,  Adjusted R-squared:  0.632
## F-statistic: 159.1 on 17 and 1548 DF,  p-value: < 2.2e-16

## [1] 0.8878818

## [1] 0.6167828

## [1] 0.6319664

## [1] 4114.222

## [1] 4191.126

## [1] 4141.716
```






```
aa.r.sq
```

```
## [1] 0.8878818
```

```
max.arch.r.sq
```

```
## [1] 0.6167828
```

```
ecoreg.r.sq
```

```
## [1] 0.6319664
```

```
aa.AIC
```

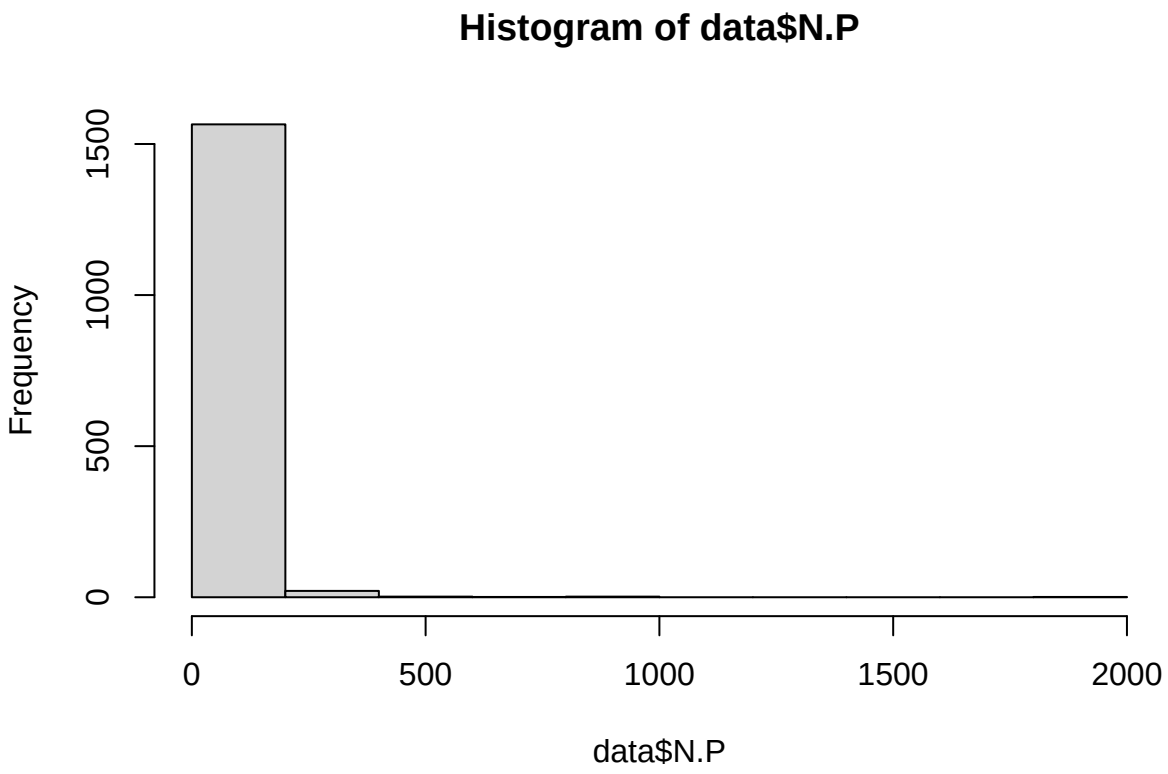
```
## [1] 4114.222
```

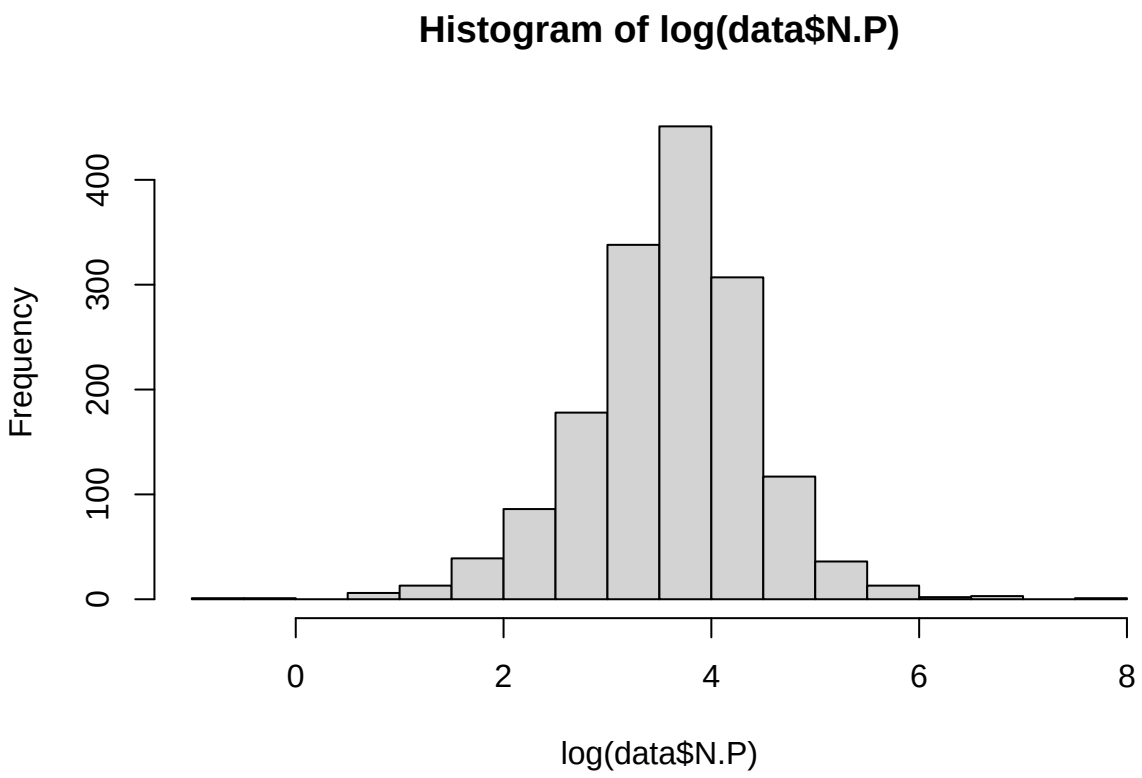
```
max.arch.AIC
```

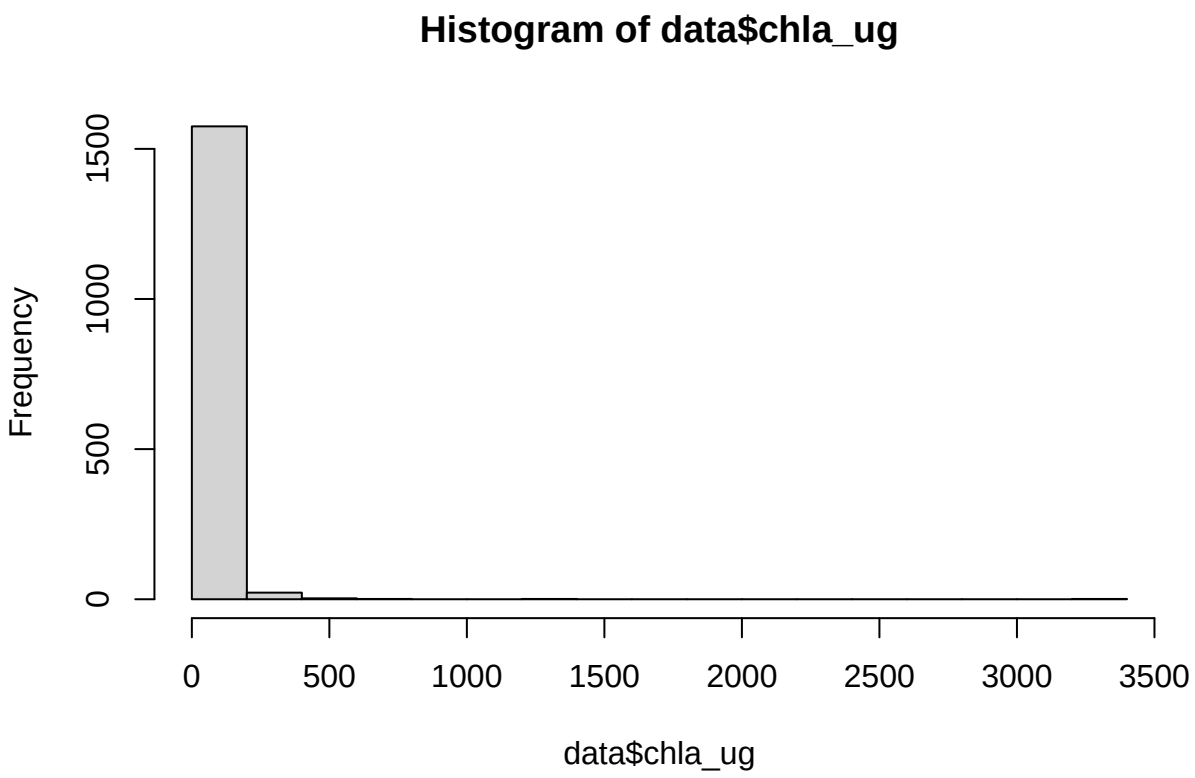
```
## [1] 4191.126
```

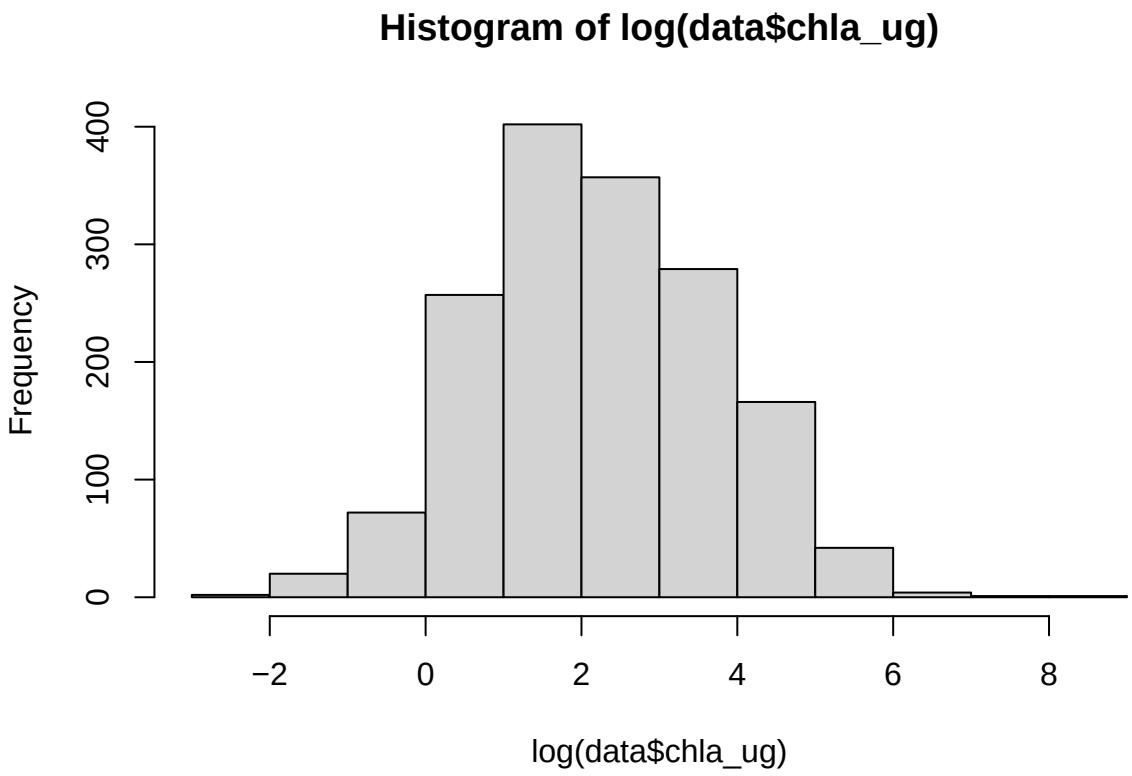
```
ecoreg.AIC
```

```
## [1] 4141.716
```


Histogram of data$N.P
Frequency
0
500
1000
1500
0
500
1000
1500
2000
data$N.P


Histogram of log(data$N.P)
Frequency
0
100
200
300
400
0
2
4
6
8
log(data$N.P)


Histogram of data$chla_ug
Frequency
0
500
1000
1500
0
500
1000
1500
2000
2500
3000
3500
data$chla_ug




```
##
## Call:
## lm(formula = log(chla_ug) ~ 0 + w.arch1 + w.arch2 + w.arch3 +
##     w.arch4 + w.arch5 + w.arch6 + w.arch7 + log(N.P):w.arch1 +
##     log(N.P):w.arch2 + log(N.P):w.arch3 + log(N.P):w.arch4 +
##     log(N.P):w.arch5 + log(N.P):w.arch6 + log(N.P):w.arch7, data = data)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -4.2343 -0.7208 -0.0219  0.6873  4.9611
##
## Coefficients:
##                   Estimate Std. Error t value Pr(>|t|)
## w.arch1            4.96534    0.52076   9.535  < 2e-16 ***
## w.arch2            4.92689    0.97881   5.034 5.37e-07 ***
## w.arch3            3.89509    0.47136   8.263 2.96e-16 ***
## w.arch4            8.75993    0.92795   9.440  < 2e-16 ***
## w.arch5            6.51655    0.78162   8.337  < 2e-16 ***
## w.arch6           -0.03194    0.44327  -0.072  0.94256
## w.arch7            1.51585    0.55054   2.753  0.00597 **
## w.arch1:log(N.P) -0.39996    0.14463  -2.765  0.00575 **
## w.arch2:log(N.P) -0.61908    0.25329  -2.444  0.01463 *
## w.arch3:log(N.P) -0.24902    0.13019  -1.913  0.05596 .
## w.arch4:log(N.P) -1.61567    0.26459  -6.106 1.28e-09 ***
## w.arch5:log(N.P) -1.08329    0.19763  -5.481 4.90e-08 ***
## w.arch6:log(N.P) -0.11362    0.12161  -0.934  0.35029
```

