CO Turtles Exploratory Analyses

Natalie Haydt

```
getwd()
```

```
## [1] "/Users/nataliehaydt/Desktop/Thesis/cocanal-turtles"
```

```
scr.data <- read.csv(file = "canalscr_9_1_18.csv")
head(scr.data)
```

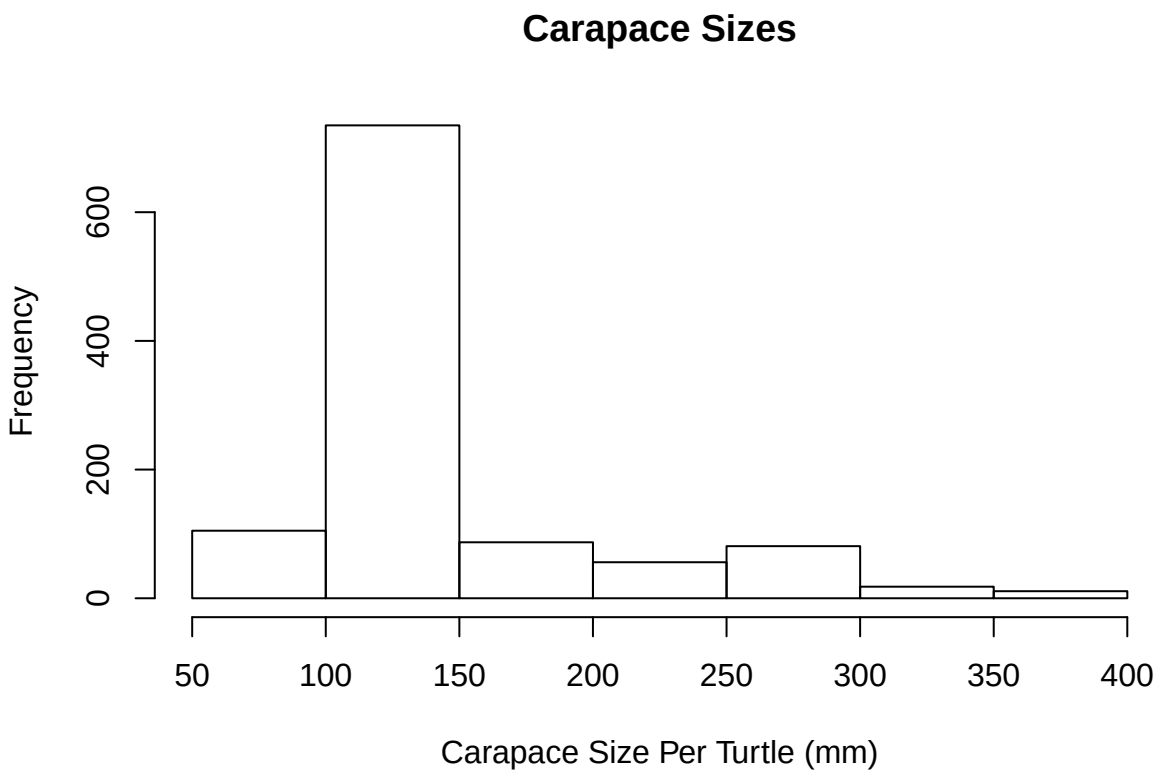
```
##   line page   date site trap species subspecies sex   A   B carapace
## 1    1    1 6/7/18    A    8    CPIC  marginata   F  NA  NA      145
## 2    2    1 6/7/18    A    8    CPIC  marginata   M  NA  NA      109
## 3    3    1 6/7/18    A    8    CPIC  marginata   F  NA  NA      151
## 4    4    1 6/7/18    A    8    CPIC  marginata   M  NA  NA      135
## 5    5    1 6/7/18    A    8    CPIC  marginata   F  NA  NA      145
## 6    6    1 6/7/18    A    7    CSER       <NA>   M 133 156      390
##   car_max plastron depth  mass leeches recap mark_1 mark_final picture
## 1     146      137    54   420       0     N    300        300       Y
## 2     109       99    38   170       0     N     30         30       Y
## 3     151      142    55   460       1     N     27         27       Y
## 4     135      123    46   270       0     N     24         24       Y
## 5     145      137    52   380       1     N     70         70       Y
## 6     397      288   162 15200      NA     N    100        200       Y
##   blood smear                                                comments
## 1     N     N                                    right front claw damage
## 2     Y     Y mark 20 wide; break line scar diagonally across plastron
## 3     Y     Y                                              hole in nose
## 4     Y     Y
## 5     Y     Y         tiny scar on both abdominal scutes; scar on tail
## 6     N     N                    marked 2nd rear scute from center line
```

```
summary(scr.data)
```

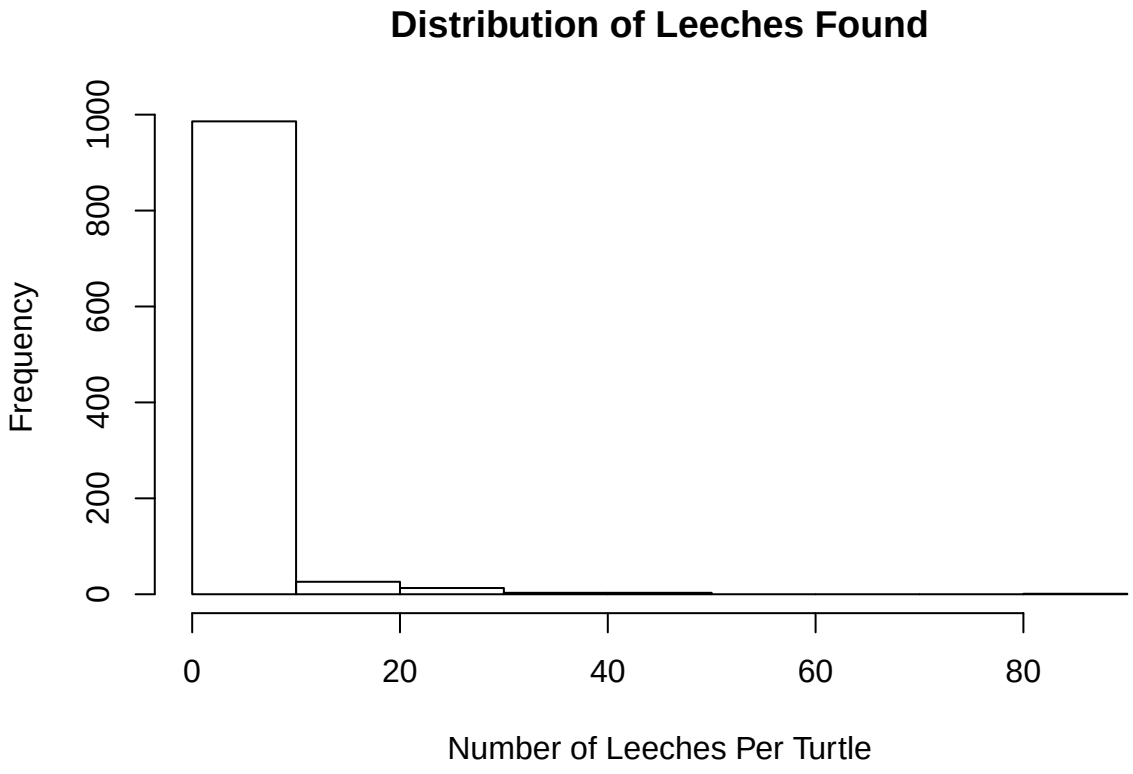
```
##       line           page            date          site
##  Min.   :   1   Min.   : 1.00   6/26/18:104   F      :165
##  1st Qu.: 274   1st Qu.:10.00   8/11/18: 73   N      :151
##  Median : 547   Median :19.00   8/16/18: 72   J      :130
##  Mean   : 547   Mean   :18.55   7/11/18: 60   O      :130
##  3rd Qu.: 820   3rd Qu.:27.00   6/19/18: 50   G      :115
##  Max.   :1093   Max.   :36.00   7/3/18 : 45   M      :100
##                                 (Other):689   (Other):302
##       trap        species        subspecies    sex            A
##  Min.   : 1.000   CPIC:807   marginata:684   F   :369   Min.   : 39.00
##  1st Qu.: 3.000   CSER: 74   na       :  1   M   :703   1st Qu.: 86.75
##  Median : 5.000   GINS:  2   picta    : 97   U   : 19   Median : 97.00
##  Mean   : 5.651   PRUB:128   NA's     :311   NA's:  2   Mean   : 98.24
##  3rd Qu.: 8.000   SODO: 81                              3rd Qu.:110.25
##  Max.   :14.000   TSCR:  1                              Max.   :133.00
##                                                         NA's   :1021
##        B             carapace        car_max       plastron
##  Min.   : 18.00   Min.   : 50.0   Min.   : 50   Min.   : 46.0
##  1st Qu.: 58.00   1st Qu.:119.0   1st Qu.:119   1st Qu.:110.0
```

```
##  Median : 73.00   Median :131.0   Median :132   Median :121.0
##  Mean   : 86.71   Mean   :148.2   Mean   :150   Mean   :132.2
##  3rd Qu.:120.50   3rd Qu.:148.0   3rd Qu.:148   3rd Qu.:139.0
##  Max.   :157.00   Max.   :390.0   Max.   :397   Max.   :302.0
##  NA's   :1021
##      depth            mass            leeches      recap       mark_1
##  Min.   : 20.0   Min.   :   15.0   Min.   : 0.00   N:939   150    :   6
##  1st Qu.: 40.0   1st Qu.:  205.0   1st Qu.: 0.00   R:154   100    :   5
##  Median : 43.0   Median :  265.0   Median : 1.00           130    :   5
##  Mean   : 52.4   Mean   :  787.8   Mean   : 2.34           20     :   5
##  3rd Qu.: 53.0   3rd Qu.:  410.0   3rd Qu.: 2.00           240    :   5
##  Max.   :169.0   Max.   :15200.0   Max.   :86.00           410    :   5
##                                    NA's   :61              (Other):1062
##    mark_final   picture    blood   smear                     comments
##  150    :   6       :280    :  3    :  3                        :615
##  130    :   5   N   :106   N:972   N:979   triangle marks       : 51
##  20     :   5   Y   :702   Y:118   Y:111   plastron blotch faint: 33
##  240    :   5   NA's:  5                   dark plastron        : 16
##  410    :   5                              tail damage          : 14
##  430    :   5                              alternate seams      : 10
##  (Other):1062                              (Other)              :354
```

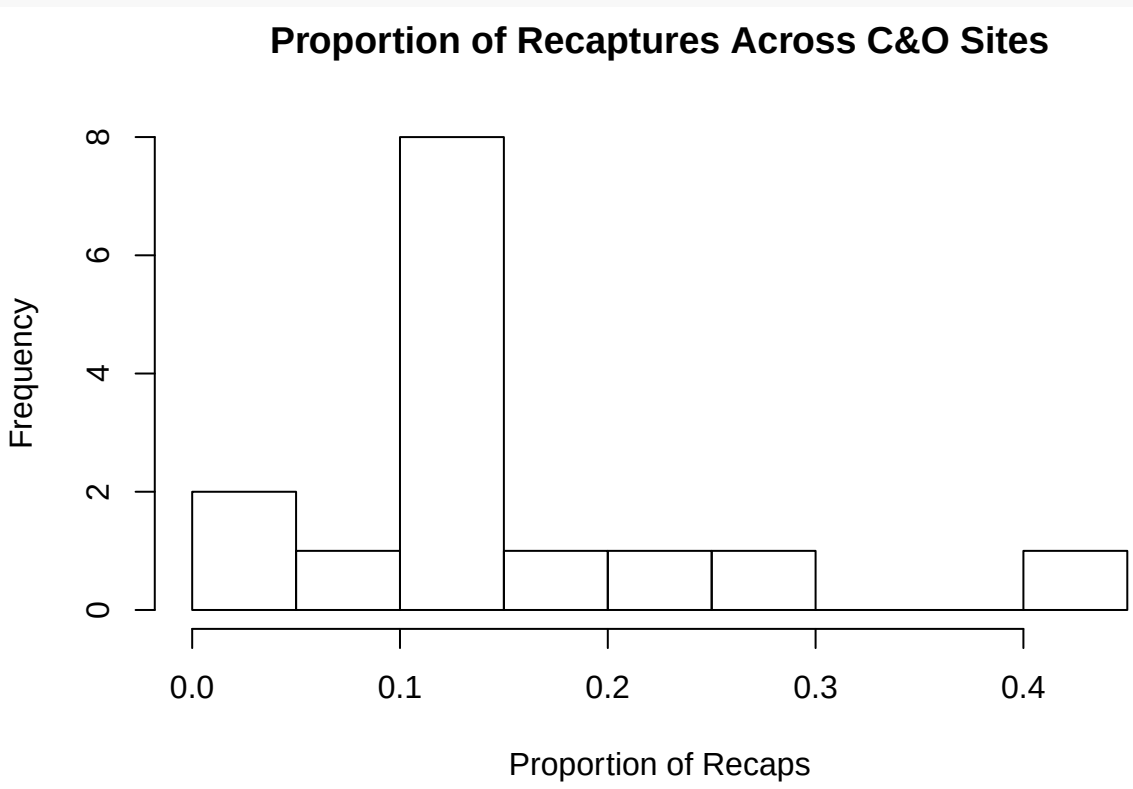
```
hist(scr.data$carapace, main = "Carapace Sizes", xlab = "Carapace Size Per Turtle (mm)")
```




```
hist(scr.data$leeches, main = "Distribution of Leeches Found", xlab = "Number of Leeches Per Turtle" )
```




```
recaps <- read.csv(file = "recaprates_9_1_18.csv")
hist(recaps$prop_recap, breaks = 10, xlab = "Proportion of Recaps", main = "Proportion of Recaptures Ac
```




```
scr_cpic <- subset(scr.data, species == "CPIC")
scr_sodo <- subset(scr.data, species == "SODO")
```

```
scr_cser <- subset(scr.data, species == "CSER")
scr_prub <- subset(scr.data, species == "PRUB")
scr_gins <- subset(scr.data, species == "GINS")
scr_tscr <- subset(scr.data, species == "TSCR")
```

```
summary(scr_cpic)
```

```
##       line             page           date          site
##  Min.   :   1.0   Min.   : 1.00   6/26/18: 87   F      :143
##  1st Qu.: 275.5   1st Qu.:10.00   8/16/18: 60   O      :106
##  Median : 557.0   Median :19.00   8/11/18: 52   N      :100
##  Mean   : 551.0   Mean   :18.67   7/11/18: 40   M      : 86
##  3rd Qu.: 824.5   3rd Qu.:27.00   7/31/18: 30   J      : 73
##  Max.   :1093.0   Max.   :36.00   7/29/18: 26   G      : 65
##                                   (Other):512   (Other):234
##       trap        species        subspecies  sex           A
##  Min.   : 1.000   CPIC:807   marginata:684   F:235   Min.   : NA
##  1st Qu.: 3.000   CSER:  0   na       :  1   M:556   1st Qu.: NA
##  Median : 5.000   GINS:  0   picta    : 97   U: 16   Median : NA
##  Mean   : 5.542   PRUB:  0   NA's     : 25           Mean   :NaN
##  3rd Qu.: 8.000   SODO:  0                          3rd Qu.: NA
##  Max.   :14.000   TSCR:  0                          Max.   : NA
##                                                     NA's   :807
##        B          carapace      car_max         plastron
##  Min.   : NA   Min.   : 50   Min.   : 50.0   Min.   : 46.0
##  1st Qu.: NA   1st Qu.:120   1st Qu.:121.0   1st Qu.:111.0
##  Median : NA   Median :130   Median :131.0   Median :119.0
##  Mean   :NaN   Mean   :128   Mean   :128.8   Mean   :118.5
##  3rd Qu.: NA   3rd Qu.:138   3rd Qu.:139.0   3rd Qu.:127.0
##  Max.   : NA   Max.   :172   Max.   :172.0   Max.   :160.0
##  NA's   :807
##      depth            mass          leeches       recap       mark_1
##  Min.   :20.00   Min.   : 15.0   Min.   : 0.000   N:687   163    :  3
##  1st Qu.:39.00   1st Qu.:210.0   1st Qu.: 0.000   R:120   592    :  3
##  Median :42.00   Median :255.0   Median : 0.000           617    :  3
##  Mean   :43.17   Mean   :266.5   Mean   : 1.286           642    :  3
##  3rd Qu.:47.00   3rd Qu.:310.0   3rd Qu.: 1.000           71     :  3
##  Max.   :64.00   Max.   :625.0   Max.   :46.000           72     :  3
##                                  NA's   :38               (Other):789
##    mark_final  picture    blood   smear                     comments
##  163    :  3       :216    :  0    :  0                        :416
##  592    :  3   N   : 80   N:729   N:733   triangle marks       : 41
##  617    :  3   Y   :508   Y: 78   Y: 74   plastron blotch faint: 33
##  642    :  3   NA's:  3                   dark plastron        : 16
##  71     :  3                              tail damage          : 12
##  72     :  3                              alternate seams      : 10
##  (Other):789                              (Other)              :279
```

```
summary(scr_sodo)
```

```
##       line             page           date          site
##  Min.   :  20.0   Min.   : 1.00   6/19/18:14   E      :22
##  1st Qu.: 184.0   1st Qu.: 7.00   7/11/18:10   J      :20
##  Median : 530.0   Median :18.00   8/8/18 : 9   N      :11
##  Mean   : 523.6   Mean   :17.79   6/20/18: 5   O      :11
```

```
##  3rd Qu.: 818.0   3rd Qu.:27.00   7/13/18: 5   G      : 4
##  Max.   :1091.0   Max.   :36.00   8/16/18: 5   M      : 4
##                                   (Other):33   (Other): 9
##       trap        species       subspecies   sex           A
##  Min.   : 1.000   CPIC: 0   marginata: 0   F   :51   Min.   : NA
##  1st Qu.: 3.000   CSER: 0   na       : 0   M   :28   1st Qu.: NA
##  Median : 6.000   GINS: 0   picta    : 0   U   : 0   Median : NA
##  Mean   : 6.123   PRUB: 0   NA's     :81   NA's: 2   Mean   :NaN
##  3rd Qu.:10.000   SODO:81                             3rd Qu.: NA
##  Max.   :13.000   TSCR: 0                             Max.   : NA
##                                                       NA's   :81
##        B          carapace         car_max          plastron
##  Min.   : NA   Min.   : 64.00   Min.   : 64.00   Min.   :48.00
##  1st Qu.: NA   1st Qu.: 92.00   1st Qu.: 92.00   1st Qu.:68.00
##  Median : NA   Median : 98.00   Median : 98.00   Median :72.00
##  Mean   :NaN   Mean   : 98.57   Mean   : 98.84   Mean   :72.58
##  3rd Qu.: NA   3rd Qu.:107.00   3rd Qu.:107.00   3rd Qu.:77.00
##  Max.   : NA   Max.   :128.00   Max.   :128.00   Max.   :91.00
##  NA's   :81
##      depth            mass        leeches       recap      mark_1
##  Min.   :28.00   Min.   : 40   Min.   : 0.000   N:76   108    : 2
##  1st Qu.:37.00   1st Qu.:125   1st Qu.: 1.000   R: 5   19     : 2
##  Median :39.00   Median :145   Median : 3.000          21     : 2
##  Mean   :39.79   Mean   :151   Mean   : 7.922          25     : 2
##  3rd Qu.:43.00   3rd Qu.:185   3rd Qu.:11.000          29     : 2
##  Max.   :49.00   Max.   :260   Max.   :50.000          1      : 1
##                                NA's   :4               (Other):70
##    mark_final picture blood  smear
##  108    : 2    :17     : 1    : 1
##  19     : 2   N: 9    N:63   N:67
##  21     : 2   Y:55    Y:17   Y:13
##  25     : 2
##  29     : 2
##  1      : 1
##  (Other):70
##                                                                                  comments
##                                                                                      :66
##  triangle marks                                                                      : 3
##  nose damage                                                                         : 2
##  blood smears not good?                                                              : 1
##  dent between 2000 and 4000                                                          : 1
##  left rear carapace damage; all pics this day until this point are a trap behind: 1
##  (Other)                                                                             : 7
```

```
summary(scr_cser)
```

```
##       line             page            date         site
##  Min.   :   6.0   Min.   : 1.00   6/19/18:11   E      :12
##  1st Qu.: 130.2   1st Qu.: 5.00   6/26/18: 7   F      : 9
##  Median : 357.5   Median :12.50   7/29/18: 7   M      : 8
##  Mean   : 422.2   Mean   :14.51   8/16/18: 5   A      : 7
##  3rd Qu.: 723.2   3rd Qu.:24.00   6/15/18: 4   C      : 7
##  Max.   :1081.0   Max.   :36.00   6/7/18 : 4   J      : 7
##                                   (Other):36   (Other):24
##       trap        species       subspecies sex           A
```

```
##  Min.   : 1.000   CPIC: 0   marginata: 0   F:40   Min.   : 39.00
##  1st Qu.: 3.250   CSER:74   na       : 0   M:33   1st Qu.: 86.75
##  Median : 5.000   GINS: 0   picta    : 0   U: 1   Median : 97.00
##  Mean   : 5.716   PRUB: 0   NA's     :74          Mean   : 98.24
##  3rd Qu.: 8.000   SODO: 0                        3rd Qu.:110.25
##  Max.   :14.000   TSCR: 0                        Max.   :133.00
##                                                  NA's   :2
##        B             carapace        car_max         plastron
##  Min.   : 18.00   Min.   : 93.0   Min.   : 97.0   Min.   : 72.0
##  1st Qu.: 58.00   1st Qu.:249.5   1st Qu.:256.5   1st Qu.:188.0
##  Median : 73.00   Median :278.0   Median :287.0   Median :209.5
##  Mean   : 86.71   Mean   :279.3   Mean   :289.9   Mean   :209.3
##  3rd Qu.:120.50   3rd Qu.:316.2   3rd Qu.:328.5   3rd Qu.:237.8
##  Max.   :157.00   Max.   :390.0   Max.   :397.0   Max.   :290.0
##  NA's   :2
##      depth            mass          leeches       recap      mark_1
##  Min.   : 41.0   Min.   :  170   Min.   : 0.000   N:62   100    : 2
##  1st Qu.:101.0   1st Qu.: 3290   1st Qu.: 1.000   R:12   20     : 2
##  Median :115.0   Median : 4885   Median : 5.000          240    : 2
##  Mean   :116.9   Mean   : 5752   Mean   : 8.686          350    : 2
##  3rd Qu.:133.8   3rd Qu.: 7662   3rd Qu.:10.750          430    : 2
##  Max.   :169.0   Max.   :15200   Max.   :86.000          630    : 2
##                                  NA's   :4               (Other):62
##    mark_final picture   blood  smear
##  20     : 2       :17    : 2    : 2
##  220    : 2   N   : 9   N:59   N:56
##  240    : 2   Y   :46   Y:13   Y:16
##  350    : 2   NA's: 2
##  430    : 2
##  630    : 2
##  (Other):62
##                                comments
##                                    :44
##  small                             : 2
##  tail damage                       : 2
##  triangle marks                    : 2
##  1 large leech, all the rest tiny: 1
##  3 big leeches                     : 1
##  (Other)                           :22
```

```
summary(scr_prub)
```

```
##       line             page            date         site
##  Min.   : 138.0   Min.   : 5.00   8/11/18:18   G      :40
##  1st Qu.: 439.8   1st Qu.:16.00   7/6/18 :16   N      :34
##  Median : 580.5   Median :20.00   7/13/18:13   J      :30
##  Mean   : 609.1   Mean   :20.63   7/3/18 :13   F      :10
##  3rd Qu.: 852.2   3rd Qu.:28.00   8/8/18 :11   O      : 7
##  Max.   :1066.0   Max.   :35.00   6/26/18: 9   E      : 6
##                                   (Other):48   (Other): 1
##       trap        species        subspecies  sex          A
##  Min.   : 1.000   CPIC:  0   marginata:  0   F:43   Min.   : NA
##  1st Qu.: 4.000   CSER:  0   na       :  0   M:84   1st Qu.: NA
##  Median : 6.000   GINS:  0   picta    :  0   U: 1   Median : NA
##  Mean   : 6.047   PRUB:128   NA's     :128          Mean   :NaN
```

```
##  3rd Qu.: 8.000   SODO:  0                          3rd Qu.: NA
##  Max.   :12.000   TSCR:  0                          Max.   : NA
##                                                     NA's   :128
##        B          carapace        car_max         plastron
##  Min.   : NA   Min.   : 85.0   Min.   : 85.0   Min.   : 78.0
##  1st Qu.: NA   1st Qu.:201.8   1st Qu.:204.0   1st Qu.:187.5
##  Median : NA   Median :242.5   Median :246.5   Median :220.0
##  Mean   :NaN   Mean   :231.1   Mean   :234.1   Mean   :211.3
##  3rd Qu.: NA   3rd Qu.:268.0   3rd Qu.:271.2   3rd Qu.:240.5
##  Max.   : NA   Max.   :314.0   Max.   :317.0   Max.   :302.0
##  NA's   :128
##      depth             mass           leeches       recap       mark_1
##  Min.   : 35.00   Min.   :  90.0   Min.   : 0.000   N:111   130     :  3
##  1st Qu.: 69.75   1st Qu.: 971.2   1st Qu.: 0.000   R: 17   150     :  3
##  Median : 81.50   Median :1540.0   Median : 1.000           111     :  2
##  Mean   : 81.09   Mean   :1606.5   Mean   : 1.816           170     :  2
##  3rd Qu.: 94.25   3rd Qu.:2190.0   3rd Qu.: 2.000           2       :  2
##  Max.   :122.00   Max.   :3770.0   Max.   :40.000           20      :  2
##                                    NA's   :14               (Other):114
##    mark_final  picture blood   smear
##  130     :  3    :28     :  0    :  0
##  150     :  3   N: 8    N:119   N:121
##  111     :  2   Y:92    Y:  9   Y:  7
##  170     :  2
##  2       :  2
##  20      :  2
##  (Other):114
##
##
##  triangle marks
##  13 marginal scutes on each side
##  damage to 20
##  ~ 3 years old; sex questionable; triangle marks
##  ~ 3 years old; sex questionable; triangle marks; trianglular gap beween most rear marginals; double
##  (Other)
```

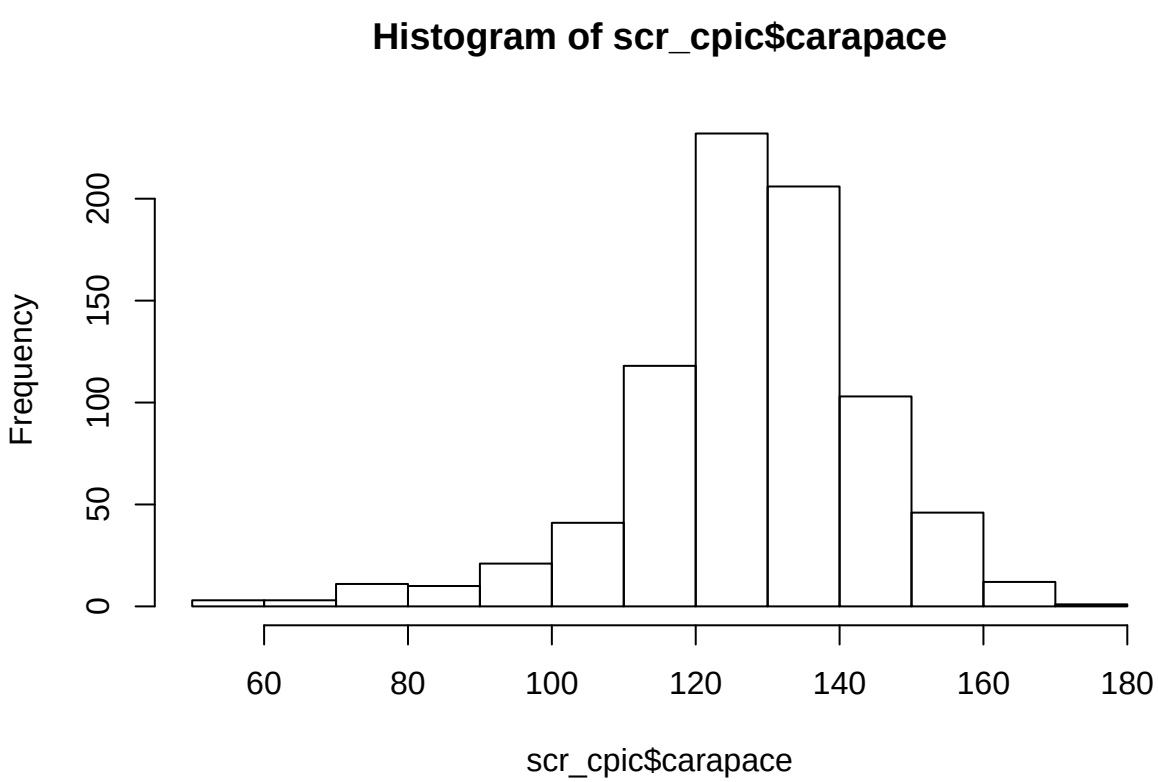
```
summary(scr_gins)
```

```
##       line            page            date        site        trap
##  Min.   :116.0   Min.   : 4.00   6/15/18:1   C      :1   Min.   :2
##  1st Qu.:259.2   1st Qu.: 8.75   7/20/18:1   L      :1   1st Qu.:3
##  Median :402.5   Median :13.50   6/10/18:0   A      :0   Median :4
##  Mean   :402.5   Mean   :13.50   6/12/18:0   D      :0   Mean   :4
##  3rd Qu.:545.8   3rd Qu.:18.25   6/13/18:0   E      :0   3rd Qu.:5
##  Max.   :689.0   Max.   :23.00   6/14/18:0   F      :0   Max.   :6
##                                  (Other):0   (Other):0
##  species      subspecies sex         A            B          carapace
##  CPIC:0   marginata:0    F:0   Min.   : NA   Min.   : NA   Min.   : 86.0
##  CSER:0   na       :0    M:1   1st Qu.: NA   1st Qu.: NA   1st Qu.:116.8
##  GINS:2   picta    :0    U:1   Median : NA   Median : NA   Median :147.5
##  PRUB:0   NA's     :2          Mean   :NaN   Mean   :NaN   Mean   :147.5
##  SODO:0                       3rd Qu.: NA   3rd Qu.: NA   3rd Qu.:178.2
##  TSCR:0                       Max.   : NA   Max.   : NA   Max.   :209.0
##                               NA's   :2     NA's   :2
##     car_max         plastron         depth         mass           leeches
```

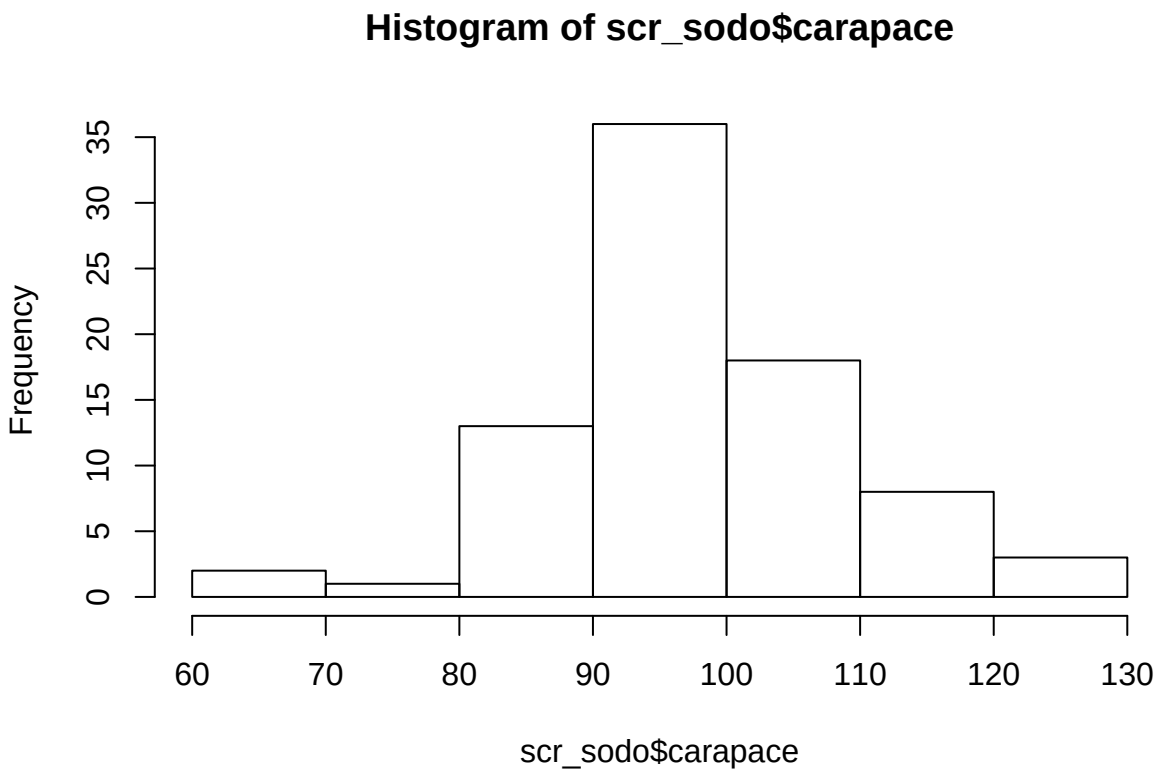
```
##  Min.   : 89.0   Min.   : 77.0   Min.   :31   Min.   :  85.0   Min.   :1
##  1st Qu.:120.5   1st Qu.:102.8   1st Qu.:41   1st Qu.: 396.2   1st Qu.:1
##  Median :152.0   Median :128.5   Median :51   Median : 707.5   Median :1
##  Mean   :152.0   Mean   :128.5   Mean   :51   Mean   : 707.5   Mean   :1
##  3rd Qu.:183.5   3rd Qu.:154.2   3rd Qu.:61   3rd Qu.:1018.8   3rd Qu.:1
##  Max.   :215.0   Max.   :180.0   Max.   :71   Max.   :1330.0   Max.   :1
##                                                                NA's   :1
##  recap     mark_1    mark_final picture blood smear
##  N:2   10     :1   10     :1     :1      :0    :0
##  R:0   20     :1   20     :1    N:0     N:1   N:1
##        1      :0          :0    Y:1     Y:1   Y:1
##        100    :0   1      :0
##        1000   :0   100    :0
##        1001   :0   1000   :0
##        (Other):0   (Other):0
##
##  depression in plastron; end of tail damaged
##  WOOD TURTLE!!!!!! Nails and tail base short -- around 3 years old
##
##  ~ 2 years old; short nais; cloaca not past carapace
##  ~ 3 years old; sex questionable; triangle marks
##  ~ 3 years old; sex questionable; triangle marks; trianglular gap beween most rear marginals; double
##  (Other)
```

```
