Module 3 Project

Name: Parth Sawant

Course name: ALY6000

Due Date: 05/02/2022

Title: Executive summary report 3

Professor: Mohammad Shafiqul Islam

NUID: 002123792

Introduction

This project is based on the different species of fishes, their comparison among each other by finding the cumulative counts and cumulative frequency and presenting them through barplots and pareto chart. Different functions are used like the count and unique. We get to learn how to read a pareto chart and how to use its parameters. Getting to learn how one can add columns to the existing dataset using the mutate function. Using pareto chart we will get to know which specie has the highest frequency and many other factors

A. Provide an analysis of descriptive characteristics of the data set provided by your instructor. This includes pertinent statistics including counts, cumulative counts, and frequency, percentages, etc. Include R console screen shots to support your observations and conclusions.

1] Implementation: -

```
> str(bio)
'data.frame':   676 obs. of  7 variables:
 $ netID  : int  12 12 12 12 12 12 12 13 13 13 ...
 $ fishID : int  16 23 30 44 50 65 66 68 69 70 ...
 $ species: chr  "Bluegill" "Bluegill" "Bluegill" "Bluegill" ...
 $ tl     : int  61 66 70 38 42 54 27 36 59 39 ...
 $ w      : num  2.9 4.5 5.2 0.5 1 2.1 NA 0.5 2 0.5 ...
 $ tag    : chr  "" "" "" "" ...
 $ scale  : logi  FALSE FALSE FALSE FALSE FALSE FALSE ...
>
```

Explanation: -

>> The structure of the dataset bio contains in total 676 rows and 7 columns with unique names like unique netID, fishID, species, total length, weight, tag nature and the scale nature for each fish whether they are sampled or not.

>> There are different data types of each variable as seen like fishID has integer datatype, scale has logical datatype containing only true or false values.

>> There are some missing values as well in the dataset like here we can see in weight of the fish.

2] Implementation: -

```
> headtail(bio)
    netID fishID      species  tl     w  tag scale
1      12     16      Bluegill  61   2.9      FALSE
2      12     23      Bluegill  66   4.5      FALSE
3      12     30      Bluegill  70   5.2      FALSE
674   110    863 Black Crappie 307 415.0 1783  TRUE
675   129    870 Black Crappie 279 344.0 1789  TRUE
676   129    879 Black Crappie 302 397.0 1792  TRUE
```

Explanation: -

>> A total of 6 rows are displayed with headtail function, to show the first 3 and last 3 values of each variable.

>> Sometimes the data frame is too huge to analyze them, so just the first and last 3 rows are enough to get a rough idea about the dataset.

>> By default, the n value for headtail function is 3 which otherwise can be changed.

3] Output: -

```
> counts <- table(bio$species)
> counts

   Black Crappie          Bluegill Bluntnose Minnow     Iowa Darter   Largemouth Bass
              36               220              103              32               228
    Pumpkinseed    Tadpole Madtom     Yellow Perch
              13                 6               38
>
```

Explanation: -

>> using the count() function we are able to know the different number of species in the dataset.

>> There are 8 different types of species Black Crappie, Bluegill, Bluntnose Minnow, Iowa Darter, Largemouth Bass, pumpkinseed, Tadpole Madtom, Yellow Perch.

>> Largemouth Bass has largest number of species with a count of 228 whereas Tadpole Madtom has a count of 6 which is the least among all species.

4] Implementation: -

```
> cSpecPct <- (table(bio$species)*100)/length(bio$species)
> cSpecPct

   Black Crappie          Bluegill Bluntnose Minnow      Iowa Darter  Largemouth Bass
        5.325444          32.544379       15.236686         4.733728        33.727811
     Pumpkinseed    Tadpole Madtom     Yellow Perch
        1.923077          0.887574        5.621302
> |
```

Explanation: -

>> We have calculated the percentage of each species using the total length of species and multiplying it by 100.

>> From the output we can observe that Largemouth Bass has the highest percentage (33.72) of all species followed by Bluegill with 32.54% while Tadpole Madtom occupies 0.8% which is the lowest.