```
## w.arch7:log(N.P) -0.02842    0.16103  -0.176  0.85995
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1.14 on 1578 degrees of freedom
##   (11 observations deleted due to missingness)
## Multiple R-squared:  0.8182, Adjusted R-squared:  0.8166
## F-statistic: 507.2 on 14 and 1578 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = log(chla_ug) ~ log(N.P) * max.arch, data = data)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -4.1886 -0.8655 -0.0521  0.7993  5.2541
##
## Coefficients:
##                   Estimate Std. Error t value Pr(>|t|)
## (Intercept)        6.52351    0.30215  21.590  < 2e-16 ***
## log(N.P)          -0.90404    0.08354 -10.822  < 2e-16 ***
## max.arch          -0.68072    0.06530 -10.425  < 2e-16 ***
## log(N.P):max.arch  0.11251    0.01814   6.202 7.09e-10 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1.279 on 1588 degrees of freedom
##   (11 observations deleted due to missingness)
## Multiple R-squared:  0.2537, Adjusted R-squared:  0.2523
## F-statistic: 179.9 on 3 and 1588 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = log(chla_ug) ~ log(N.P) * ag_eco9, data = data)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -4.2216 -0.7923 -0.0144  0.7524  5.4928
##
## Coefficients:
##                     Estimate Std. Error t value Pr(>|t|)
## (Intercept)          5.60333    0.41611  13.466  < 2e-16 ***
## log(N.P)            -0.75625    0.11501  -6.576 6.57e-11 ***
## ag_eco9NAP           1.28579    0.88381   1.455 0.145916
## ag_eco9NPL          -2.31488    0.61862  -3.742 0.000189 ***
## ag_eco9SAP          -0.65677    0.64577  -1.017 0.309292
## ag_eco9SPL          -1.12871    0.64589  -1.748 0.080739 .
## ag_eco9TPL           0.37506    0.55949   0.670 0.502723
## ag_eco9UMW          -0.57665    0.63644  -0.906 0.365044
## ag_eco9WMT          -4.40053    0.51267  -8.584  < 2e-16 ***
## ag_eco9XER          -2.48208    0.56512  -4.392 1.20e-05 ***
## log(N.P):ag_eco9NAP -0.55848    0.22704  -2.460 0.014008 *
## log(N.P):ag_eco9NPL  0.55507    0.17311   3.206 0.001371 **
## log(N.P):ag_eco9SAP  0.03710    0.17480   0.212 0.831921
```

```
## log(N.P):ag_eco9SPL  0.24830    0.18183   1.366 0.172273
## log(N.P):ag_eco9TPL -0.05691    0.15437  -0.369 0.712434
## log(N.P):ag_eco9UMW  0.03469    0.16386   0.212 0.832365
## log(N.P):ag_eco9WMT  0.70067    0.14435   4.854 1.33e-06 ***
## log(N.P):ag_eco9XER  0.35217    0.16261   2.166 0.030480 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1.224 on 1574 degrees of freedom
##   (11 observations deleted due to missingness)
## Multiple R-squared:  0.3235, Adjusted R-squared:  0.3162
## F-statistic: 44.28 on 17 and 1574 DF,  p-value: < 2.2e-16
```

```
## [1] 0.8165694
```

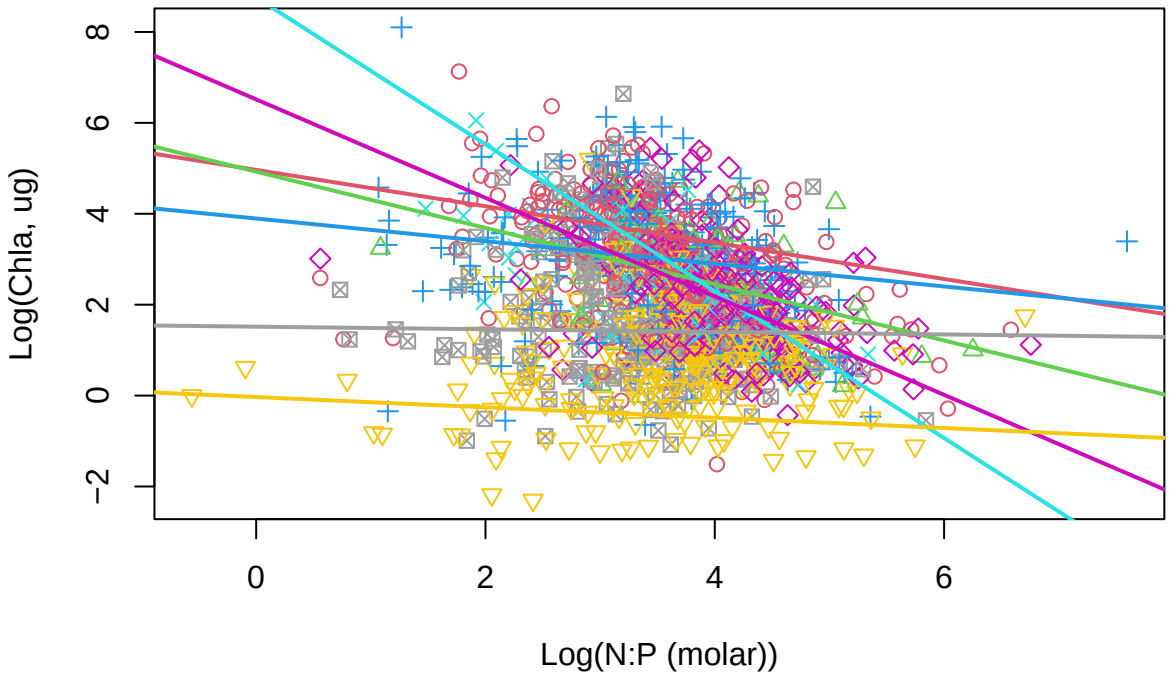
```
## [1] 0.2522727
```

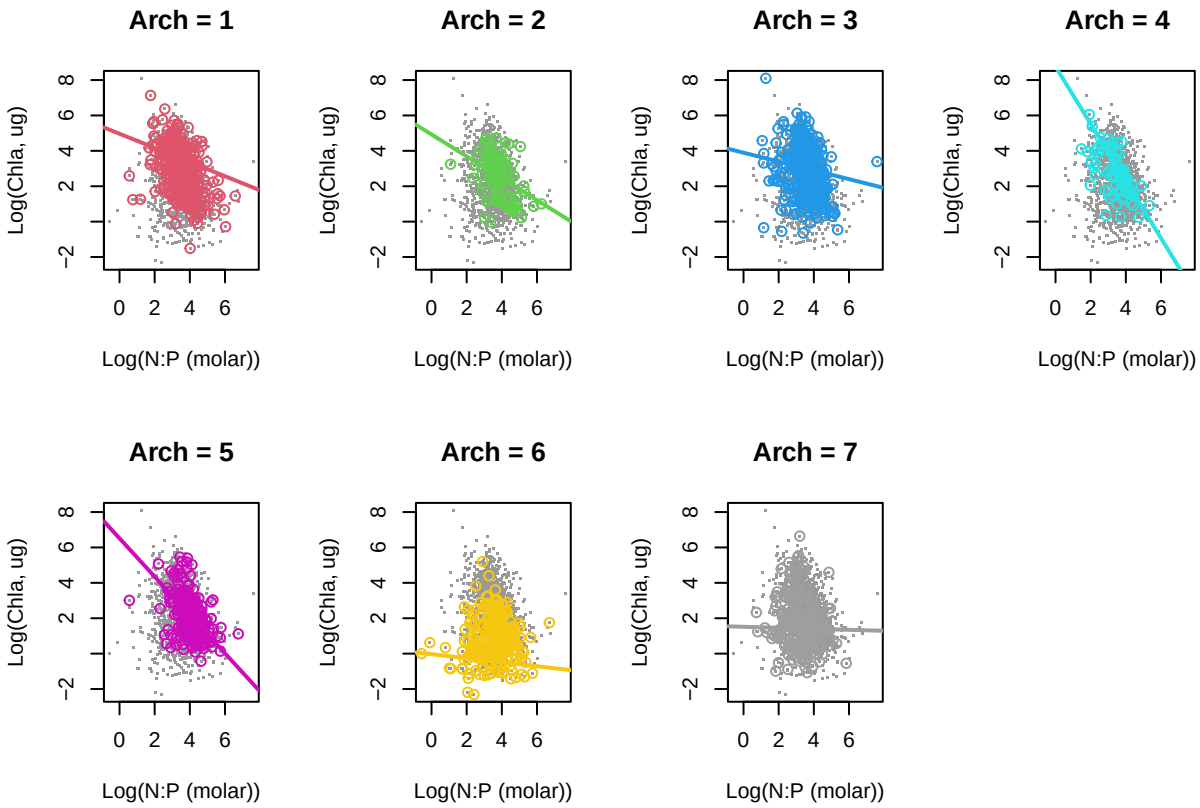
```
## [1] 0.3161952
```