## only 1 tscr caught, so did not create summary
```

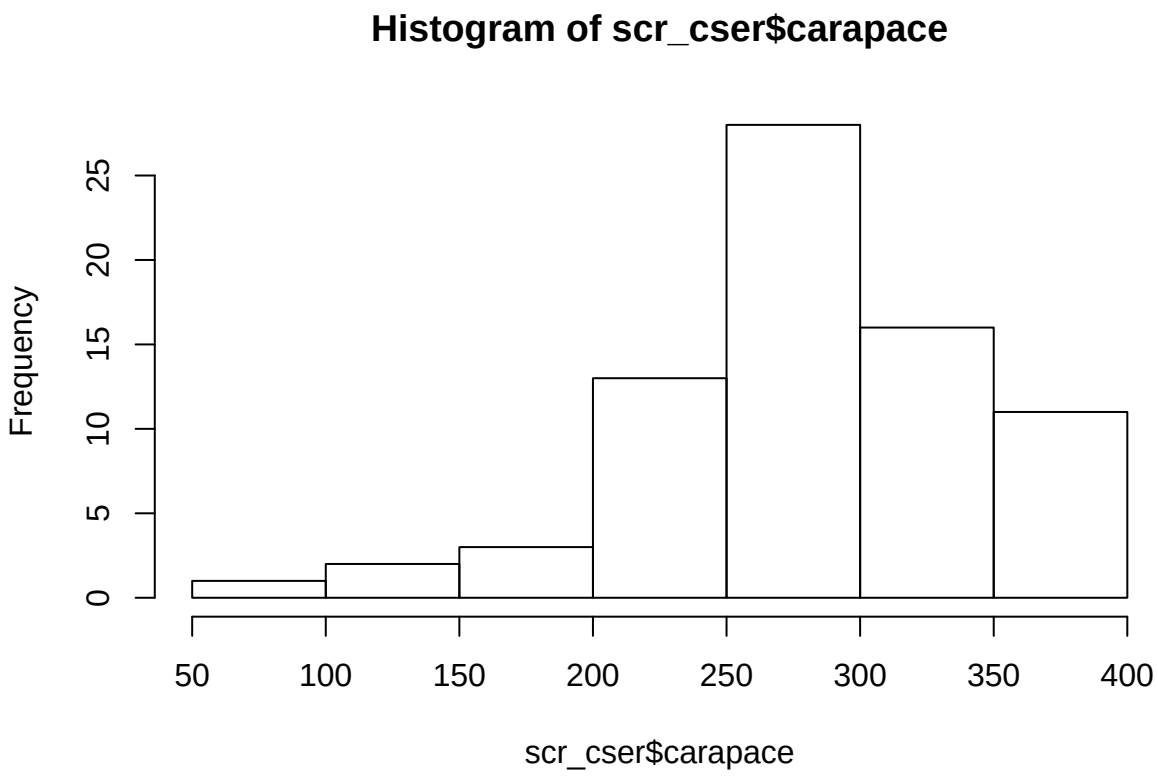
```
hist(scr_cpic$carapace)
```



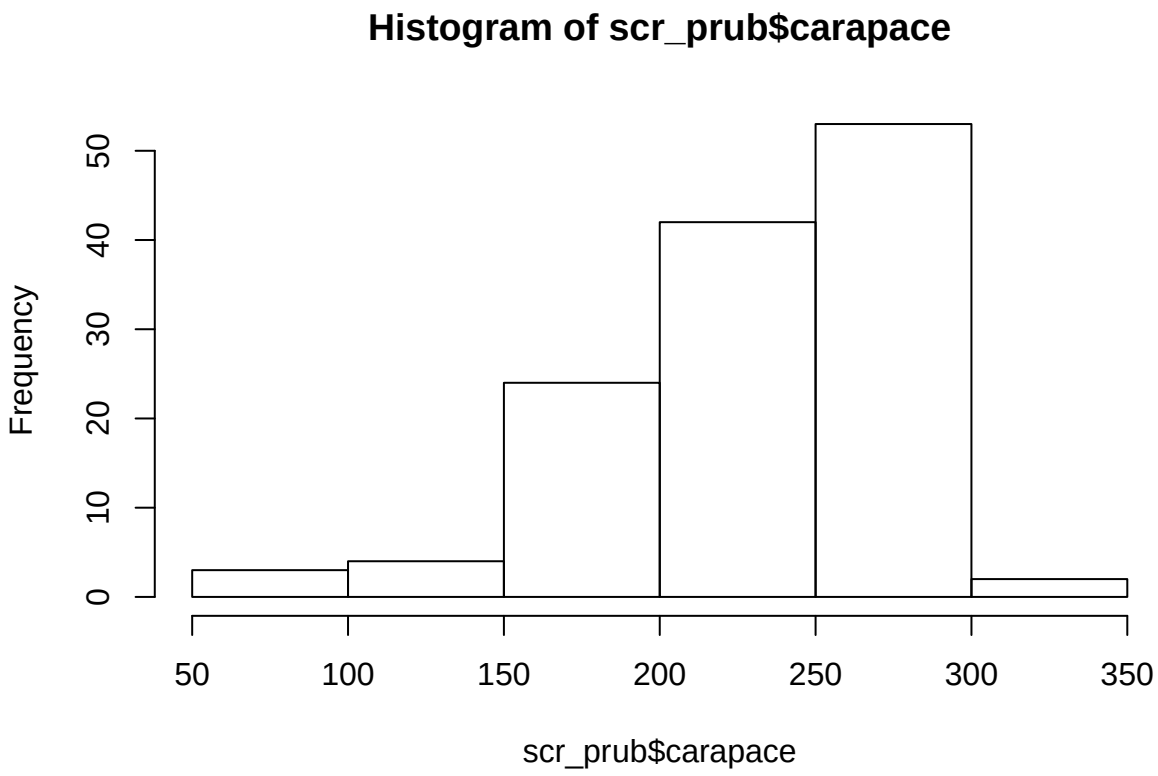

```
hist(scr_sodo$carapace)
```



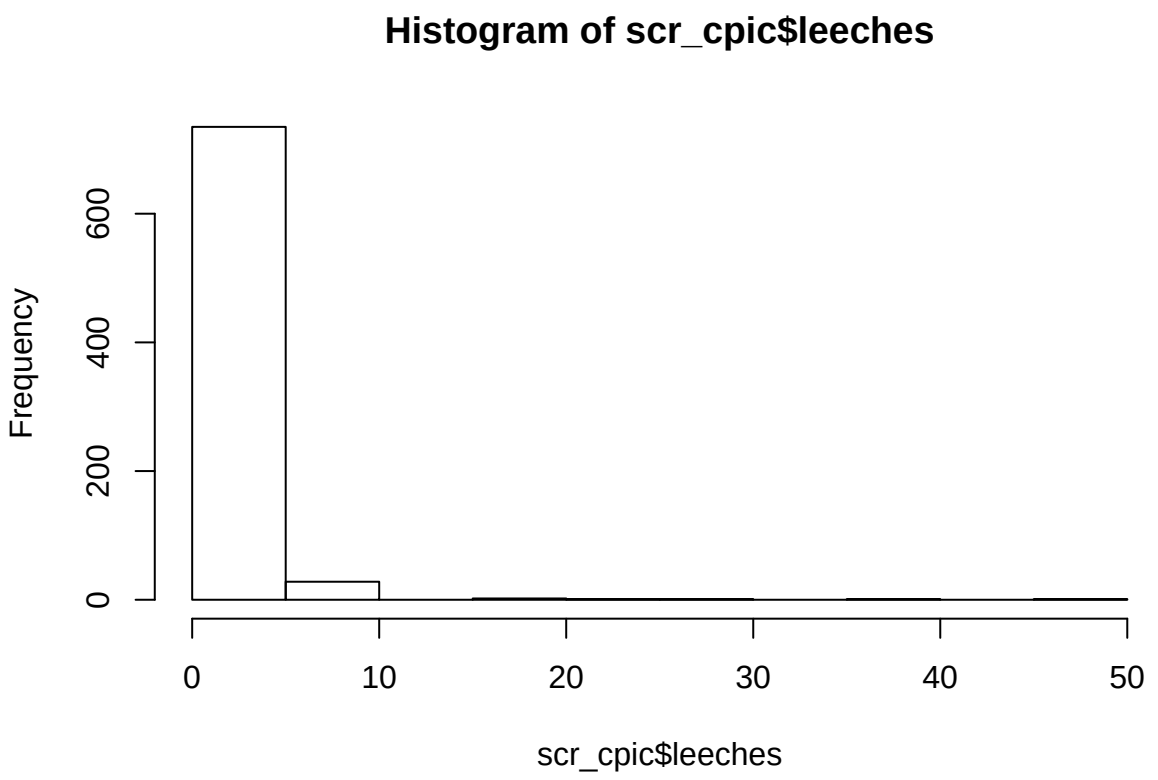

```
hist(scr_cser$carapace)
```



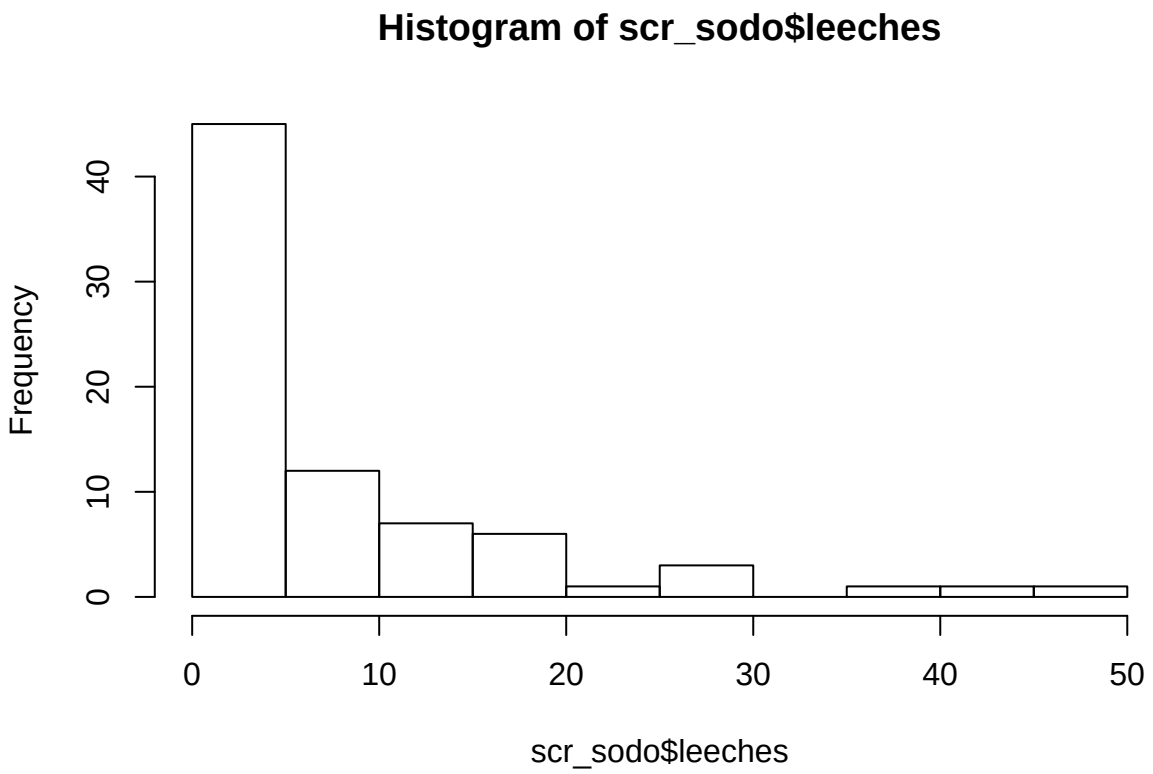

```
hist(scr_prub$carapace)
```



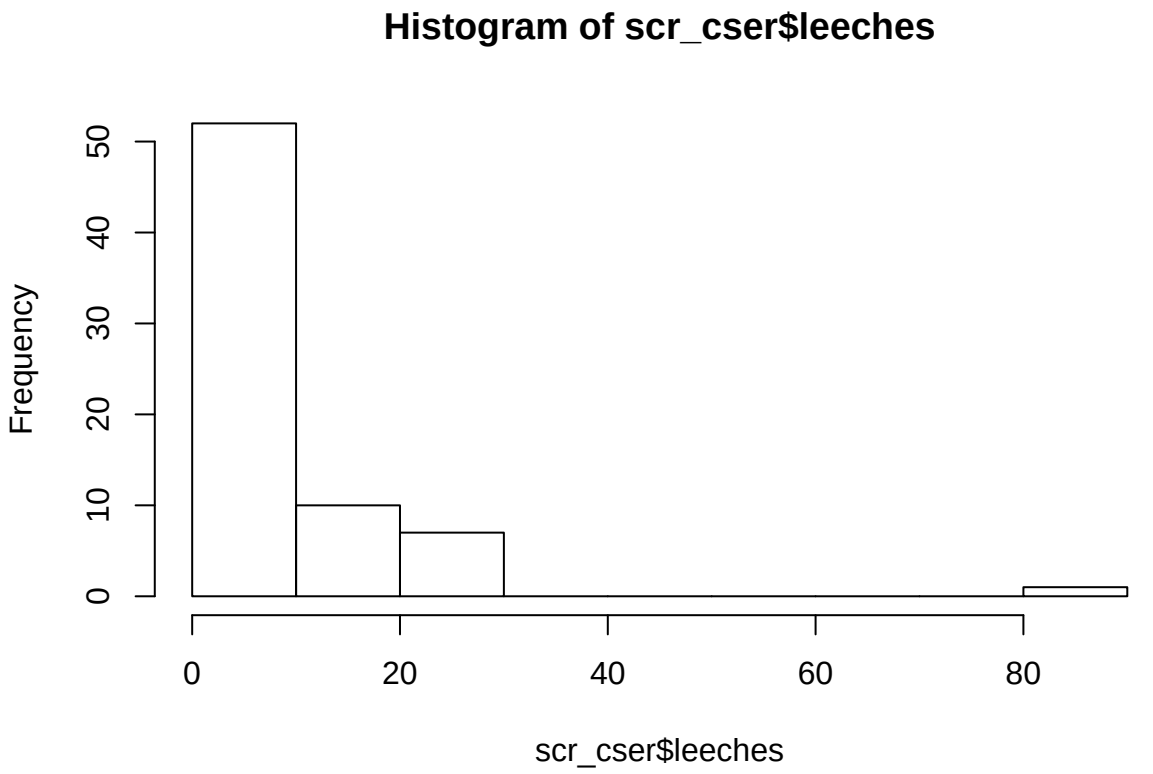

```
hist(scr_cpic$leeches)
```



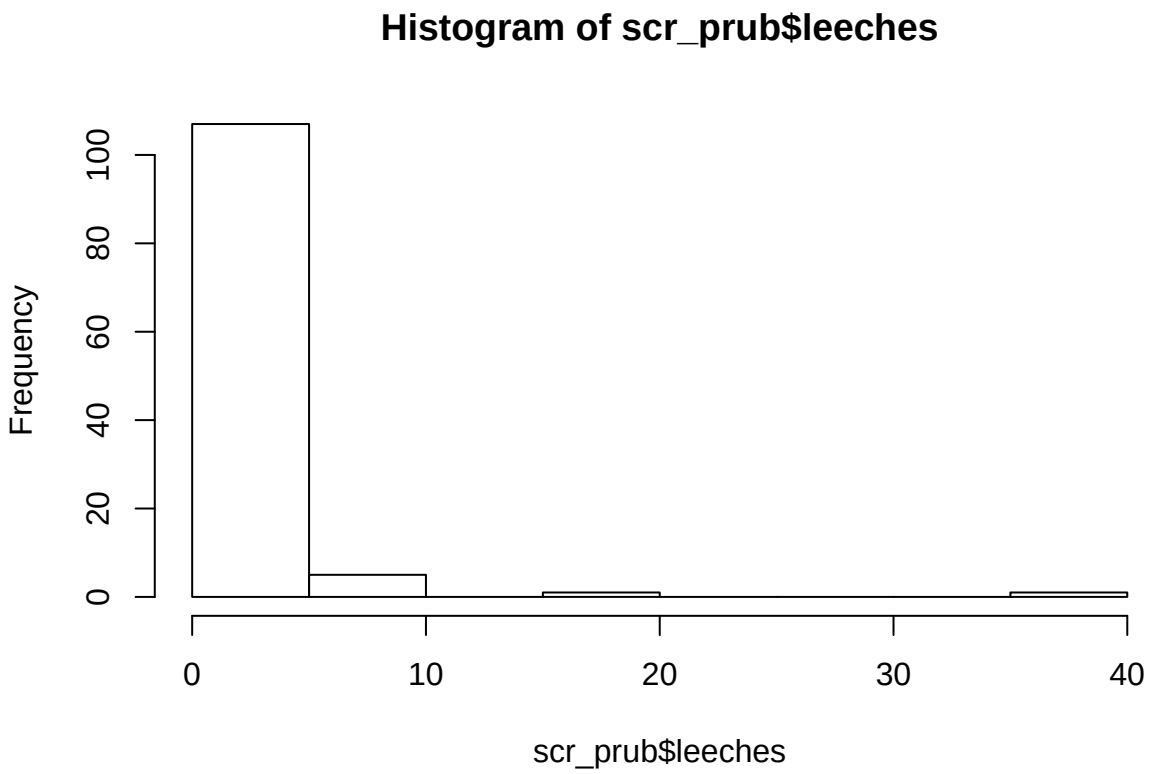

```
hist(scr_sodo$leeches)
```




```
hist(scr_cser$leeches)
```




```
hist(scr_prub$leeches)
```




```
cpic_size_site <- aov(data = scr_cpic, carapace ~ site)
cpic_size_summary <- summary(cpic_size_site)
cpic_size_summary
```

```
##              Df Sum Sq Mean Sq F value   Pr(>F)
## site         13  12388   953.0   3.501 2.48e-05 ***
## Residuals   793 215864   272.2
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
cpic_posthoc <- TukeyHSD(cpic_size_site, 'site', conf.level = 0.95)
cpic_posthoc
```

```
##   Tukey multiple comparisons of means
##     95% family-wise confidence level
##
## Fit: aov(formula = carapace ~ site, data = scr_cpic)
##
## $site
##            diff         lwr        upr     p adj
## C-A  -0.4897959 -13.1051631 12.1255713 1.0000000
## D-A  -7.9897959 -21.8187134  5.8391215 0.8016856
## E-A   7.5102041  -3.7034556 18.7238638 0.5904317
## F-A  -1.1471386 -10.3350113  8.0407342 1.0000000
## G-A  -0.6590267 -11.1599654  9.8419120 1.0000000
## H-A   1.8435374 -31.1685830 34.8556578 1.0000000
## I-A   2.2244898 -14.5959998 19.0449794 1.0000000
## J-A  -9.4487000 -19.6993372  0.8019371 0.1075190
## K-A  -8.4897959 -20.7737447  3.7941528 0.5366938
## L-A  -5.0612245 -18.2104061  8.0879571 0.9909938
```

```
## M-A  -4.1874703 -14.1220623  5.7471216 0.9797405
## N-A  -1.4397959 -11.1186849  8.2390931 0.9999998
## O-A  -3.6784752 -13.2668564  5.9099060 0.9912649
## D-C  -7.5000000 -22.4880046  7.4880046 0.9214587
## E-C   8.0000000  -4.6153672 20.6153672 0.6778772
## F-C  -0.6573427 -11.5117579 10.1970726 1.0000000
## G-C  -0.1692308 -12.1555162 11.8170547 1.0000000
## H-C   2.3333333 -31.1808639 35.8475306 1.0000000
## I-C   2.7142857 -15.0713881 20.4999596 0.9999997
## J-C  -8.9589041 -20.7265244  2.8087162 0.3674151
## K-C  -8.0000000 -21.5755929  5.5755929 0.7784524
## L-C  -4.5714286 -18.9346560  9.7917988 0.9986059
## M-C  -3.6976744 -15.1910396  7.7956907 0.9984421
## N-C  -0.9500000 -12.2230749 10.3230749 1.0000000
## O-C  -3.1886792 -14.3841417  8.0067832 0.9995699
## E-D  15.5000000   1.6710825 29.3289175 0.0126893
## F-D   6.8426573  -5.4011084 19.0864231 0.8369226
## G-D   7.3307692  -5.9267761 20.5883145 0.8471966
## H-D   9.8333333 -24.1562663 43.8229330 0.9994909
## I-D  10.2142857  -8.4517707 28.8803422 0.8567986
## J-D  -1.4589041 -14.5190862 11.6012780 1.0000000
## K-D  -0.5000000 -15.2101391 14.2101391 1.0000000
## L-D   2.9285714 -12.5114341 18.3685769 0.9999960
## M-D   3.8023256  -9.0112965 16.6159477 0.9993318
## N-D   6.5500000  -6.0664054 19.1664054 0.8984742
## O-D   4.3113208  -8.2357844 16.8584259 0.9969695
## F-E  -8.6573427 -17.8452154  0.5305301 0.0888557
## G-E  -8.1692308 -18.6701695  2.3317079 0.3309758
## H-E  -5.6666667 -38.6787870 27.3454537 0.9999988
## I-E  -5.2857143 -22.1062039 11.5347753 0.9987784
## J-E -16.9589041 -27.2095413 -6.7082670 0.0000032
## K-E -16.0000000 -28.2839488 -3.7160512 0.0011031
## L-E -12.5714286 -25.7206101  0.5777530 0.0778323
## M-E -11.6976744 -21.6322664 -1.7630825 0.0062083
## N-E  -8.9500000 -18.6288890  0.7288890 0.1046776
## O-E -11.1886792 -20.7770605 -1.6002980 0.0071180
## G-F   0.4881119  -7.8149330  8.7911568 1.0000000
## H-F   2.9906760 -29.3894249 35.3707769 1.0000000
## I-F   3.3716284 -12.1718497 18.9151065 0.9999802
## J-F  -8.3015615 -16.2856959 -0.3174270 0.0326259
## K-F  -7.3426573 -17.8100466  3.1247319 0.5107535
## L-F  -3.9140859 -15.3845618  7.5563900 0.9971720
## M-F  -3.0403318 -10.6144296  4.5337661 0.9868039
## N-F  -0.2926573  -7.5281071  6.9427924 1.0000000
## O-F  -2.5313366  -9.6452592  4.5825860 0.9957271
## H-G   2.5025641 -30.2743125 35.2794407 1.0000000
## I-G   2.8835165 -13.4704561 19.2374891 0.9999983
## J-G  -8.7896733 -18.2553540  0.6760074 0.1009924
## K-G  -7.8307692 -19.4677339  3.8061954 0.5824485
## L-G  -4.4021978 -16.9490908  8.1446952 0.9962758
## M-G  -3.5284436 -12.6509250  5.5940377 0.9905803
## N-G  -0.7807692  -9.6240967  8.0625583 1.0000000
## O-G  -3.0194485 -11.7636239  5.7247269 0.9968176
## I-H   0.3809524 -34.9316912 35.6935960 1.0000000
```

```
## J-H -11.2922374 -43.9897831 21.4053082 0.9968135
## K-H -10.3333333 -43.7241902 23.0575236 0.9989588
## L-H  -6.9047619 -40.6235238 26.8140000 0.9999900
## M-H  -6.0310078 -38.6308551 26.5688396 0.9999970
## N-H  -3.2833333 -35.8061687 29.2395020 1.0000000
## O-H  -5.5220126 -38.0180274 26.9740023 0.9999989
## J-I -11.6731898 -27.8675798  4.5212002 0.4628653
## K-I -10.7142857 -28.2664395  6.8378681 0.7328724
## L-I  -7.2857143 -25.4539195 10.8824910 0.9869204
## M-I  -6.4119601 -22.4081729  9.5842526 0.9869707
## N-I  -3.6642857 -19.5029598 12.1743884 0.9999582
## O-I  -5.9029650 -21.6864931  9.8805632 0.9931145
## K-J   0.9589041 -10.4527038 12.3705120 1.0000000
## L-J   4.3874755  -7.9506918 16.7256429 0.9957536
## M-J   5.2612297  -3.5719756 14.0944349 0.7651946
## N-J   8.0089041  -0.5357018 16.5535100 0.0931071
## O-J   5.7702249  -2.6717211 14.2121708 0.5558250
## L-K   3.4285714 -10.6444598 17.5016027 0.9999243
## M-K   4.3023256  -6.8262570 15.4309082 0.9906215
## N-K   7.0500000  -3.8509231 17.9509231 0.6474517
## O-K   4.8113208  -6.0093210 15.6319625 0.9682783
## M-L   0.8737542 -11.2031216 12.9506300 1.0000000
## N-L   3.6214286  -8.2459934 15.4888505 0.9991014
## O-L   1.3827493 -10.4109721 13.1764708 1.0000000
## N-M   2.7476744  -5.4150975 10.9104463 0.9975327
## O-M   0.5089952  -7.5462520  8.5642424 1.0000000
## O-N  -2.2386792  -9.9763651  5.4990066 0.9994906
```

```
sodo_size_site <- aov(data = scr_sodo, carapace ~ site)
sodo_size_summary <- summary(sodo_size_site)
sodo_size_summary
```

```
##             Df Sum Sq Mean Sq F value   Pr(>F)
## site         9   4691   521.2   7.192 2.42e-07 ***
## Residuals   71   5145    72.5
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