5] Implementation: -

```
> tdesc <- t[order(-t$Freq),]
> tdesc$Freq
[1] 228 220 103  38  36  32  13   6
> d <- d %>% mutate(cumfreq=cumsum(d$RelFreq), counts=tdesc$Freq, cumcounts=cumsum(tdesc$Freq))
> d
            Species   RelFreq   cumfreq counts cumcounts
5  Largemouth Bass 33.727811  33.72781    228       228
2         Bluegill 32.544379  66.27219    220       448
3 Bluntnose Minnow 15.236686  81.50888    103       551
8     Yellow Perch  5.621302  87.13018     38       589
1    Black Crappie  5.325444  92.45562     36       625
4      Iowa Darter  4.733728  97.18935     32       657
6      Pumpkinseed  1.923077  99.11243     13       670
7   Tadpole Madtom  0.887574 100.00000      6       676
> |
```
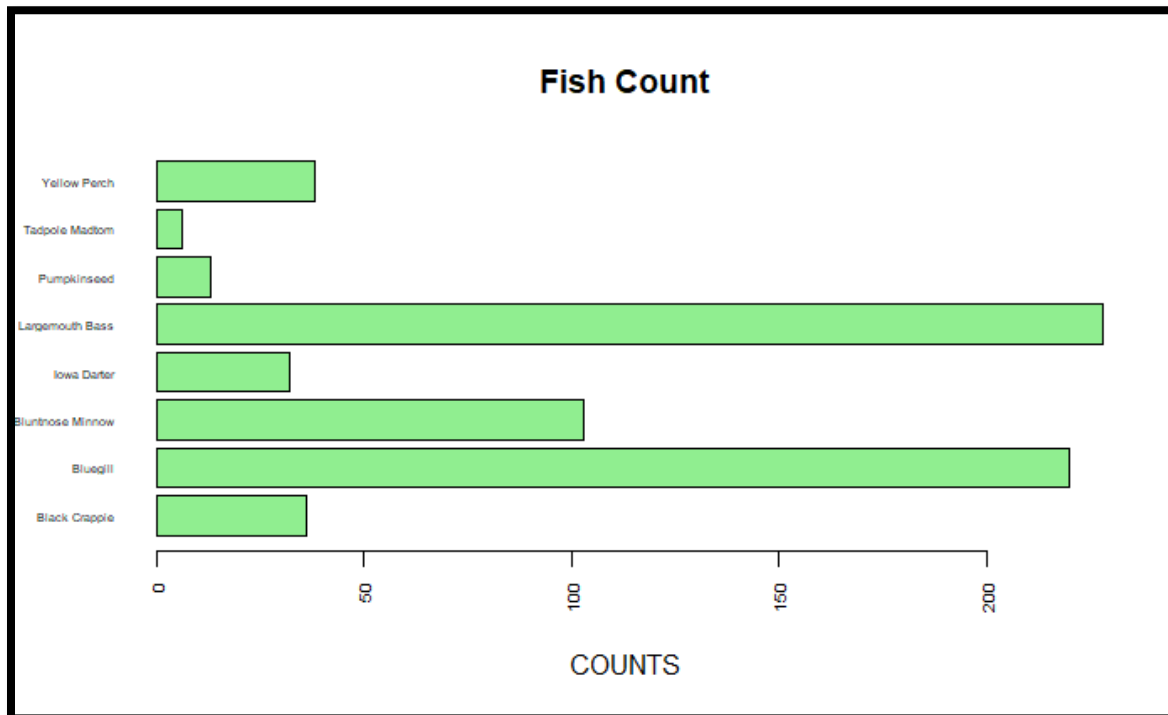
Explanation: -

>> To find cumulative frequency, we have first calculated counts and then cumulative counts for all individual species.

>> <mark>Cumcounts is calculated by adding the counts to the preceding one</mark>. This is how a pareto chart is calculated.

>> We have used the mutate function where we were able to add 3 columns for cumulative counts, cumulative frequency and counts.

B. Provide the executive with visualizations (at least 3) in that help them see the key characteristics you want to highlight. They can be boxplots, histograms, frequency and probability distributions, or barplots (bar charts). A pareto plot as illustrated below must be included in this part of your report. Include screen snippets of your plots to support your findings and conclusions. The goal is not only to present your visual results, but also to explain the significance of them.

Implementation: -

Explanation: -

>> The above graph is for the count of fishes.

>> It can be noticed that Largemouth Bass and bluegill have most count of species as compared to others.

>> Tadpole madtom and pumpkinseed have the least no of species.

>> Though I kept a limit on the axis up to 200, we can see that Both Largemouth Bass and Bluegill have larger count than 200.