```
## [1] 4952.182
```

```
## [1] 5308.619
```

```
## [1] 5180.251
```






```
aa.r.sq
```

```
## [1] 0.8165694
```

```
max.arch.r.sq
```

```
## [1] 0.2522727
```

```
ecoreg.r.sq
```

```
## [1] 0.3161952
```

```
aa.AIC
```

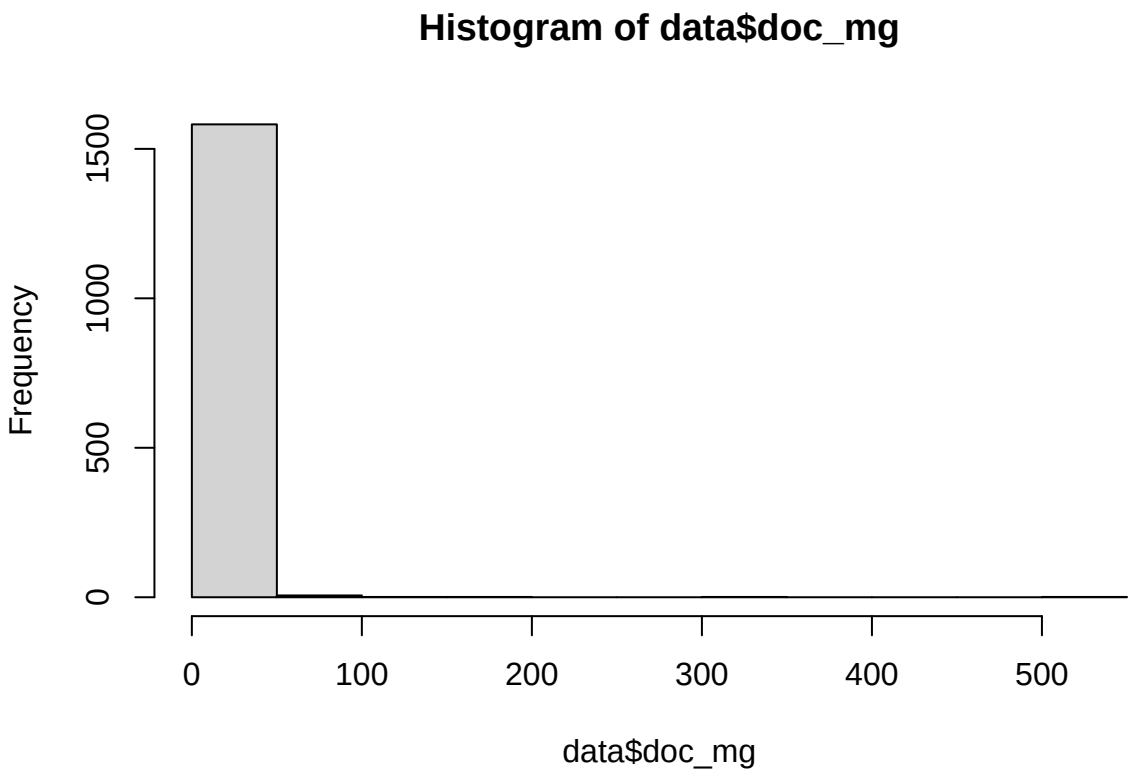
```
## [1] 4952.182
```

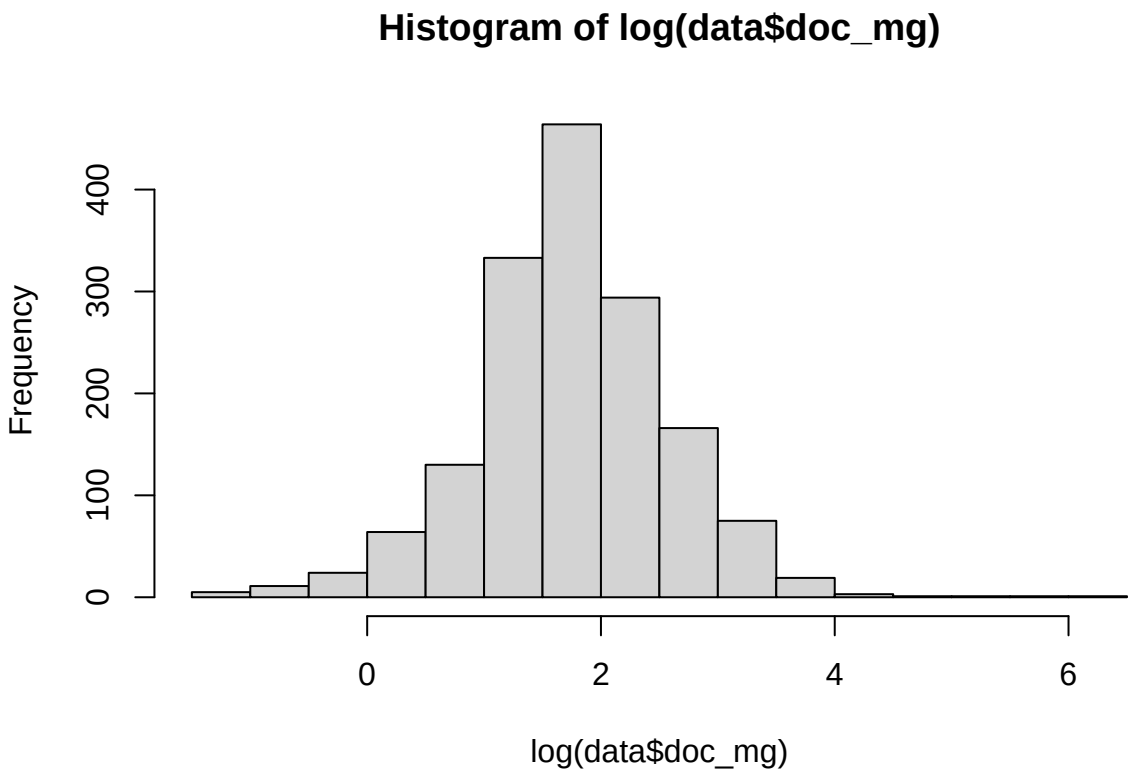
```
max.arch.AIC
```

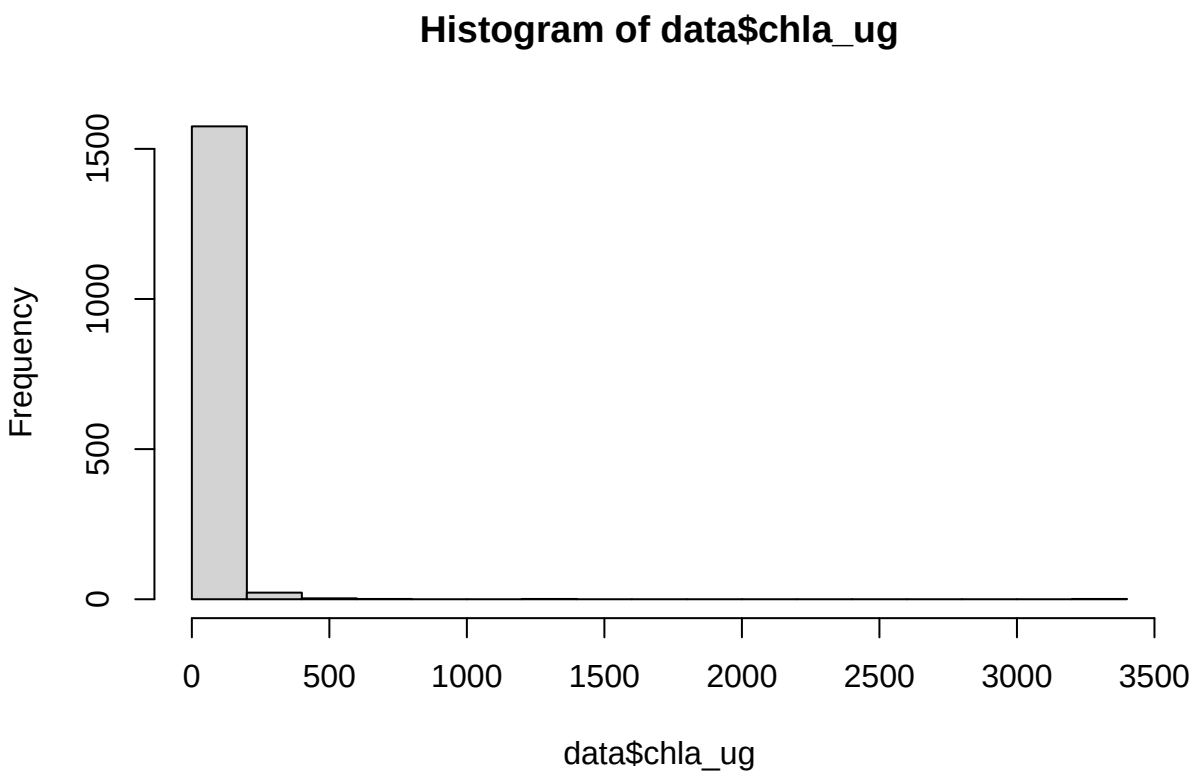
```
## [1] 5308.619
```

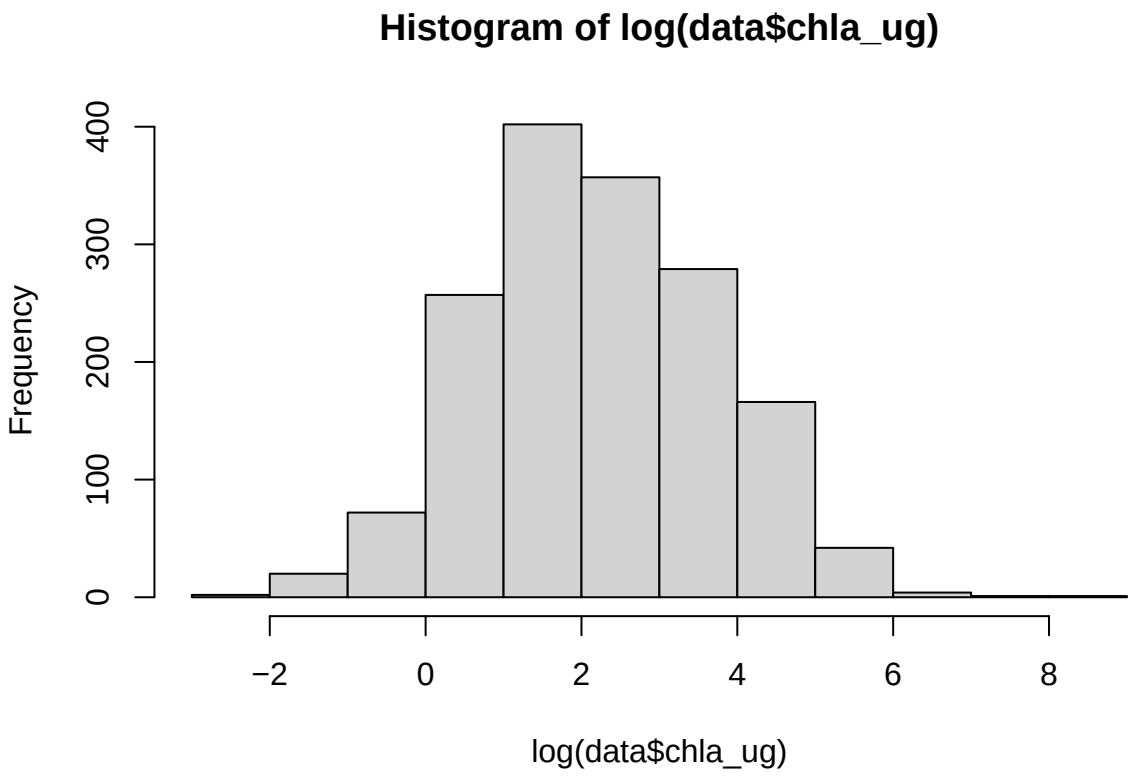
```
ecoreg.AIC
```

```
## [1] 5180.251
```


Histogram of data$doc_mg
Frequency
0
500
1000
1500
0
100
200
300
400
500
data$doc_mg


Histogram of log(data$doc_mg)
Frequency
0
100
200
300
400
0
2
4
6
log(data$doc_mg)


Histogram of data$chla_ug
Frequency
0
500
1000
1500
0
500
1000
1500
2000
2500
3000
3500
data$chla_ug




```
##
## Call:
## lm(formula = log(chla_ug) ~ 0 + w.arch1 + w.arch2 + w.arch3 +
##     w.arch4 + w.arch5 + w.arch6 + w.arch7 + log(doc_mg):w.arch1 +
##     log(doc_mg):w.arch2 + log(doc_mg):w.arch3 + log(doc_mg):w.arch4 +
##     log(doc_mg):w.arch5 + log(doc_mg):w.arch6 + log(doc_mg):w.arch7,
##     data = data)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -3.8090 -0.7120 -0.0767  0.7154  4.7780
##
## Coefficients:
##                      Estimate Std. Error t value Pr(>|t|)
## w.arch1                2.2041     0.3502   6.293 4.02e-10 ***
## w.arch2                2.1063     0.5303   3.972 7.46e-05 ***
## w.arch3                2.0163     0.3622   5.567 3.04e-08 ***
## w.arch4               -1.2116     0.6920  -1.751  0.08018 .
## w.arch5               -1.1046     0.4627  -2.387  0.01710 *
## w.arch6               -0.4453     0.1687  -2.640  0.00837 **
## w.arch7                0.7005     0.2884   2.429  0.01524 *
## w.arch1:log(doc_mg)    0.7927     0.1866   4.249 2.28e-05 ***
## w.arch2:log(doc_mg)    0.2325     0.2673   0.870  0.38450
## w.arch3:log(doc_mg)    0.2668     0.1351   1.975  0.04847 *
## w.arch4:log(doc_mg)    2.7833     0.3826   7.275 5.45e-13 ***
## w.arch5:log(doc_mg)    1.3537     0.2034   6.654 3.91e-11 ***
```

```
## w.arch6:log(doc_mg)   0.5572     0.1291   4.315 1.69e-05 ***
## w.arch7:log(doc_mg)   0.4173     0.1602   2.605  0.00928 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1.114 on 1578 degrees of freedom
##   (11 observations deleted due to missingness)
## Multiple R-squared:  0.8251, Adjusted R-squared:  0.8235
## F-statistic: 531.7 on 14 and 1578 DF,  p-value: < 2.2e-16
```

```
##
## Call:
## lm(formula = log(chla_ug) ~ log(doc_mg) * max.arch, data = data)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -4.3545 -0.8127 -0.0566  0.7680  4.8763
##
## Coefficients:
##                      Estimate Std. Error t value Pr(>|t|)
## (Intercept)           1.50204    0.17625   8.522  < 2e-16 ***
## log(doc_mg)           0.89056    0.09274   9.603  < 2e-16 ***
## max.arch             -0.19057    0.03451  -5.523 3.89e-08 ***
## log(doc_mg):max.arch -0.02164    0.01935  -1.119    0.263
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1.18 on 1588 degrees of freedom
##   (11 observations deleted due to missingness)
## Multiple R-squared:  0.3719, Adjusted R-squared:  0.3708
## F-statistic: 313.5 on 3 and 1588 DF,  p-value: < 2.2e-16
```

```
##
## Call:
## lm(formula = log(chla_ug) ~ log(doc_mg) * ag_eco9, data = data)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -4.0982 -0.7505 -0.0618  0.7255  5.4598
##
## Coefficients:
##                          Estimate Std. Error t value Pr(>|t|)
## (Intercept)              1.506335   0.284921   5.287 1.42e-07 ***
## log(doc_mg)              0.783839   0.148573   5.276 1.51e-07 ***
## ag_eco9NAP              -1.525571   0.431809  -3.533 0.000423 ***
## ag_eco9NPL              -1.151903   0.530155  -2.173 0.029947 *
## ag_eco9SAP              -1.027245   0.376463  -2.729 0.006430 **
## ag_eco9SPL              -0.279757   0.403048  -0.694 0.487720
## ag_eco9TPL              -0.051194   0.379006  -0.135 0.892570
## ag_eco9UMW              -1.602139   0.435465  -3.679 0.000242 ***
## ag_eco9WMT              -1.410035   0.304569  -4.630 3.96e-06 ***
## ag_eco9XER              -0.802383   0.368187  -2.179 0.029459 *
## log(doc_mg):ag_eco9NAP   0.332986   0.251264   1.325 0.185284
## log(doc_mg):ag_eco9NPL  -0.005293   0.212588  -0.025 0.980139
```

```
## log(doc_mg):ag_eco9SAP  0.694090   0.236334   2.937 0.003363 **
## log(doc_mg):ag_eco9SPL -0.071480   0.194663  -0.367 0.713521
## log(doc_mg):ag_eco9TPL  0.006055   0.187757   0.032 0.974279
## log(doc_mg):ag_eco9UMW  0.267214   0.214203   1.247 0.212408
## log(doc_mg):ag_eco9WMT  0.089058   0.168522   0.528 0.597253
## log(doc_mg):ag_eco9XER -0.086685   0.196788  -0.440 0.659636
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1.168 on 1574 degrees of freedom
##   (11 observations deleted due to missingness)
## Multiple R-squared:   0.39,  Adjusted R-squared:  0.3834
## F-statistic: 59.19 on 17 and 1574 DF,  p-value: < 2.2e-16
```