sodo_posthoc <- TukeyHSD(sodo_size_site, 'site', conf.level = 0.95)
sodo_posthoc
```

```
##   Tukey multiple comparisons of means
##     95% family-wise confidence level
##
## Fit: aov(formula = carapace ~ site, data = scr_sodo)
##
## $site
##             diff         lwr         upr     p adj
## D-A   3.83333333 -21.5494822  29.2161489 0.9999693
## E-A   2.33333333 -14.7797574  19.4464241 0.9999872
## F-A  20.33333333  -2.3697471  43.0364137 0.1177549
## G-A  -5.16666667 -26.4034538  16.0701205 0.9984592
## J-A  -9.81666667 -27.0321298   7.3987964 0.6934259
## K-A -37.66666667 -69.7736709  -5.5596624 0.0095934
## M-A  -6.16666667 -27.4034538  15.0701205 0.9941145
```

```
## N-A  -2.12121212 -20.2320050  15.9895808 0.9999966
## O-A  -6.21212121 -24.3229141  11.8986717 0.9809529
## E-D  -1.50000000 -22.0357089  19.0357089 0.9999999
## F-D  16.50000000  -8.8828156  41.8828156 0.5178953
## G-D  -9.00000000 -33.0802532  15.0802532 0.9665263
## J-D -13.65000000 -34.2710968   6.9710968 0.4916918
## K-D -41.50000000 -75.5546206  -7.4453794 0.0059748
## M-D -10.00000000 -34.0802532  14.0802532 0.9361147
## N-D  -5.95454545 -27.3287890  15.4196980 0.9956677
## O-D -10.04545455 -31.4196980  11.3287890 0.8732548
## F-E  18.00000000   0.8869092  35.1130908 0.0313600
## G-E  -7.50000000 -22.6138725   7.6138725 0.8335155
## J-E -12.15000000 -20.7407034  -3.5592966 0.0006688
## K-E -40.00000000 -68.4304016 -11.5695984 0.0007292
## M-E  -8.50000000 -23.6138725   6.6138725 0.7097918
## N-E  -4.45454545 -14.7223999   5.8133090 0.9178285
## O-E  -8.54545455 -18.8133090   1.7223999 0.1864370
## G-F -25.50000000 -46.7367871  -4.2632129 0.0072107
## J-F -30.15000000 -47.3654631 -12.9345369 0.0000101
## K-F -58.00000000 -90.1070042 -25.8929958 0.0000049
## M-F -26.50000000 -47.7367871  -5.2632129 0.0043743
## N-F -22.45454545 -40.5653384  -4.3437525 0.0047667
## O-F -26.54545455 -44.6562475  -8.4346616 0.0003634
## J-G  -4.65000000 -19.8796893  10.5796893 0.9915308
## K-G -32.50000000 -63.5874732  -1.4125268 0.0332617
## M-G  -1.00000000 -20.6614444  18.6614444 1.0000000
## N-G   3.04545455 -13.1894488  19.2803579 0.9998100
## O-G  -1.04545455 -17.2803579  15.1894488 1.0000000
## K-J -27.85000000 -56.3421398   0.6421398 0.0607473
## M-J   3.65000000 -11.5796893  18.8796893 0.9986297
## N-J   7.69545455  -2.7421280  18.1330371 0.3368572
## O-J   3.60454545  -6.8330371  14.0421280 0.9800621
## M-K  31.50000000   0.4125268  62.5874732 0.0444793
## N-K  35.54545455   6.5035765  64.5873326 0.0056481
## O-K  31.45454545   2.4126674  60.4964235 0.0233899
## N-M   4.04545455 -12.1894488  20.2803579 0.9981442
## O-M  -0.04545455 -16.2803579  16.1894488 1.0000000
## O-N  -4.09090909 -15.9472062   7.7653880 0.9801790
```

```
cser_size_site <- aov(data = scr_cser, carapace ~ site)
cser_size_summary <- summary(cser_size_site)
cser_size_summary
```

```
##             Df Sum Sq Mean Sq F value  Pr(>F)
## site        11 103331    9394   3.359 0.00111 **
## Residuals   62 173382    2796
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
cser_posthoc <- TukeyHSD(cser_size_site, 'site', conf.level = 0.95)
cser_posthoc
```

```
##   Tukey multiple comparisons of means
##     95% family-wise confidence level
##
```

```
## Fit: aov(formula = carapace ~ site, data = scr_cser)
##
## $site
##              diff         lwr       upr     p adj
## C-A  -83.2857143 -179.272606  12.70118 0.1504182
## D-A  -23.1904762 -147.109021 100.72807 0.9999613
## E-A  -33.7738095 -119.178773  51.63115 0.9696784
## F-A  -28.5238095 -119.021119  61.97350 0.9949229
## G-A    5.9761905  -93.930134 105.88252 1.0000000
## J-A  -31.1428571 -127.129749  64.84403 0.9935282
## K-A   -0.8571429 -144.837481 143.12320 1.0000000
## L-A -204.8571429 -396.830927 -12.88336 0.0266410
## M-A    1.2678571  -91.671051  94.20677 1.0000000
## N-A   21.3095238  -78.596801 121.21585 0.9998586
## O-A   31.6428571  -68.263468 131.54918 0.9947104
## D-C   60.0952381  -63.823307 184.01378 0.8843423
## E-C   49.5119048  -35.893058 134.91687 0.7118484
## F-C   54.7619048  -35.735405 145.25921 0.6551893
## G-C   89.2619048  -10.644420 189.16823 0.1233471
## J-C   52.1428571  -43.844035 148.12975 0.7870125
## K-C   82.4285714  -61.551767 226.40891 0.7274201
## L-C -121.5714286 -313.545213  70.40236 0.5900441
## M-C   84.5535714   -8.385337 177.49248 0.1083244
## N-C  104.5952381    4.688913 204.50156 0.0323373
## O-C  114.9285714   15.022247 214.83490 0.0115394
## E-D  -10.5833333 -126.498518 105.33185 1.0000000
## F-D   -5.3333333 -125.050021 114.38335 1.0000000
## G-D   29.1666667  -97.812056 156.14539 0.9997108
## J-D   -7.9523810 -131.870926 115.96616 1.0000000
## K-D   22.3333333 -141.595493 186.26216 0.9999985
## L-D -181.6666667 -389.022053  25.68872 0.1410933
## M-D   24.4583333  -97.114538 146.03120 0.9999204
## N-D   44.5000000  -82.478723 171.47872 0.9878897
## O-D   54.8333333  -72.145389 181.81206 0.9440472
## F-E    5.2500000  -73.935146  84.43515 1.0000000
## G-E   39.7500000  -50.037516 129.53752 0.9340836
## J-E    2.6309524  -82.774011  88.03592 1.0000000
## K-E   32.9166667 -104.236029 170.06936 0.9995611
## L-E -171.0833333 -357.990952  15.82429 0.1035597
## M-E   35.0416667  -46.922746 117.00608 0.9476851
## N-E   55.0833333  -34.704183 144.87085 0.6360099
## O-E   65.4166667  -24.370849 155.20418 0.3750262
## G-F   34.5000000  -60.144352 129.14435 0.9835198
## J-F   -2.6190476  -93.116357  87.87826 1.0000000
## K-F   27.6666667 -112.713593 168.04693 0.9999351
## L-F -176.3333333 -365.622037  12.95537 0.0906350
## M-F   29.7916667  -57.466114 117.04945 0.9901724
## N-F   49.8333333  -44.811019 144.47769 0.8180756
## O-F   60.1666667  -34.477685 154.81102 0.5843362
## J-G  -37.1190476 -137.025372  62.78728 0.9809262
## K-G   -6.8333333 -153.455733 139.78907 1.0000000
## L-G -210.8333333 -404.796536 -16.87013 0.0219353
## M-G   -4.7083333 -101.689935  92.27327 1.0000000
## N-G   15.3333333  -88.344360 119.01103 0.9999965
```

```