Implementation: -
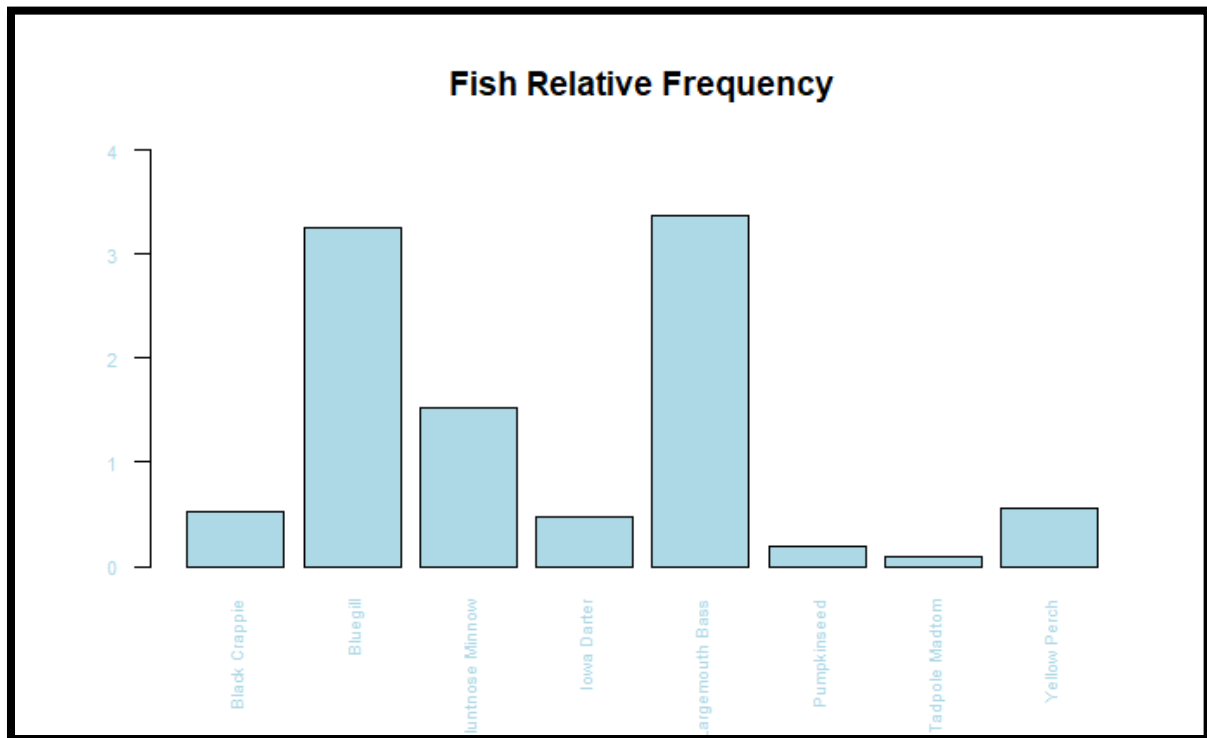
Explanation: -

>> The above graph is for the relative frequency of the fish.

>> From the above barplot it is noticed that Largemouth Bass and Bluegill have high relative frequency which means these species of fishes are to be seen more than other ones.

>> On the other hand, the Tadpole Madtom are the least seen species as they have the lowest relative frequency, followed by Pumpkinseed.

>> We can say that approximately Black Clappie, lowa Darter and Yellow Perch have approximately same frequency that is below 1%.