```
## [1] 0.8235273
```

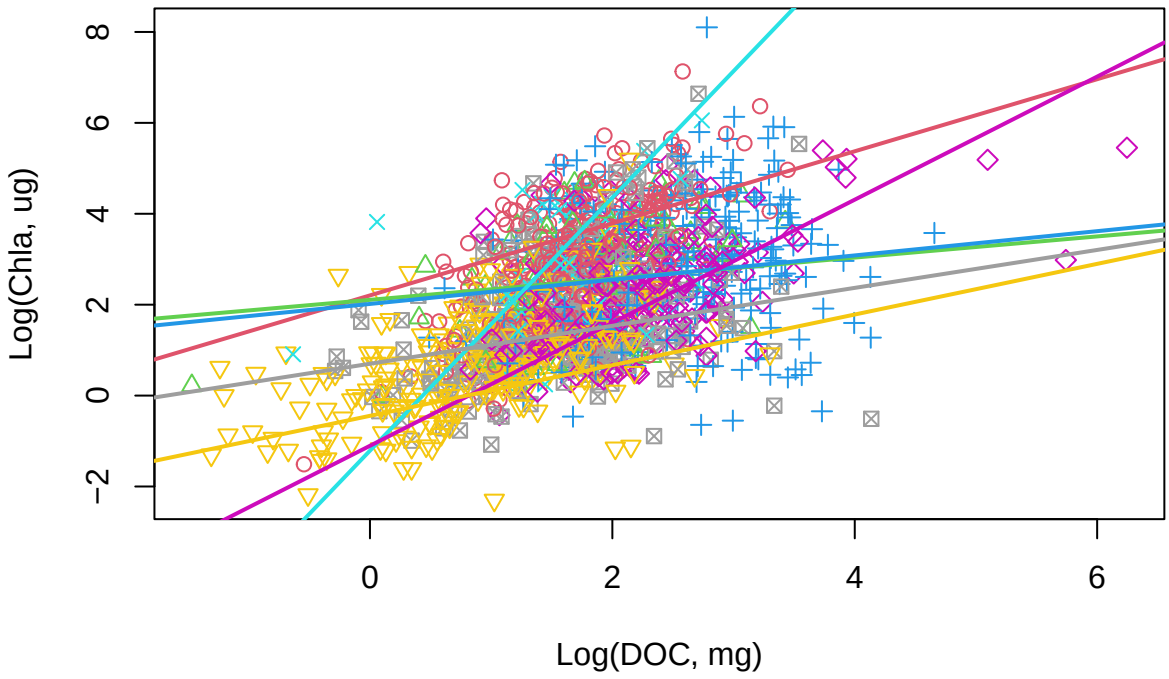
```
## [1] 0.3707593
```

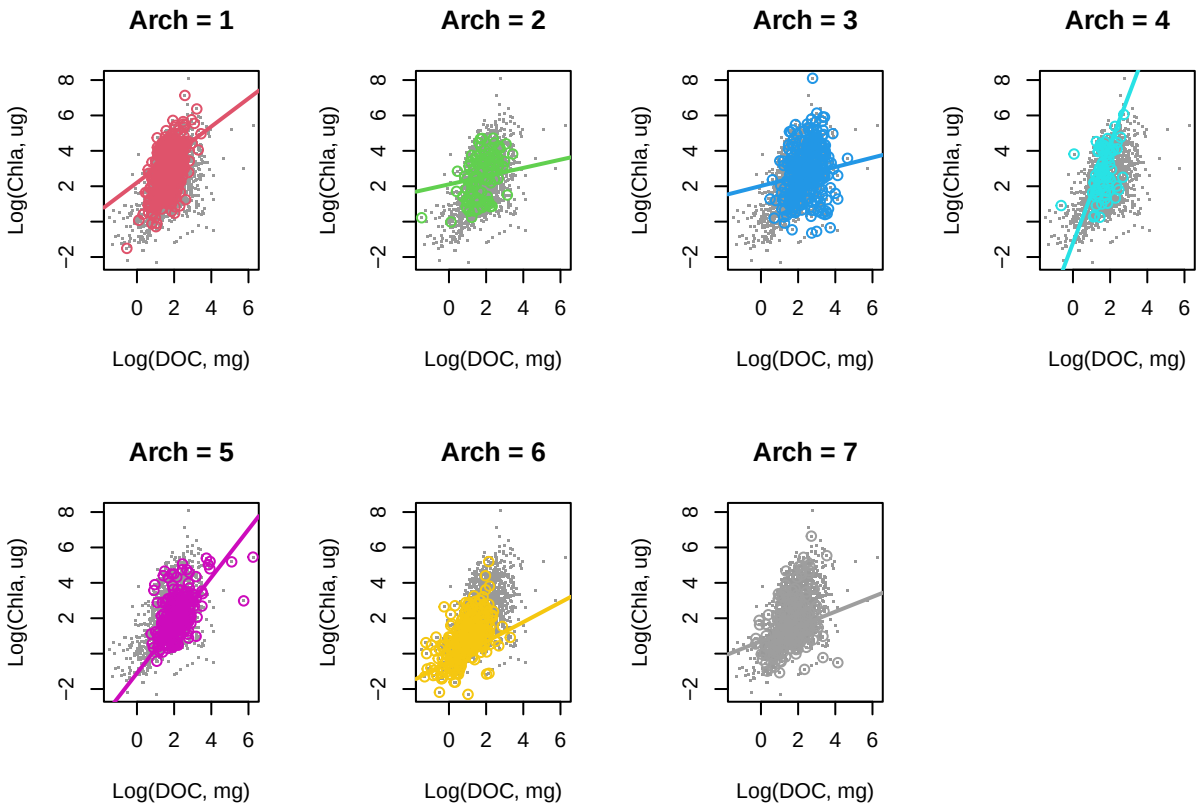
```
## [1] 0.3833691
```

```
## [1] 4876.639
```

```
## [1] 5050.994
```

```
## [1] 5032.669
```






```
aa.r.sq
```

```
## [1] 0.8235273
```

```
max.arch.r.sq
```

```
## [1] 0.3707593
```

```
ecoreg.r.sq
```

```
## [1] 0.3833691
```

```
aa.AIC
```

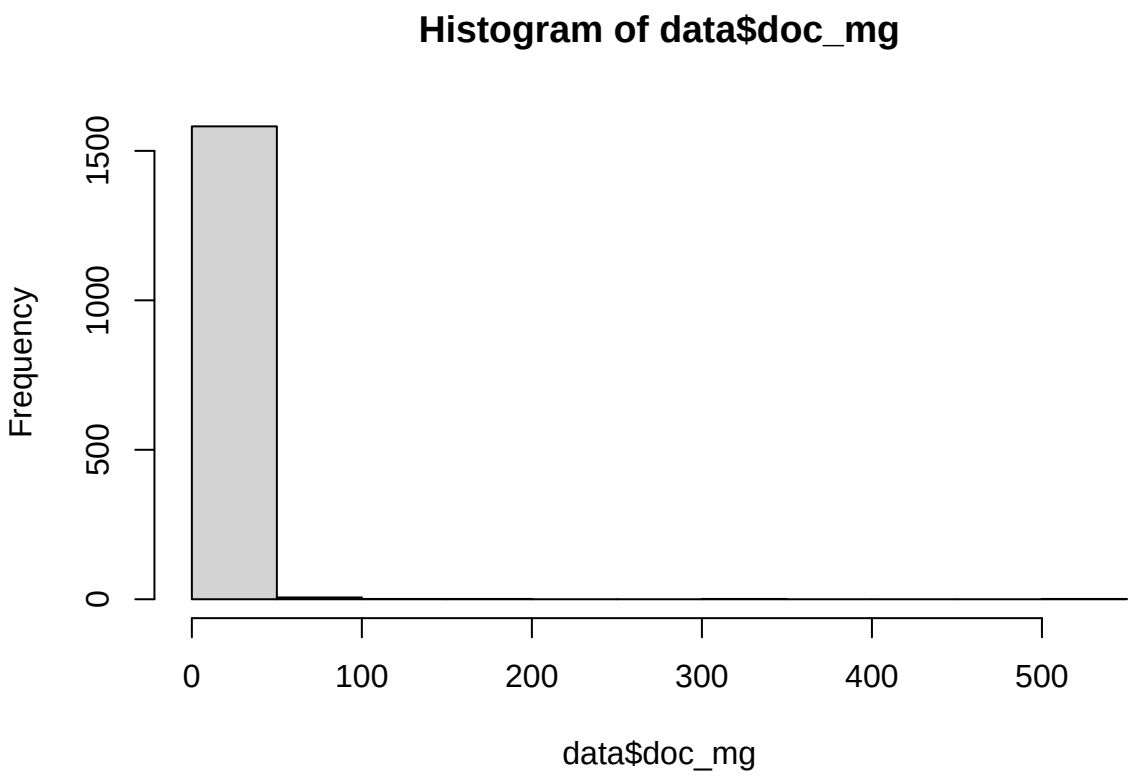
```
## [1] 4876.639
```

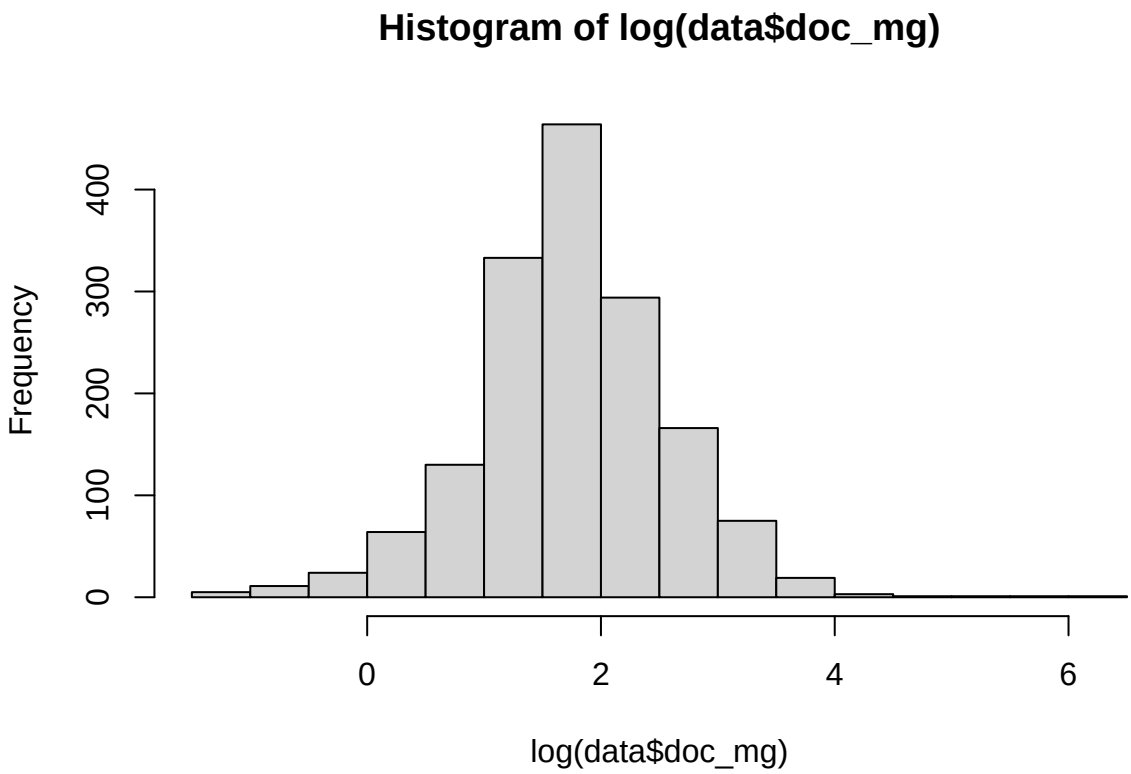
```
max.arch.AIC
```

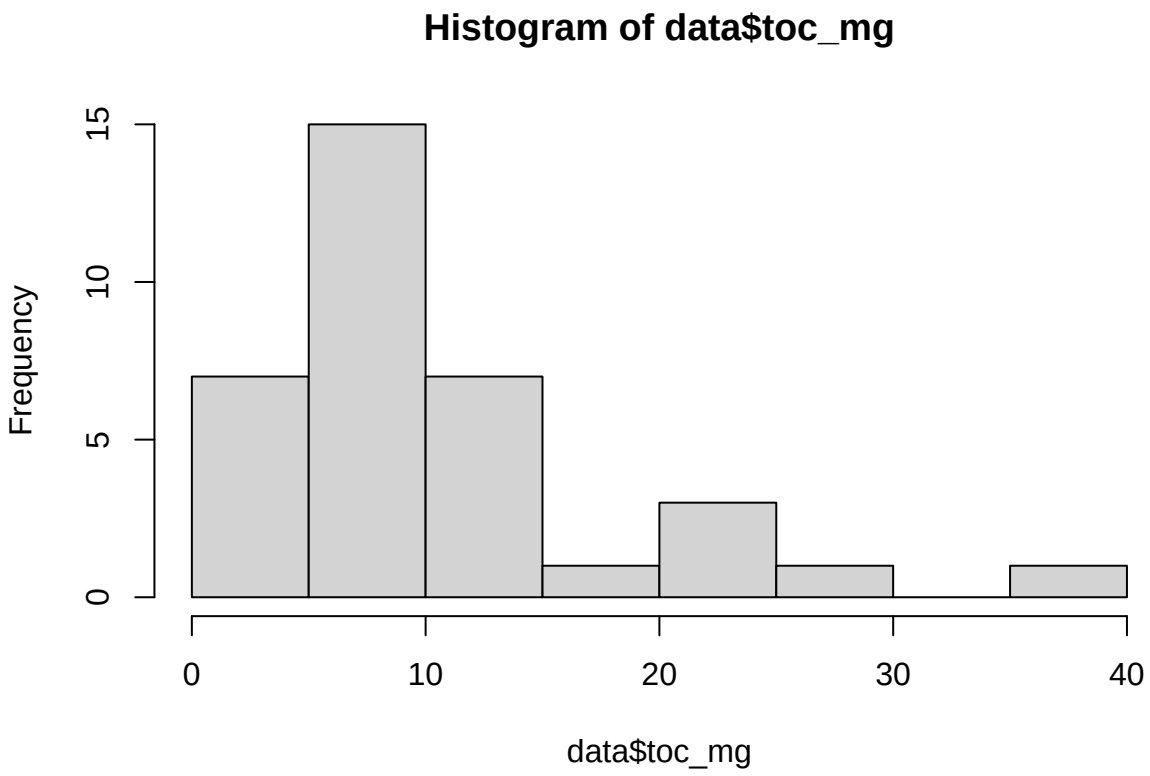
```
## [1] 5050.994
```

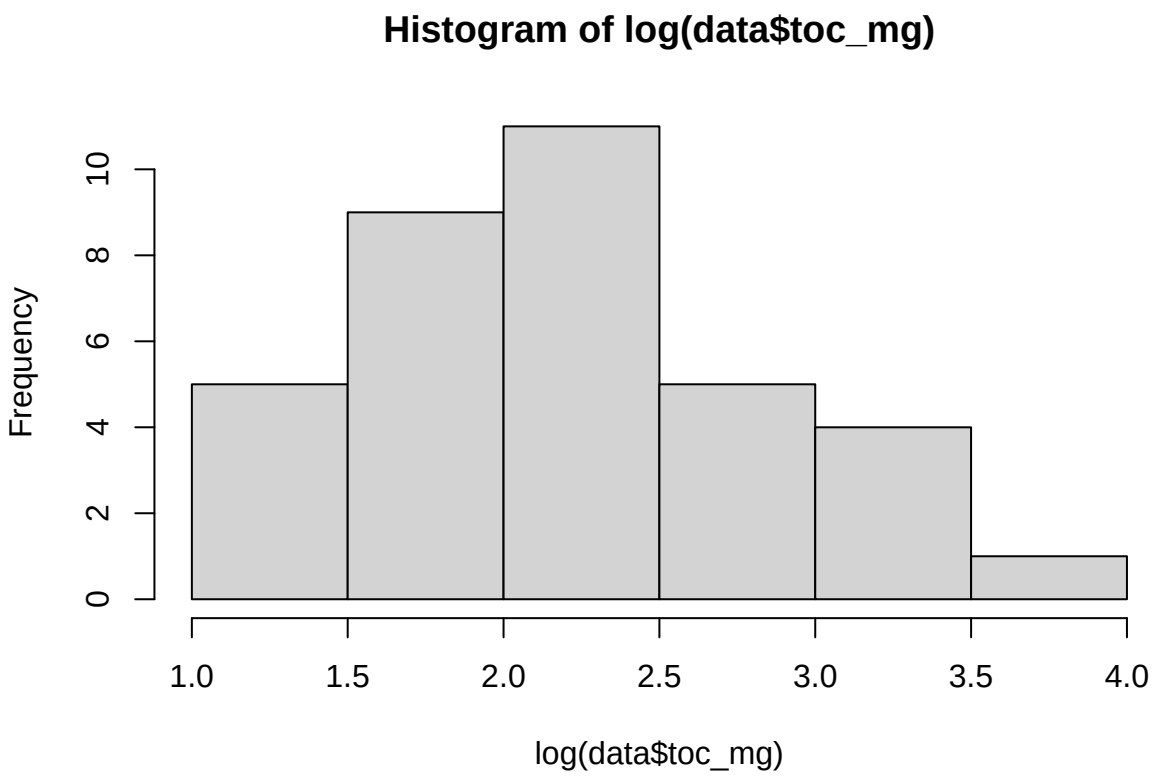
```
ecoreg.AIC
```