## O-G   25.6666667  -78.011026 129.34436 0.9994125
## K-J   30.2857143 -113.694624 174.26605 0.9998766
## L-J -173.7142857 -365.688070  18.25950 0.1126614
## M-J   32.4107143  -60.528194 125.34962 0.9883542
## N-J   52.4523810  -47.453944 152.35871 0.8207793
## O-J   62.7857143  -37.120610 162.69204 0.6013066
## L-K -204.0000000 -423.933599  15.93360 0.0936944
## M-K    2.1250000 -139.841528 144.09153 1.0000000
## N-K   22.1666667 -124.455733 168.78907 0.9999956
## O-K   32.5000000 -114.122399 179.12240 0.9997946
## M-L  206.1250000   15.656916 396.59308 0.0229913
## N-L  226.1666667   32.203464 420.12987 0.0097975
## O-L  236.5000000   42.536797 430.46320 0.0055416
## N-M   20.0416667  -76.939935 117.02327 0.9998963
## O-M   30.3750000  -66.606601 127.35660 0.9951873
## O-N   10.3333333  -93.344360 114.01103 0.9999999
```

```
prub_size_site <- aov(data = scr_prub, carapace ~ site)
prub_size_summary <- summary(prub_size_site)
prub_size_summary
```

```
##              Df Sum Sq Mean Sq F value Pr(>F)
## site          6  33591    5599   2.555  0.023 *
## Residuals   121 265165    2191
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
prub_posthoc <- TukeyHSD(prub_size_site, 'site', conf.level = 0.95)
prub_posthoc
```

```
##   Tukey multiple comparisons of means
##     95% family-wise confidence level
##
## Fit: aov(formula = carapace ~ site, data = scr_prub)
##
## $site
##           diff         lwr       upr     p adj
## F-E   0.500000  -71.987011  72.98701 1.0000000
## G-E -19.275000  -80.728853  42.17885 0.9651236
## J-E  -3.066667  -65.842259  59.70893 0.9999991
## M-E  37.000000 -114.617460 188.61746 0.9903388
## N-E  19.588235  -42.568863  81.74533 0.9643062
## O-E  24.000000  -54.094933 102.09493 0.9684476
## G-F -19.775000  -69.403464  29.85346 0.8948983
## J-F  -3.566667  -54.822723  47.68939 0.9999928
## M-F  36.500000 -110.721814 183.72181 0.9894944
## N-F  19.088235  -31.408430  69.58490 0.9164997
## O-F  23.500000  -45.675334  92.67533 0.9488171
## J-G  16.208333  -17.694361  50.11103 0.7825751
## M-G  56.275000  -85.839292 198.38929 0.8976780
## N-G  38.863235    6.119952  71.60652 0.0093627
## O-G  43.275000  -14.235314 100.78531 0.2740359
## M-J  40.066667 -102.624156 182.75749 0.9799387
## N-J  22.654902  -12.506463  57.81627 0.4634788
## O-J  27.066667  -31.853917  85.98725 0.8127357
```

```
## N-M -17.411765 -159.831570 125.00804 0.9998013
## O-M -13.000000 -163.062368 137.06237 0.9999737
## O-N   4.411765  -53.849415  62.67294 0.9999881
```

```
cpic_leeches_site <- aov(data = scr_cpic, leeches ~ site)
cpic_leeches_summary <- summary(cpic_leeches_site)
cpic_leeches_summary
```

```
##              Df Sum Sq Mean Sq F value  Pr(>F)
## site         13    281  21.640   2.258 0.00653 **
## Residuals   755   7236   9.584
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## 38 observations deleted due to missingness
```

```
cpic_leeches_posthoc <- TukeyHSD(cpic_leeches_site, 'site', conf.level = 0.95)
cpic_leeches_posthoc
```

```
##   Tukey multiple comparisons of means
##     95% family-wise confidence level
##
## Fit: aov(formula = leeches ~ site, data = scr_cpic)
##
## $site
##              diff        lwr         upr     p adj
## C-A  1.176020408 -1.1914412  3.54348197 0.9253700
## D-A  0.717687075 -1.8775153  3.31288942 0.9996870
## E-A  2.402084238  0.2754044  4.52876403 0.0114176
## F-A  0.292955892 -1.4646748  2.05058657 0.9999992
## G-A  1.185941043 -0.7981160  3.16999808 0.7604547
## H-A  0.884353741 -5.3108624  7.07956985 0.9999999
## I-A  1.765306122 -1.3913093  4.92192154 0.8360719
## J-A  0.724933452 -1.2210174  2.67088434 0.9933476
## K-A  1.351020408 -0.9542456  3.65628637 0.7848731
## L-A  1.625094482 -0.8714559  4.12164484 0.6368997
## M-A  1.270532603 -0.6102740  3.15133919 0.5756668
## N-A  0.529743812 -1.3056088  2.36509640 0.9995019
## O-A  0.400077012 -1.3993255  2.19947957 0.9999735
## D-C -0.458333333 -3.2710557  2.35438899 0.9999994
## E-C  1.226063830 -1.1612147  3.61334231 0.9055813
## F-C -0.883064516 -2.9483968  1.18226772 0.9770646
## G-C  0.009920635 -2.2512326  2.27107387 1.0000000
## H-C -0.291666667 -6.5811050  5.99777165 1.0000000
## I-C  0.589285714 -2.7484609  3.92703234 0.9999983
## J-C -0.451086957 -2.6788788  1.77670488 0.9999912
## K-C  0.175000000 -2.3726622  2.72266222 1.0000000
## L-C  0.449074074 -2.2728913  3.17103941 0.9999993
## M-C  0.094512195 -2.0766085  2.26563289 1.0000000
## N-C -0.646276596 -2.7781422  1.48558896 0.9991592
## O-C -0.775943396 -2.8769387  1.32505189 0.9938718
## E-D  1.684397163 -0.9288957  4.29769002 0.6525313
## F-D -0.424731183 -2.7476169  1.89815457 0.9999974
## G-D  0.468253968 -2.0303486  2.96685657 0.9999965
## H-D  0.166666667 -6.2119880  6.54532133 1.0000000
## I-D  1.047619048 -2.4553445  4.55058258 0.9992717
```

```
## J-D  0.007246377 -2.4612061  2.47569882 1.0000000
## K-D  0.633333333 -2.1272434  3.39391004 0.9999619
## L-D  0.907407407 -2.0148000  3.82961484 0.9989179
## M-D  0.552845528 -1.8645841  2.97027516 0.9999633
## N-D -0.187943262 -2.5701800  2.19429345 1.0000000
## O-D -0.317610063 -2.6722612  2.03704111 0.9999999
## F-E -2.109128346 -3.8933621 -0.32489464 0.0058529
## G-E -1.216143195 -3.2238052  0.79151879 0.7430285
## H-E -1.517730496 -7.7205466  4.68508556 0.9999202
## I-E -0.636778116 -3.8082833  2.53472708 0.9999920
## J-E -1.677150786 -3.6471633  0.29286169 0.1955965
## K-E -1.051063830 -3.3766767  1.27454909 0.9637241
## L-E -0.776989756 -3.2923402  1.73836072 0.9989756
## M-E -1.131551635 -3.0372425  0.77413925 0.7688696
## N-E -1.872340426 -3.7331852 -0.01149561 0.0468682
## O-E -2.002007226 -3.8274041 -0.17661032 0.0169775
## G-F  0.892985151 -0.7185996  2.50456988 0.8450367
## H-F  0.591397849 -5.4947689  6.67756460 1.0000000
## I-F  1.472350230 -1.4644752  4.40917571 0.9202748
## J-F  0.431977560 -1.1324546  1.99640968 0.9996922
## K-F  1.058064516 -0.9356692  3.05179823 0.8822458
## L-F  1.332138590 -0.8799841  3.54426125 0.7508135
## M-F  0.977576711 -0.5050414  2.46019481 0.6160782
## N-F  0.236787920 -1.1877268  1.66130262 0.9999992
## O-F  0.107121120 -1.2707659  1.48500811 1.0000000
## H-G -0.301587302 -6.4569624  5.85378778 1.0000000
## I-G  0.579365079 -2.4983225  3.65705262 0.9999963
## J-G -0.461007591 -2.2761287  1.35411349 0.9998783
## K-G  0.165079365 -2.0308694  2.36102810 1.0000000
## L-G  0.439153439 -1.9568231  2.83512994 0.9999973
## M-G  0.084591560 -1.6605082  1.82969131 1.0000000
## N-G -0.656197231 -2.3522099  1.03981540 0.9905306
## O-G -0.785864031 -2.4429064  0.87117829 0.9470834
## I-H  0.880952381 -5.7459912  7.50789594 0.9999999
## J-H -0.159420290 -6.3026186  5.98377797 1.0000000
## K-H  0.466666667 -5.7996250  6.73295833 1.0000000
## L-H  0.740740741 -5.5984172  7.07989871 1.0000000
## M-H  0.386178862 -5.7366957  6.50905347 1.0000000
## N-H -0.354609929 -6.4636753  5.75445540 1.0000000
## O-H -0.484276730 -6.5826380  5.61408449 1.0000000
## J-I -1.040372671 -4.0936337  2.01288839 0.9972046
## K-I -0.414285714 -3.7082088  2.87963739 1.0000000
## L-I -0.140211640 -3.5707279  3.29030464 1.0000000
## M-I -0.494773519 -3.5069342  2.51738712 0.9999993
## N-I -1.235562310 -4.2195525  1.74842787 0.9825992
## O-I -1.365229111 -4.3272433  1.59678504 0.9575886
## K-J  0.626086957 -1.5354943  2.78766818 0.9994828
## L-J  0.900161031 -1.4643571  3.26467914 0.9918481
## M-J  0.545599152 -1.1560517  2.24725002 0.9984914
## N-J -0.195189639 -1.8464623  1.45608301 1.0000000
## O-J -0.324856440 -1.9360770  1.28636415 0.9999916
## L-K  0.274074074 -2.3939724  2.94212059 1.0000000
## M-K -0.080487805 -2.1836145  2.02263890 1.0000000
## N-K -0.821276596 -2.8838545  1.24130132 0.9876998
```

```
## O-K -0.950943396 -2.9815980  1.07971120 0.9519867
## M-L -0.354561879 -2.6657638  1.95664008 0.9999997
## N-L -1.095350670 -3.3697166  1.17901522 0.9405577
## O-L -1.225017470 -3.4704730  1.02043808 0.8593272
## N-M -0.740788791 -2.3147678  0.83319022 0.9500928
## O-M -0.870455591 -2.4023630  0.66145184 0.8197377
## O-N -0.129666800 -1.6054127  1.34607913 1.0000000
```

```
sodo_leeches_site <- aov(data = scr_sodo, leeches ~ site)
sodo_leeches_summary <- summary(sodo_leeches_site)
sodo_leeches_summary
```

```
##             Df Sum Sq Mean Sq F value   Pr(>F)
## site         9   4113   457.0   6.756 7.85e-07 ***
## Residuals   67   4532    67.6
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## 4 observations deleted due to missingness
```

```
sodo_leeches_posthoc <- TukeyHSD(sodo_leeches_site, 'site', conf.level = 0.95)
sodo_leeches_posthoc
```

```
##   Tukey multiple comparisons of means
##     95% family-wise confidence level
##
## Fit: aov(formula = leeches ~ site, data = scr_sodo)
##
## $site
##            diff        lwr         upr     p adj
## D-A  13.0000000 -11.570826 37.57082618 0.7737077
## E-A   7.2272727  -9.338375 23.79292036 0.9140177
## F-A  -0.3333333 -22.310148 21.64348170 1.0000000
## G-A   4.0000000 -17.976815 25.97681504 0.9998482
## J-A  -8.8235294 -25.678977  8.03191829 0.7841631
## K-A  -8.0000000 -39.079910 23.07990988 0.9975627
## M-A  -7.5000000 -28.057428 13.05742808 0.9708446
## N-A  -6.8181818 -24.349615 10.71325175 0.9563120
## O-A  -8.4545455 -25.985979  9.07688812 0.8537644
## E-D  -5.7727273 -25.651504 14.10604988 0.9939859
## F-D -13.3333333 -37.904160 11.23749284 0.7475199
## G-D  -9.0000000 -33.570826 15.57082618 0.9700842
## J-D -21.8235294 -41.944444 -1.70261450 0.0231503
## K-D -21.0000000 -53.965223 11.96522256 0.5444160
## M-D -20.5000000 -43.809932  2.80993241 0.1325035
## N-D -19.8181818 -40.508669  0.87230544 0.0715467
## O-D -21.4545455 -42.145033 -0.76405820 0.0360163
## F-E  -7.5606061 -24.126254  9.00504157 0.8900077
## G-E  -3.2272727 -19.792920 13.33837490 0.9997338
## J-E -16.0508021 -24.742545 -7.35905897 0.0000032
## K-E -15.2272727 -42.748194 12.29364805 0.7261865
## M-E -14.7272727 -29.357657 -0.09688888 0.0471881
## N-E -14.0454545 -23.984843 -4.10606597 0.0007036
## O-E -15.6818182 -25.621207 -5.74242960 0.0000982
## G-F   4.3333333 -17.643482 26.31014837 0.9997062
## J-F  -8.4901961 -25.345644  8.36525162 0.8192468
```

```
## K-F  -7.6666667 -38.746577 23.41324322 0.9982439
## M-F  -7.1666667 -27.724095 13.39076141 0.9783713
## N-F  -6.4848485 -24.016282 11.04658509 0.9681360
## O-F  -8.1212121 -25.652646  9.41022145 0.8810106
## J-G -12.8235294 -29.678977  4.03191829 0.2928332
## K-G -12.0000000 -43.079910 19.07990988 0.9582319
## M-G -11.5000000 -32.057428  9.05742808 0.7136701
## N-G -10.8181818 -28.349615  6.71325175 0.5888628
## O-G -12.4545455 -29.985979  5.07688812 0.3872902
## K-J   0.8235294 -26.872797 28.51985618 1.0000000
## M-J   1.3235294 -13.634197 16.28125542 0.9999997
## N-J   2.0053476  -8.409876 12.42057112 0.9997583
## O-J   0.3689840 -10.046240 10.78420748 1.0000000
## M-K   0.5000000 -29.592993 30.59299334 1.0000000
## N-K   1.1818182 -26.931018 29.29465444 1.0000000
## O-K  -0.4545455 -28.567382 27.65829080 1.0000000
## N-M   0.6818182 -15.033735 16.39737141 1.0000000
## O-M  -0.9545455 -16.670099 14.76100777 1.0000000
## O-N  -1.6363636 -13.113381  9.84065370 0.9999807
```

```
cser_leeches_site <- aov(data = scr_cser, leeches ~ site)
cser_leeches_summary <- summary(cser_leeches_site)
cser_leeches_summary
```

```
##             Df Sum Sq Mean Sq F value Pr(>F)
## site        11   2100   190.9   1.293  0.252
## Residuals   58   8567   147.7
## 4 observations deleted due to missingness
```

```
cser_leeches_posthoc <- TukeyHSD(cser_leeches_site, 'site', conf.level = 0.95)
cser_leeches_posthoc
```

```
##   Tukey multiple comparisons of means
##     95% family-wise confidence level
##
## Fit: aov(formula = leeches ~ site, data = scr_cser)
##
## $site
##              diff        lwr       upr     p adj
## C-A  1.909524e+01  -3.926099 42.116575 0.1973344
## D-A  1.200000e+01 -17.259609 41.259609 0.9596522
## E-A  8.000000e+00 -12.689668 28.689668 0.9735354
## F-A  8.952381e+00 -14.068956 31.973718 0.9724088
## G-A  5.500000e+00 -18.390370 29.390370 0.9996915
## J-A  5.500000e+00 -18.390370 29.390370 0.9996915
## K-A  2.166667e+00 -31.619419 35.952752 1.0000000
## L-A -1.333333e+00 -46.028124 43.361457 1.0000000
## M-A -2.083333e-01 -22.555728 22.139062 1.0000000
## N-A  5.833333e+00 -18.057037 29.723704 0.9994618
## O-A  2.333333e+00 -21.557037 26.223704 1.0000000
## D-C -7.095238e+00 -35.649692 21.459216 0.9993662
## E-C -1.109524e+01 -30.775037  8.584561 0.7423930
## F-C -1.014286e+01 -32.261042 11.975328 0.9156996
## G-C -1.359524e+01 -36.616575  9.426099 0.6844811
## J-C -1.359524e+01 -36.616575  9.426099 0.6844811
```

```