```
## [1] 5032.669
```


Histogram of data$doc_mg
Frequency
0
500
1000
1500
0
100
200
300
400
500
data$doc_mg


Histogram of log(data$doc_mg)
Frequency
0
100
200
300
400
0
2
4
6
log(data$doc_mg)


Histogram of data$toc_mg
Frequency
0
5
10
15
0
10
20
30
40
data$toc_mg




```
##
## Call:
## lm(formula = log(toc_mg) ~ 0 + w.arch1 + w.arch2 + w.arch3 +
##     w.arch4 + w.arch5 + w.arch6 + w.arch7 + log(doc_mg):w.arch1 +
##     log(doc_mg):w.arch2 + log(doc_mg):w.arch3 + log(doc_mg):w.arch4 +
##     log(doc_mg):w.arch5 + log(doc_mg):w.arch6 + log(doc_mg):w.arch7,
##     data = data)
##
## Residuals:
##       Min        1Q    Median        3Q       Max
## -0.153186 -0.034299 -0.001711  0.042525  0.120364
##
## Coefficients:
##                     Estimate Std. Error t value Pr(>|t|)
## w.arch1              -0.1037     0.3175  -0.327   0.7473
## w.arch2              -1.5085     1.5499  -0.973   0.3415
## w.arch3               0.6582     0.6792   0.969   0.3435
## w.arch4              -0.2240     1.4305  -0.157   0.8771
## w.arch5               0.4055     0.3181   1.275   0.2164
## w.arch6              -1.5346     1.1422  -1.344   0.1934
## w.arch7               2.3817     2.5907   0.919   0.3684
## w.arch1:log(doc_mg)   1.1179     0.1652   6.765 1.08e-06 ***
## w.arch2:log(doc_mg)   1.7128     0.7224   2.371   0.0274 *
## w.arch3:log(doc_mg)   0.7082     0.3429   2.065   0.0515 .
## w.arch4:log(doc_mg)   1.1765     0.7125   1.651   0.1136
## w.arch5:log(doc_mg)   0.7898     0.1614   4.894 7.69e-05 ***
```

```
## w.arch6:log(doc_mg)   2.1175     0.6827   3.101   0.0054 **
## w.arch7:log(doc_mg)  -0.1073     1.0672  -0.101   0.9208
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.07787 on 21 degrees of freedom
##   (1568 observations deleted due to missingness)
## Multiple R-squared:  0.9993, Adjusted R-squared:  0.9988
## F-statistic:  2149 on 14 and 21 DF,  p-value: < 2.2e-16
```

```
##
## Call:
## lm(formula = log(toc_mg) ~ log(doc_mg) * max.arch, data = data)
##
## Residuals:
##       Min        1Q    Median        3Q       Max
## -0.151056 -0.035568  0.006864  0.036765  0.141266
##
## Coefficients:
##                       Estimate Std. Error t value Pr(>|t|)
## (Intercept)          -0.012457   0.099184  -0.126    0.901
## log(doc_mg)           1.019244   0.045897  22.207   <2e-16 ***
## max.arch              0.029444   0.023732   1.241    0.224
## log(doc_mg):max.arch -0.006776   0.011009  -0.616    0.543
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.06647 on 31 degrees of freedom
##   (1568 observations deleted due to missingness)
## Multiple R-squared:  0.9887, Adjusted R-squared:  0.9876
## F-statistic: 907.2 on 3 and 31 DF,  p-value: < 2.2e-16
```

```
##
## Call:
## lm(formula = log(toc_mg) ~ log(doc_mg) * ag_eco9, data = data)
##
## Residuals:
##       Min        1Q    Median        3Q       Max
## -0.189955 -0.037874  0.001624  0.045699  0.156711
##
## Coefficients:
##                         Estimate Std. Error t value Pr(>|t|)
## (Intercept)              0.06891    0.08916   0.773    0.445
## log(doc_mg)              1.01194    0.03986  25.385   <2e-16 ***
## ag_eco9UMW               0.04361    0.10322   0.422    0.676
## log(doc_mg):ag_eco9UMW -0.02407    0.04643  -0.518    0.608
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.07114 on 31 degrees of freedom
##   (1568 observations deleted due to missingness)
## Multiple R-squared:  0.9871, Adjusted R-squared:  0.9859
## F-statistic: 790.6 on 3 and 31 DF,  p-value: < 2.2e-16
```

```
## [1] 0.9988377
```

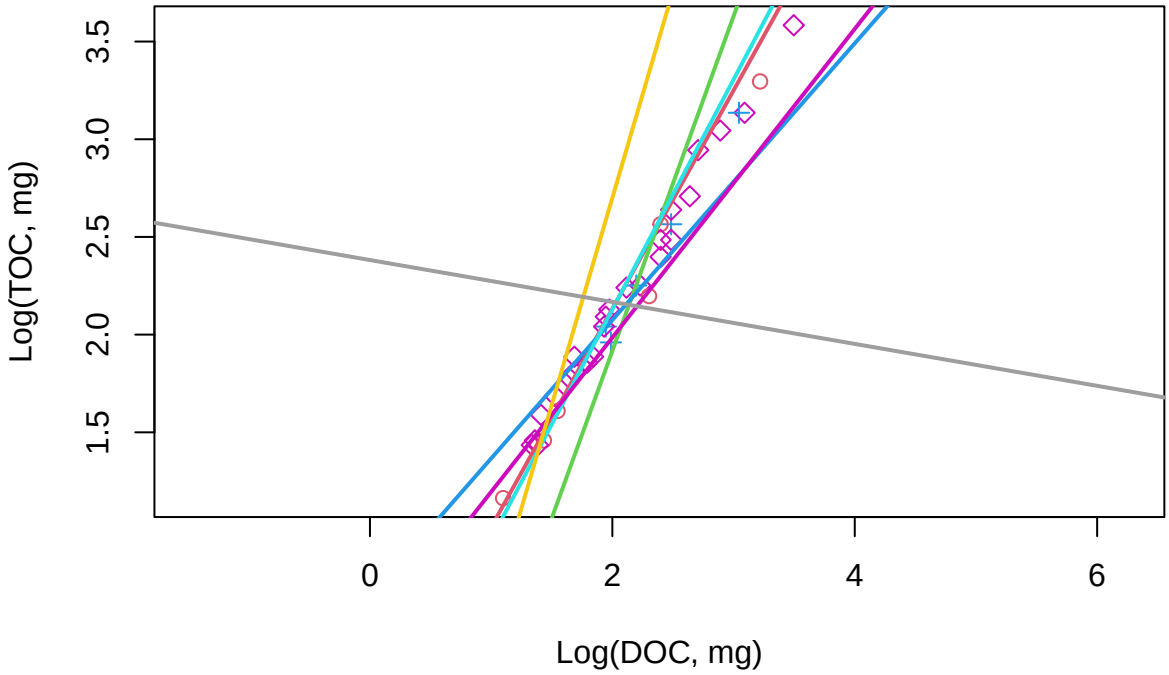
```
## [1] 0.9876477
```

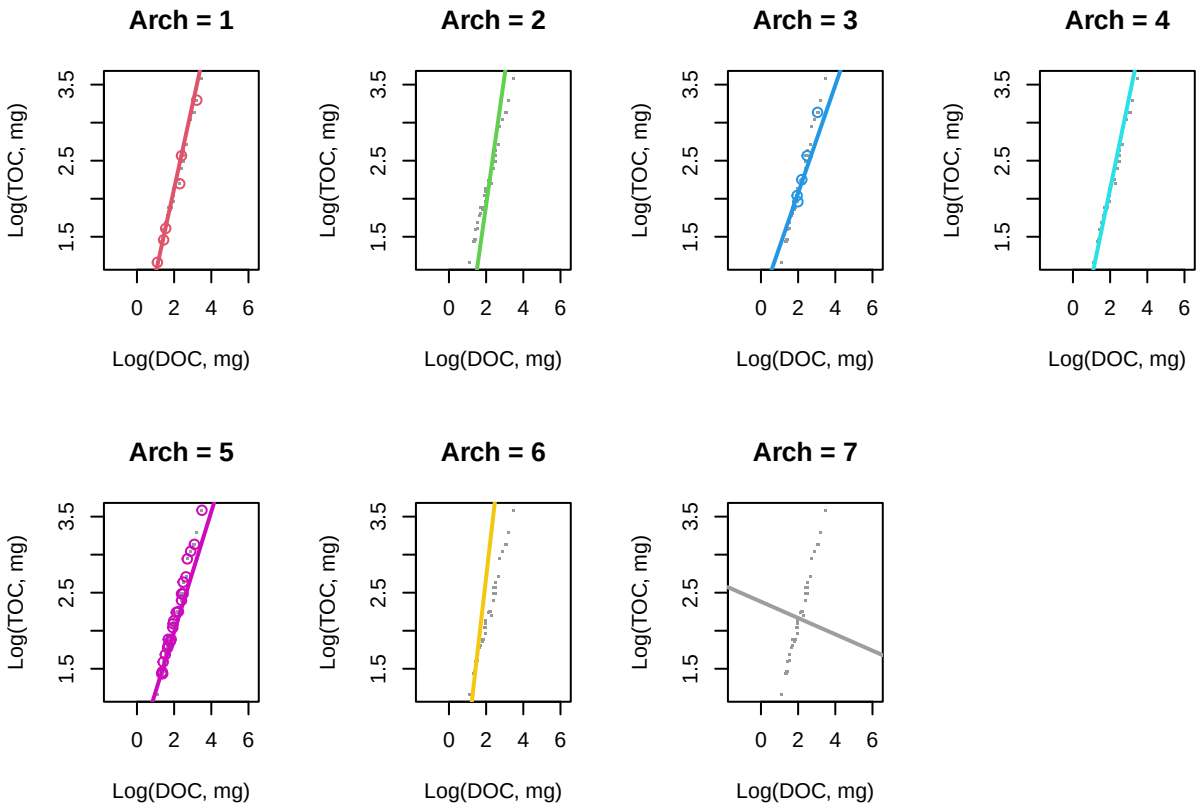
```
## [1] 0.9858503
```

```
## [1] -67.24284
```

```
## [1] -84.6967
```

```
## [1] -79.94186
```






```
aa.r.sq
```

```
## [1] 0.9988377
```

```
max.arch.r.sq
```

```
## [1] 0.9876477
```

```
ecoreg.r.sq
```

```
## [1] 0.9858503
```

```
aa.AIC
```

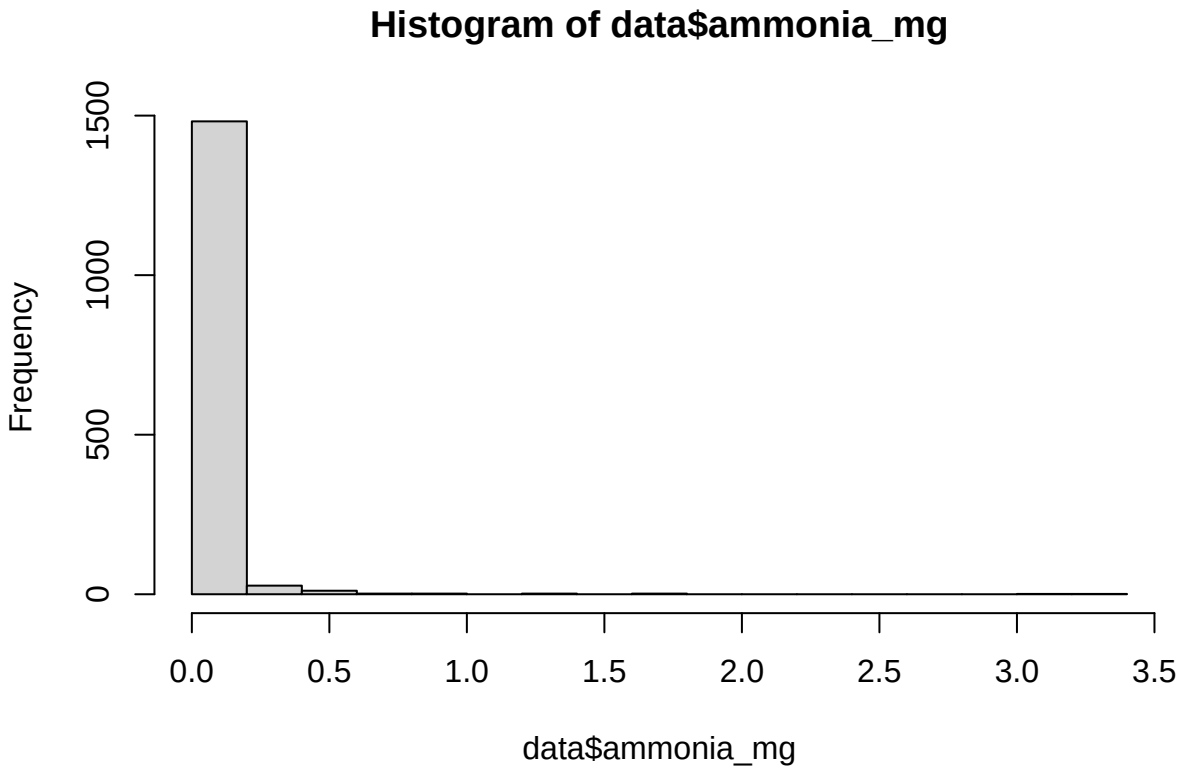
```
## [1] -67.24284
```

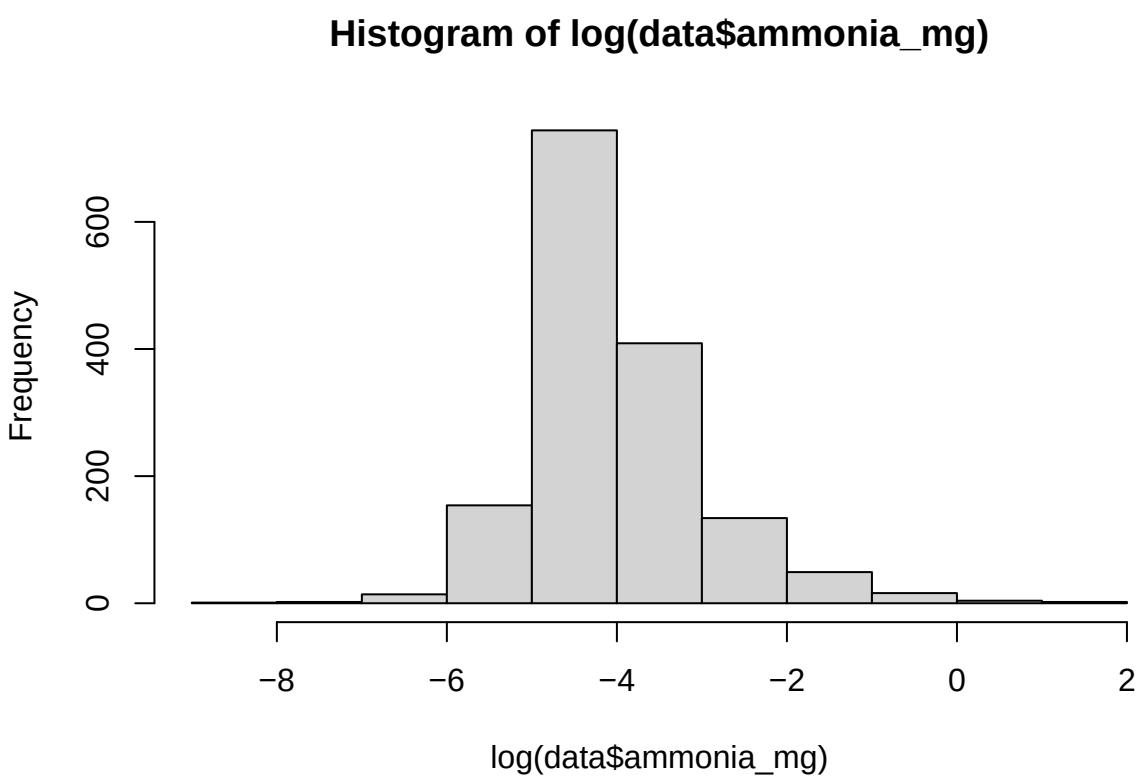
```
max.arch.AIC
```

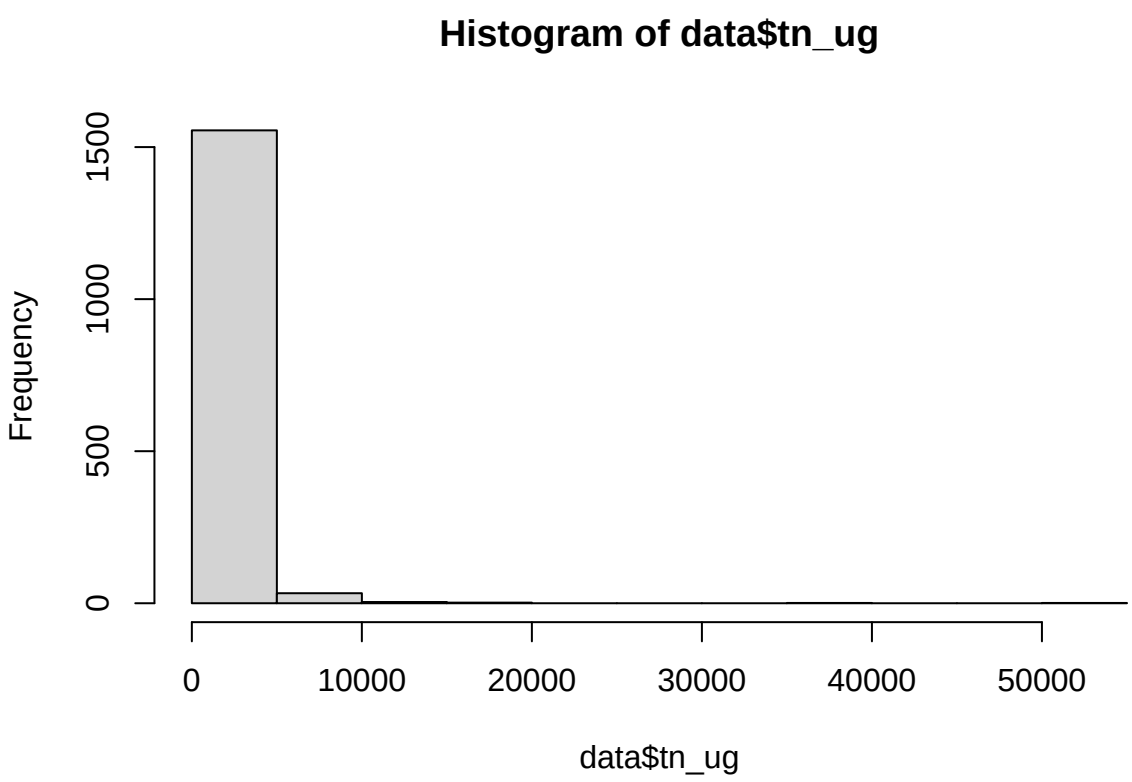
```
## [1] -84.6967
```

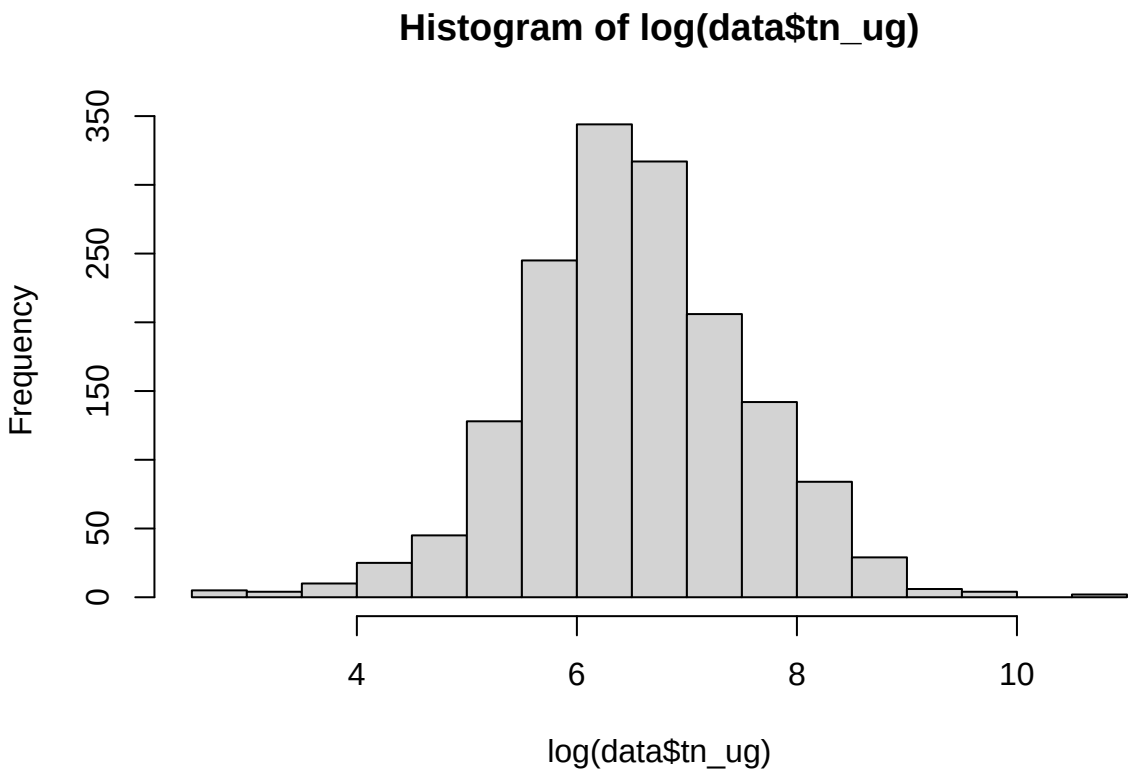
```
ecoreg.AIC
```

```
## [1] -79.94186
```


Histogram of data$ammonia_mg
Frequency
0
500
1000
1500
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
data$ammonia_mg


Histogram of log(data$ammonia_mg)
Frequency
0
200
400
600
−8
−6
−4
−2
0
2
log(data$ammonia_mg)


Histogram of data$tn_ug
Frequency
0
500
1000
1500
0
10000
20000
30000
40000
50000
data$tn_ug




```
##
## Call:
## lm(formula = log(tn_ug) ~ 0 + w.arch1 + w.arch2 + w.arch3 + w.arch4 +
##     w.arch5 + w.arch6 + w.arch7 + log(ammonia_mg):w.arch1 + log(ammonia_mg):w.arch2 +
##     log(ammonia_mg):w.arch3 + log(ammonia_mg):w.arch4 + log(ammonia_mg):w.arch5 +
##     log(ammonia_mg):w.arch6 + log(ammonia_mg):w.arch7, data = data)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -3.4175 -0.3829 -0.0440  0.3494  3.1551
##
## Coefficients:
##                          Estimate Std. Error t value Pr(>|t|)
## w.arch1                   8.06541    0.27531  29.296  < 2e-16 ***
## w.arch2                   7.33520    0.45315  16.187  < 2e-16 ***
## w.arch3                   8.96260    0.18811  47.646  < 2e-16 ***
## w.arch4                   7.60665    0.48135  15.803  < 2e-16 ***
## w.arch5                   8.41080    0.40871  20.579  < 2e-16 ***
## w.arch6                   6.50604    0.42600  15.273  < 2e-16 ***
## w.arch7                   8.57327    0.31211  27.469  < 2e-16 ***
## w.arch1:log(ammonia_mg)   0.26676    0.06892   3.870 0.000113 ***
## w.arch2:log(ammonia_mg)   0.20243    0.10220   1.981 0.047795 *
## w.arch3:log(ammonia_mg)   0.31218    0.05344   5.842 6.30e-09 ***
## w.arch4:log(ammonia_mg)   0.21810    0.11504   1.896 0.058179 .
## w.arch5:log(ammonia_mg)   0.44248    0.10301   4.296 1.85e-05 ***
## w.arch6:log(ammonia_mg)   0.43891    0.08905   4.929 9.19e-07 ***
```

```
## w.arch7:log(ammonia_mg)  0.54286    0.07245   7.493 1.14e-13 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.6399 on 1515 degrees of freedom
##   (73 observations deleted due to missingness)
## Multiple R-squared:  0.9907, Adjusted R-squared:  0.9906
## F-statistic: 1.156e+04 on 14 and 1515 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = log(tn_ug) ~ log(ammonia_mg) * max.arch, data = data)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -3.3645 -0.4824 -0.0272  0.4721  3.4831
##
## Coefficients:
##                          Estimate Std. Error t value Pr(>|t|)
## (Intercept)               8.55153    0.16385  52.190  < 2e-16 ***
## log(ammonia_mg)           0.38745    0.04028   9.619  < 2e-16 ***
## max.arch                  0.06520    0.03975   1.640    0.101
## log(ammonia_mg):max.arch  0.04483    0.00939   4.775 1.97e-06 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.7755 on 1525 degrees of freedom
##   (73 observations deleted due to missingness)
## Multiple R-squared:  0.4311, Adjusted R-squared:  0.4299
## F-statistic: 385.1 on 3 and 1525 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = log(tn_ug) ~ log(ammonia_mg) * ag_eco9, data = data)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -3.6143 -0.3998 -0.0508  0.4057  3.2692
##
## Coefficients:
##                            Estimate Std. Error t value Pr(>|t|)
## (Intercept)                 8.12904    0.21897  37.124  < 2e-16 ***
## log(ammonia_mg)             0.33333    0.05056   6.593 5.95e-11 ***
## ag_eco9NAP                 -0.67197    0.40120  -1.675  0.09417 .
## ag_eco9NPL                  0.90184    0.29124   3.097  0.00199 **
## ag_eco9SAP                  0.42488    0.40020   1.062  0.28856
## ag_eco9SPL                  0.83061    0.33175   2.504  0.01240 *
## ag_eco9TPL                  0.19408    0.27407   0.708  0.47896
## ag_eco9UMW                  0.05199    0.34354   0.151  0.87973
## ag_eco9WMT                  0.58444    0.31631   1.848  0.06484 .
## ag_eco9XER                  0.15937    0.31202   0.511  0.60959
## log(ammonia_mg):ag_eco9NAP  0.01241    0.09124   0.136  0.89179
## log(ammonia_mg):ag_eco9NPL  0.10659    0.07633   1.396  0.16277
## log(ammonia_mg):ag_eco9SAP  0.21544    0.09036   2.384  0.01724 *
```

```
## log(ammonia_mg):ag_eco9SPL  0.18476    0.08215   2.249  0.02465 *
## log(ammonia_mg):ag_eco9TPL -0.02019    0.06743  -0.299  0.76467
## log(ammonia_mg):ag_eco9UMW  0.05295    0.08273   0.640  0.52223
## log(ammonia_mg):ag_eco9WMT  0.35906    0.07083   5.069 4.49e-07 ***
## log(ammonia_mg):ag_eco9XER  0.13883    0.07383   1.880  0.06024 .
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.7001 on 1511 degrees of freedom
##   (73 observations deleted due to missingness)
## Multiple R-squared:  0.5405, Adjusted R-squared:  0.5353
## F-statistic: 104.6 on 17 and 1511 DF,  p-value: < 2.2e-16
```