## K-C -1.692857e+01 -50.105849 16.248706 0.8433328
## L-C -2.042857e+01 -64.664941 23.807799 0.9119626
## M-C -1.930357e+01 -40.719412  2.112269 0.1152982
## N-C -1.326190e+01 -36.283242  9.759432 0.7162917
## O-C -1.676190e+01 -39.783242  6.259432 0.3732181
## E-D -4.000000e+00 -30.710246 22.710246 0.9999958
## F-D -3.047619e+00 -31.602073 25.506835 0.9999999
## G-D -6.500000e+00 -35.759609 22.759609 0.9997809
## J-D -6.500000e+00 -35.759609 22.759609 0.9997809
## K-D -9.833333e+00 -47.607326 27.940659 0.9990253
## L-D -1.333333e+01 -61.114074 34.447407 0.9981723
## M-D -1.220833e+01 -40.222276 15.805609 0.9391237
## N-D -6.166667e+00 -35.426275 23.092942 0.9998685
## O-D -9.666667e+00 -38.926275 19.592942 0.9922251
## F-E  9.523810e-01 -18.727418 20.632180 1.0000000
## G-E -2.500000e+00 -23.189668 18.189668 0.9999996
## J-E -2.500000e+00 -23.189668 18.189668 0.9999996
## K-E -5.833333e+00 -37.437323 25.770656 0.9999647
## L-E -9.333333e+00 -52.402311 33.735644 0.9998276
## M-E -8.208333e+00 -27.095329 10.678663 0.9402111
## N-E -2.166667e+00 -22.856334 18.523001 0.9999999
## O-E -5.666667e+00 -26.356334 15.023001 0.9984538
## G-F -3.452381e+00 -26.473718 19.568956 0.9999958
## J-F -3.452381e+00 -26.473718 19.568956 0.9999958
## K-F -6.785714e+00 -39.962992 26.391563 0.9999020
## L-F -1.028571e+01 -54.522084 33.950656 0.9996609
## M-F -9.160714e+00 -30.576555 12.255126 0.9461972
## N-F -3.119048e+00 -26.140384 19.902289 0.9999985
## O-F -6.619048e+00 -29.640384 16.402289 0.9976178
## J-G  9.769963e-15 -23.890370 23.890370 1.0000000
## K-G -3.333333e+00 -37.119419 30.452752 0.9999999
## L-G -6.833333e+00 -51.528124 37.861457 0.9999948
## M-G -5.708333e+00 -28.055728 16.639062 0.9991812
## N-G  3.333333e-01 -23.557037 24.223704 1.0000000
## O-G -3.166667e+00 -27.057037 20.723704 0.9999988
## K-J -3.333333e+00 -37.119419 30.452752 0.9999999
## L-J -6.833333e+00 -51.528124 37.861457 0.9999948
## M-J -5.708333e+00 -28.055728 16.639062 0.9991812
## N-J  3.333333e-01 -23.557037 24.223704 1.0000000
## O-J -3.166667e+00 -27.057037 20.723704 0.9999988
## L-K -3.500000e+00 -54.179129 47.179129 1.0000000
## M-K -2.375000e+00 -35.088237 30.338237 1.0000000
## N-K  3.666667e+00 -30.119419 37.452752 0.9999999
## O-K  1.666667e-01 -33.619419 33.952752 1.0000000
## M-L  1.125000e+00 -42.764413 45.014413 1.0000000
## N-L  7.166667e+00 -37.528124 51.861457 0.9999915
## O-L  3.666667e+00 -41.028124 48.361457 1.0000000
## N-M  6.041667e+00 -16.305728 28.389062 0.9986248
## O-M  2.541667e+00 -19.805728 24.889062 0.9999998
## O-N -3.500000e+00 -27.390370 20.390370 0.9999967
```

```
prub_leeches_site <- aov(data = scr_prub, leeches ~ site)
prub_leeches_summary <- summary(prub_leeches_site)
prub_leeches_summary
```

```
##              Df Sum Sq Mean Sq F value Pr(>F)
## site          6   99.6   16.60   0.863  0.524
## Residuals   107 2057.5   19.23
## 14 observations deleted due to missingness
```

```
prub_leeches_posthoc <- TukeyHSD(prub_leeches_site, 'site', conf.level = 0.95)
prub_leeches_posthoc
```

```
##   Tukey multiple comparisons of means
##     95% family-wise confidence level
##
## Fit: aov(formula = leeches ~ site, data = scr_prub)
##
## $site
##             diff        lwr       upr     p adj
## F-E -0.91666667  -8.033647  6.200314 0.9997259
## G-E -0.23423423  -6.033995  5.565527 0.9999997
## J-E -0.16666667  -6.095062  5.761729 1.0000000
## M-E -1.66666667 -15.900628 12.567294 0.9998426
## N-E -2.40740741  -8.355146  3.540331 0.8863714
## O-E -1.38095238  -8.712563  5.950658 0.9976068
## G-F  0.68243243  -4.455789  5.820653 0.9996726
## J-F  0.75000000  -4.532988  6.032988 0.9995190
## M-F -0.75000000 -14.727472 13.227472 0.9999984
## N-F -1.49074074  -6.795425  3.813943 0.9795505
## O-F -0.46428571  -7.284594  6.356022 0.9999936
## J-G  0.06756757  -3.233308  3.368443 1.0000000
## M-G -1.43243243 -14.787415 11.922550 0.9999057
## N-G -2.17317317  -5.508663  1.162317 0.4473728
## O-G -1.14671815  -6.578331  4.284895 0.9955044
## M-J -1.50000000 -14.911346 11.911346 0.9998795
## N-J -2.24074074  -5.795194  1.313713 0.4884781
## O-J -1.21428571  -6.783044  4.354473 0.9946378
## N-M -0.74074074 -14.160648 12.679166 0.9999982
## O-M  0.28571429 -13.802253 14.373682 1.0000000
## O-N  1.02645503  -4.562890  6.615800 0.9979226
```

```
leeches_species <- aov(data = scr.data, leeches ~ species)
leeches_species_summary <- summary(leeches_species)
leeches_species_summary
```

```
##               Df Sum Sq Mean Sq F value Pr(>F)
## species        5   6111  1222.2   43.26 <2e-16 ***
## Residuals   1026  28987    28.3
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## 61 observations deleted due to missingness
```

```
##leeches_species_posthoc <- TukeyHSD(leeches_species, 'leeches', conf.level = 0.95)
##NaNs produced
##leeches_species_posthoc
```

```
leeches_size <- aov(data = scr.data, leeches ~ carapace)
leeches_size_summary <- summary(leeches_size)
leeches_size_summary
```

```
##               Df Sum Sq Mean Sq F value   Pr(>F)
## carapace       1    798   798.3   23.97 1.13e-06 ***
## Residuals   1030  34299    33.3
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## 61 observations deleted due to missingness
```

```
cpic_leeches_size <- aov(data = scr_cpic, leeches ~ carapace)
cpic_leeches_size_summary <- summary(cpic_leeches_size)
cpic_leeches_size_summary
```

```
##              Df Sum Sq Mean Sq F value   Pr(>F)
## carapace      1    182  182.14   19.05 1.45e-05 ***
## Residuals   767   7335    9.56
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## 38 observations deleted due to missingness
```

```
##cpic_leeches_size_posthoc <- TukeyHSD(cpic_leeches_size, 'carapace', conf.level = 0.95)
##cpic_leeches_size_posthoc

##sodo_leeches_size <- aov(data = scr_sodo, leeches ~ carapace)
##sodo_leeches_size_summary <- summary(sodo_leeches_size)
##sodo_leeches_size_summary
##sodo_leeches_size_posthoc <- TukeyHSD(sodo_leeches_size, 'carapace', conf.level = 0.95)
##sodo_leeches_size_posthoc

##cser_leeches_size <- aov(data = scr_cser, leeches ~ carapace)
##cser_leeches_size_summary <- summary(cser_leeches_size)
##cser_leeches_size_summary
##cser_leeches_size_posthoc <- TukeyHSD(cser_leeches_size, 'carapace', conf.level = 0.95)
##cser_leeches_size_posthoc

##prub_leeches_size <- aov(data = scr_prub, leeches ~ carapace)
##prub_leeches_size_summary <- summary(prub_leeches_size)
##prub_leeches_size_summary
##prub_leeches_size_posthoc <- TukeyHSD(prub_leeches_size, 'carapace', conf.level = 0.95)
##prub_leeches_size_posthoc
```