```
## [1] 0.9906391
```

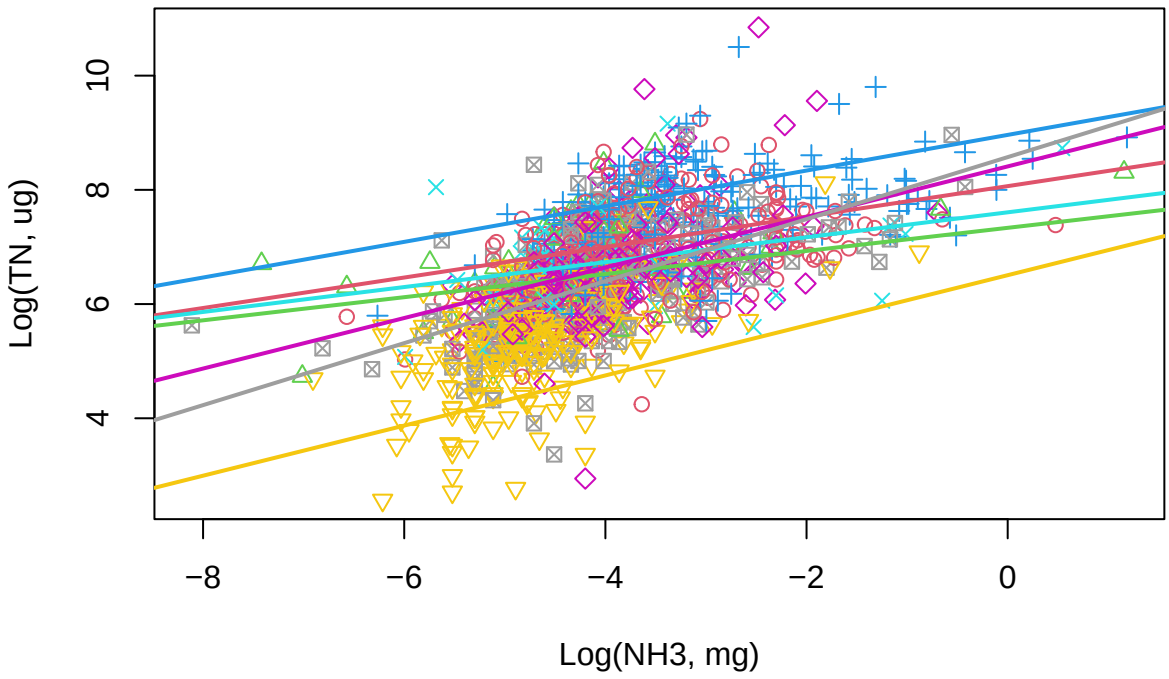
```
## [1] 0.429945
```

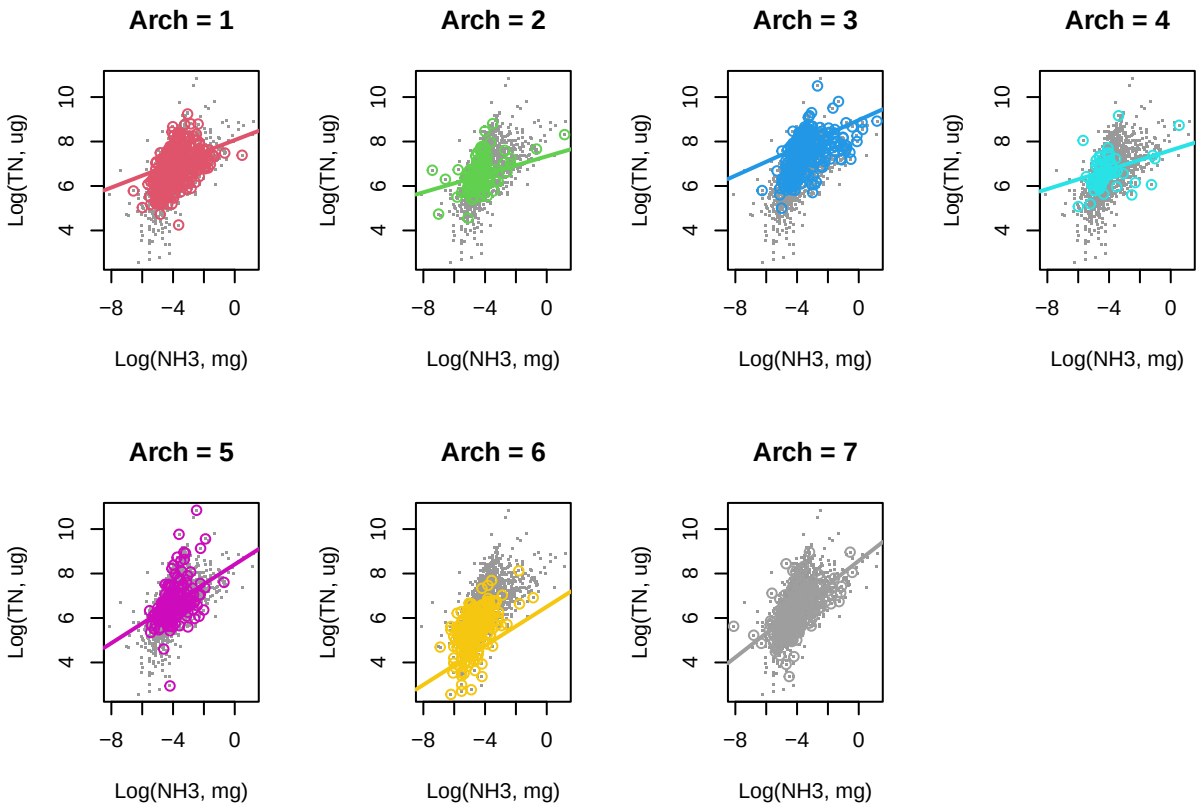
```
## [1] 0.5353458
```

```
## [1] 2989.674
```

```
## [1] 3567.537
```

```
## [1] 3268.847
```






```
aa.r.sq
```

```
## [1] 0.9906391
```

```
max.arch.r.sq
```

```
## [1] 0.429945
```

```
ecoreg.r.sq
```

```
## [1] 0.5353458
```

```
aa.AIC
```

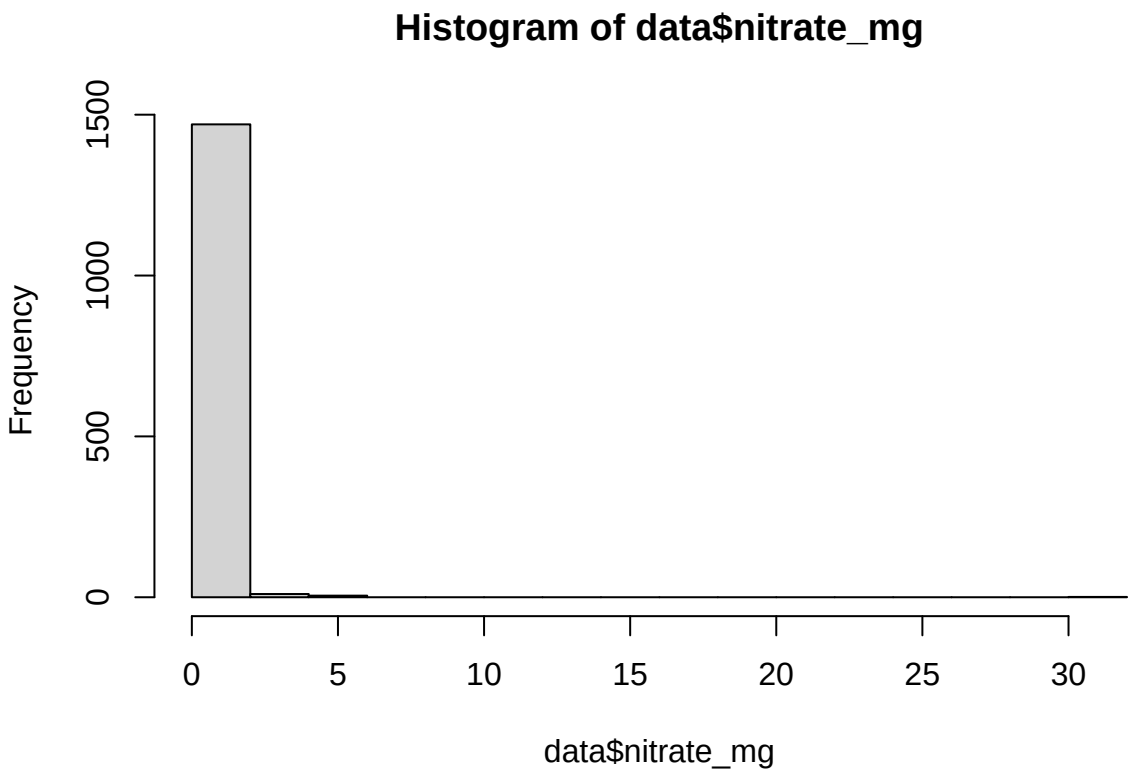
```
## [1] 2989.674
```

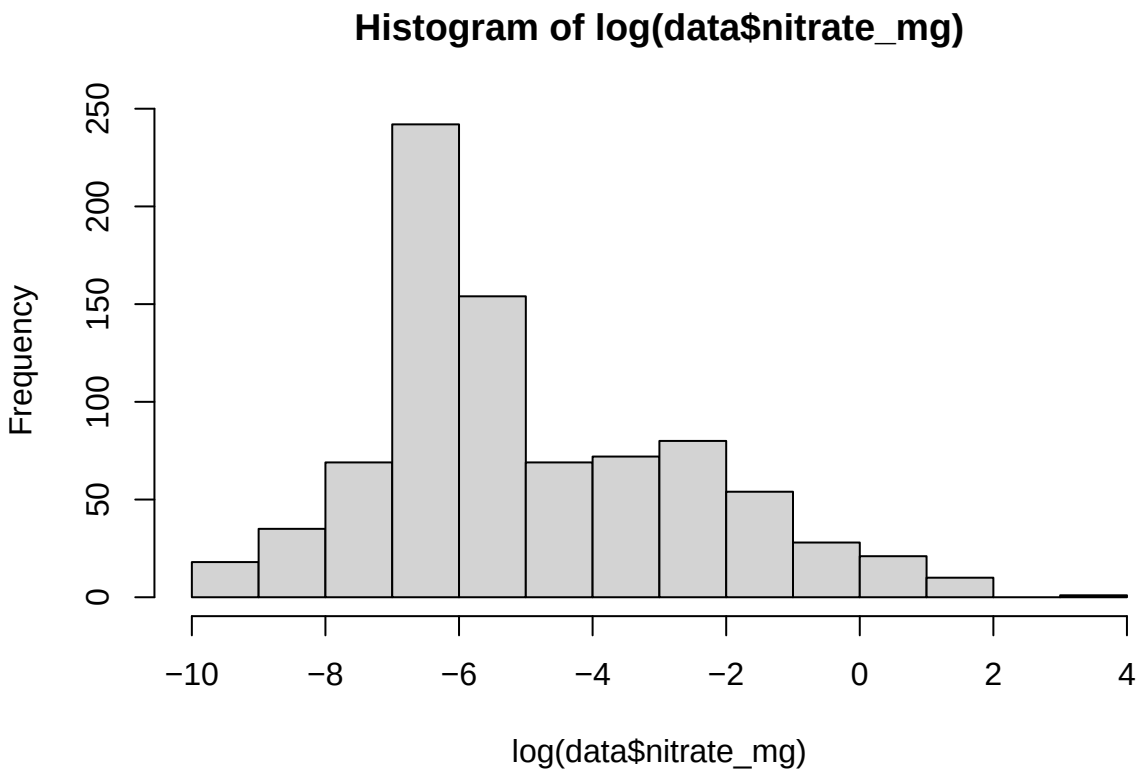
```
max.arch.AIC
```

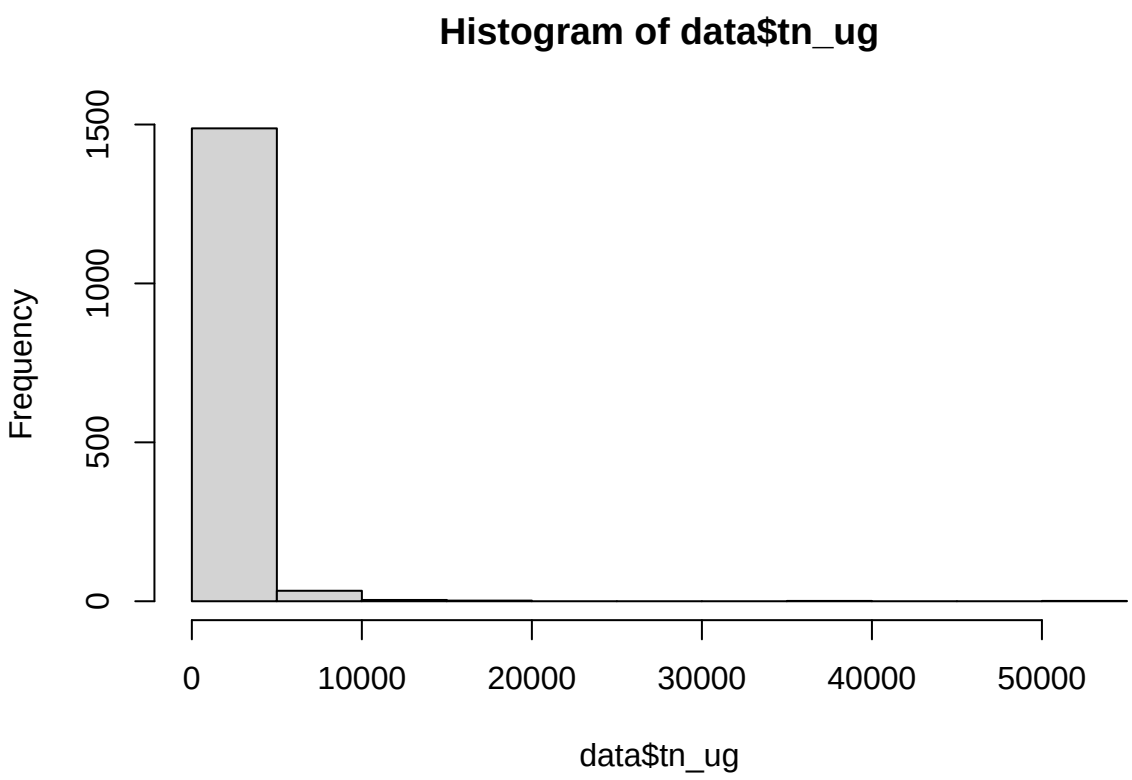
```
## [1] 3567.537
```

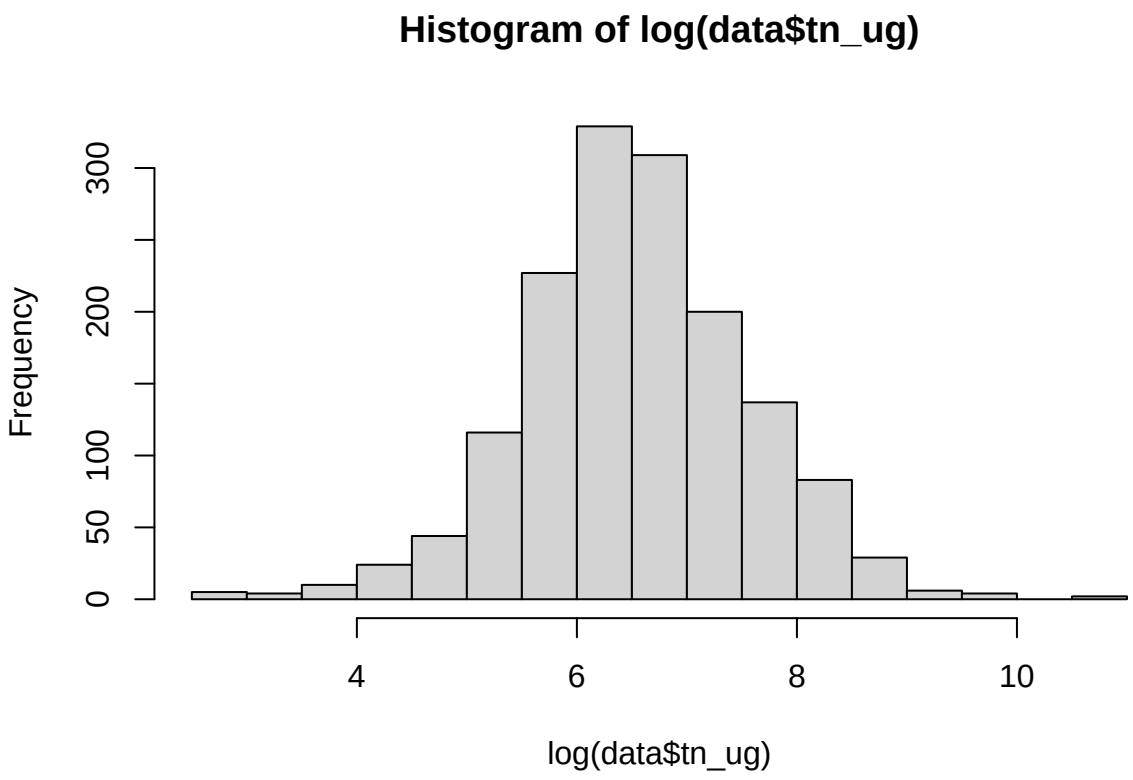
```
ecoreg.AIC
```

```
## [1] 3268.847
```


Histogram of data$nitrate_mg
Frequency
0
500
1000
1500
0
5
10
15
20
25
30
data$nitrate_mg


Histogram of log(data$nitrate_mg)
Frequency
0
50
100
150
200
250
−10
−8
−6
−4
−2
0
2
4
log(data$nitrate_mg)


Histogram of data$tn_ug
Frequency
0
500
1000
1500
0
10000
20000
30000
40000
50000
data$tn_ug




```
##
## Call:
## lm(formula = log(tn_ug) ~ 0 + w.arch1 + w.arch2 + w.arch3 + w.arch4 +
##     w.arch5 + w.arch6 + w.arch7 + log(nitrate_mg):w.arch1 + log(nitrate_mg):w.arch2 +
##     log(nitrate_mg):w.arch3 + log(nitrate_mg):w.arch4 + log(nitrate_mg):w.arch5 +
##     log(nitrate_mg):w.arch6 + log(nitrate_mg):w.arch7, data = data)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -2.77716 -0.40689 -0.01059  0.38867  2.47481
##
## Coefficients:
##                           Estimate Std. Error t value Pr(>|t|)
## w.arch1                    8.23786    0.18079  45.566  < 2e-16 ***
## w.arch2                    6.50568    0.38220  17.021  < 2e-16 ***
## w.arch3                    8.17024    0.20223  40.401  < 2e-16 ***
## w.arch4                    6.50012    0.44994  14.447  < 2e-16 ***
## w.arch5                    6.96833    0.28269  24.650  < 2e-16 ***
## w.arch6                    3.95731    0.31096  12.726  < 2e-16 ***
## w.arch7                    6.13198    0.30694  19.978  < 2e-16 ***
## w.arch1:log(nitrate_mg)    0.23379    0.03557   6.573 8.64e-11 ***
## w.arch2:log(nitrate_mg)    0.05528    0.07057   0.783    0.434
## w.arch3:log(nitrate_mg)    0.07304    0.04069   1.795    0.073 .
## w.arch4:log(nitrate_mg)   -0.09178    0.08388  -1.094    0.274
## w.arch5:log(nitrate_mg)    0.05499    0.05276   1.042    0.298
## w.arch6:log(nitrate_mg)   -0.05168    0.05257  -0.983    0.326
```

```
## w.arch7:log(nitrate_mg) -0.06200    0.05792  -1.070    0.285
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.6645 on 845 degrees of freedom
##   (110 observations deleted due to missingness)
## Multiple R-squared:  0.9899, Adjusted R-squared:  0.9897
## F-statistic:  5921 on 14 and 845 DF,  p-value: < 2.2e-16
```

```
##
## Call:
## lm(formula = log(tn_ug) ~ log(nitrate_mg) * max.arch, data = data)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -3.4151 -0.5125  0.0002  0.5530  2.9193
##
## Coefficients:
##                            Estimate Std. Error t value Pr(>|t|)
## (Intercept)               7.6108175  0.1232095  61.771  < 2e-16 ***
## log(nitrate_mg)           0.1151175  0.0237061   4.856 1.42e-06 ***
## max.arch                 -0.1435103  0.0326984  -4.389 1.28e-05 ***
## log(nitrate_mg):max.arch  0.0005439  0.0060024   0.091    0.928
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.8641 on 855 degrees of freedom
##   (110 observations deleted due to missingness)
## Multiple R-squared:  0.2222, Adjusted R-squared:  0.2195
## F-statistic: 81.41 on 3 and 855 DF,  p-value: < 2.2e-16
```

```
##
## Call:
## lm(formula = log(tn_ug) ~ log(nitrate_mg) * ag_eco9, data = data)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -3.0462 -0.4527 -0.0168  0.4114  3.0499
##
## Coefficients:
##                               Estimate Std. Error t value Pr(>|t|)
## (Intercept)                   7.331820   0.179605  40.822  < 2e-16 ***
## log(nitrate_mg)               0.119572   0.032726   3.654 0.000274 ***
## ag_eco9NAP                   -1.246896   0.280689  -4.442 1.01e-05 ***
## ag_eco9NPL                    1.134091   0.290615   3.902 0.000103 ***
## ag_eco9SAP                   -0.509105   0.249030  -2.044 0.041229 *
## ag_eco9SPL                    0.115265   0.270504   0.426 0.670136
## ag_eco9TPL                    0.307388   0.228369   1.346 0.178660
## ag_eco9UMW                    0.043060   0.245899   0.175 0.861035
## ag_eco9WMT                   -1.660098   0.294023  -5.646 2.24e-08 ***
## ag_eco9XER                   -0.453593   0.259546  -1.748 0.080891 .
## log(nitrate_mg):ag_eco9NAP -0.104960   0.048182  -2.178 0.029653 *
## log(nitrate_mg):ag_eco9NPL  0.105926   0.057862   1.831 0.067504 .
## log(nitrate_mg):ag_eco9SAP -0.007065   0.046698  -0.151 0.879783
```

```
## log(nitrate_mg):ag_eco9SPL -0.005509   0.050877  -0.108 0.913803
## log(nitrate_mg):ag_eco9TPL -0.002866   0.043263  -0.066 0.947203
## log(nitrate_mg):ag_eco9UMW  0.008793   0.044182   0.199 0.842297
## log(nitrate_mg):ag_eco9WMT -0.110260   0.051996  -2.121 0.034252 *
## log(nitrate_mg):ag_eco9XER -0.022367   0.050424  -0.444 0.657458
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.7729 on 841 degrees of freedom
##   (110 observations deleted due to missingness)
## Multiple R-squared:  0.3879, Adjusted R-squared:  0.3755
## F-statistic: 31.35 on 17 and 841 DF,  p-value: < 2.2e-16
```

```
## [1] 0.9897415
```

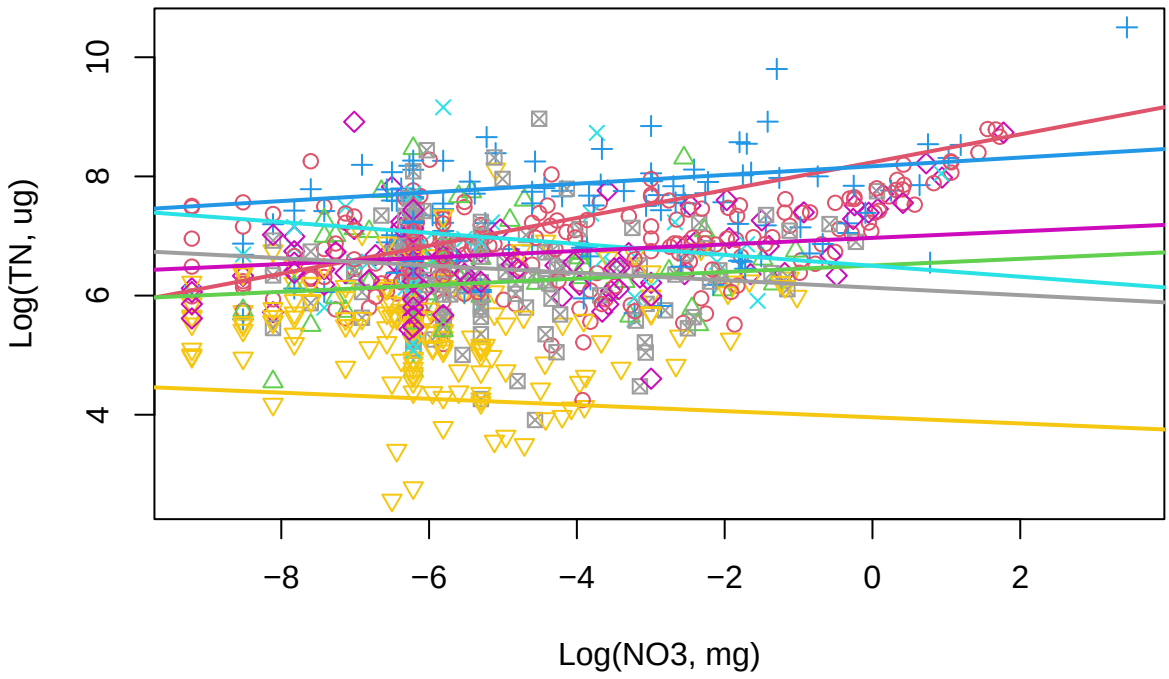
```
## [1] 0.2194558
```

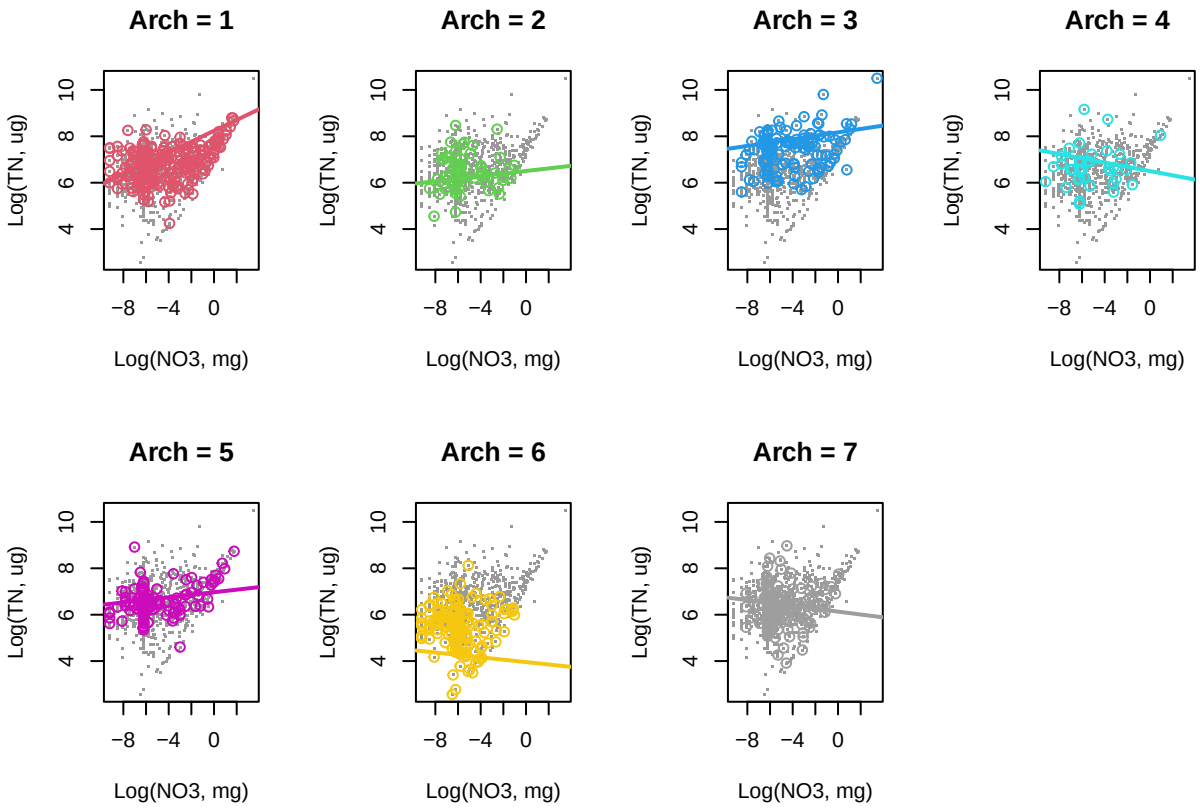
```
## [1] 0.3755316
```

```
## [1] 1751.318
```

```
## [1] 2192.821
```

```
## [1] 2015.004
```




Arch = 1
Arch = 2
Arch = 3
Arch = 4
Arch = 5
Arch = 6
Arch = 7
Log(TN, ug)
Log(NO3, mg)
4
6
8
10
−8
−4
0