Implementation: -
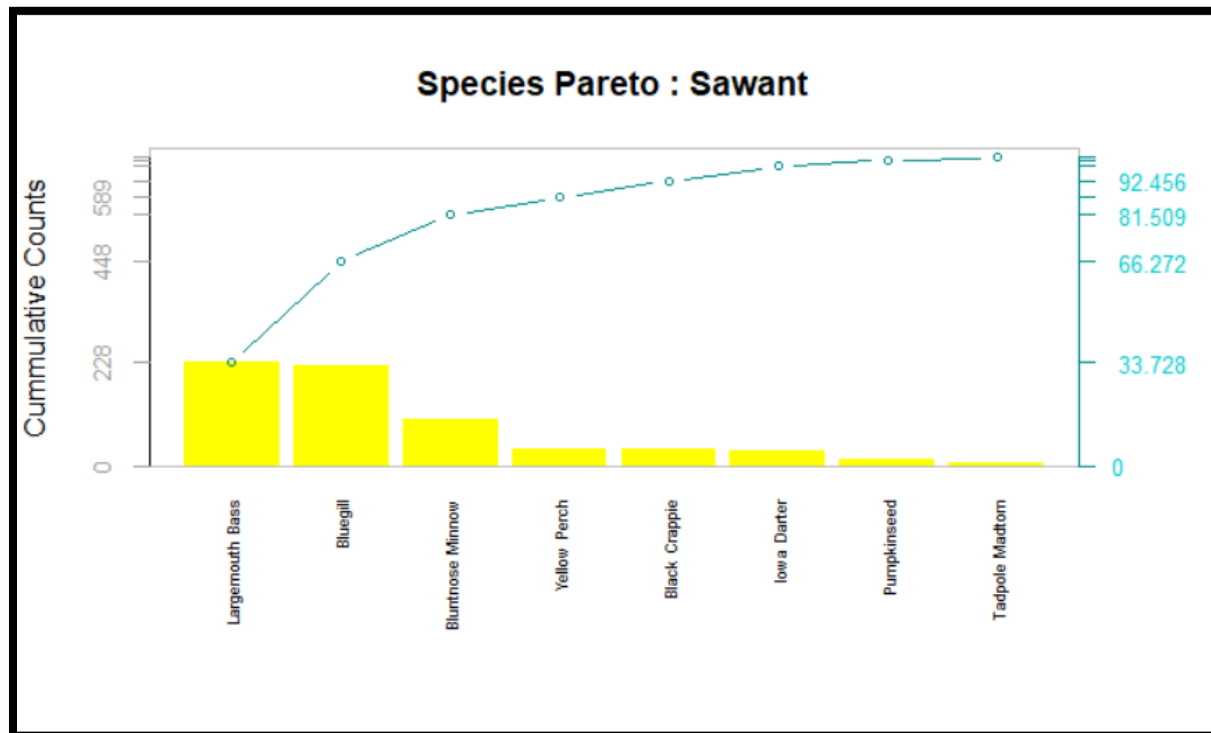
Explanation: -

>> Pareto Chart is a type of chart that contains both bars and a line graph where values are represented in descending order by bars, and cumulative values by blue line as seen in the chart.

>> It is better than pie charts and many other, as it reveals more information.

>> To make a Pareto chart we must first sort data in descending order and then calculate cumulative sum and frequency of the counts.

>> As noticed from the Pareto chart, the cumulative counts are on the left side whereas the frequency is on the other side. Also, the different species are placed on the X axis.

>> It is observed that Largemouth Bass, Bluegill are the ruling species among all.

>> Largemouth Bass constitute 33.72% where as Tadpole Madtom constitutes only nearly 1% of all species.

>> It can be observed that first three species have a majority among all. It can also be noted that since Largemouth Bass, Bluegill have high frequency, they may be feeding on other fishes since their population is high.

C. Finally, provide a clear two to three sentence paragraph summary of the key points that you want the audience to walk away with regarding your analysis. This summary should present accurate analysis and be supported by the data presented in the rest of the report.

The InchBio dataset provides a wide Explanation of different fishes with each fish having unique fishID and specie type. We arranged the data in descending order according to relative frequency of different species. Using the mutate function we calculated the cumulative frequency and cumulative counts needed for pareto chart. With the Pareto we concluded that Largemouth Bass and Bluegill have the highest frequency and are the most dangerous species among all.

Bibliography

[1] Rotating axis labels in R plots (Tender is the byte, May 2021)

Source: https://www.tenderisthebyte.com/blog/2019/04/25/rotating-axis-labels-in-r/

Last Accessed: 04th February,2022

[2] How do I find percentage of R in something. (Stack overflow)

Source: https://stackoverflow.com/questions/42379751/how-do-i-find-the-percentage-of-something-in-r

Last Accessed: 04th February,2022

[3] Pareto Chart with Base R plotting System. (Amazon news)

Source: https://rstudio-pubs-static.s3.amazonaws.com/72023_670962b57f444c04999fd1a0a393e113.html

Last Accessed: 04th February,2022

[4] How to use mutate in R (sharpsightlabs, August 2018)

Source: https://www.sharpsightlabs.com/blog/mutate-in-r/

Last Accessed: 05th February, 2022

My Github repository Link

https://github.com/parthh03/ALY6000_module3.git

module3.R

Parth

2022-02-05

```r
#1. print your name at the top of the script and load these libraries:
FSA, FSAdata, magrittr, dplyr, tidyr plyr and tidyverse

print("Parth Sawant")
```

```
## [1] "Parth Sawant"
```

```r
r=getOption("repos")
r["CRAN"]="http://cran.us.r-project.org"
options(repos=r)

install.packages('FSA')
```

```
## Installing package into 'C:/Users/Parth/OneDrive/Documents/R/win-li
brary/4.1'
## (as 'lib' is unspecified)
```

```
## package 'FSA' successfully unpacked and MD5 sums checked
##
## The downloaded binary packages are in
##   C:\Users\Parth\AppData\Local\Temp\RtmpgPNLyt\downloaded_packages
```

```r
install.packages('FSAdata')
```

```
## Installing package into 'C:/Users/Parth/OneDrive/Documents/R/win-li
brary/4.1'
## (as 'lib' is unspecified)
```

```
## package 'FSAdata' successfully unpacked and MD5 sums checked
##
## The downloaded binary packages are in
##   C:\Users\Parth\AppData\Local\Temp\RtmpgPNLyt\downloaded_packages
```

```r
install.packages('magrittr')
```

```
## Installing package into 'C:/Users/Parth/OneDrive/Documents/R/win-li
brary/4.1'
## (as 'lib' is unspecified)
```

```
## package 'magrittr' successfully unpacked and MD5 sums checked
```

```
## Warning: cannot remove prior installation of package 'magrittr'
```

```
## Warning in file.copy(savedcopy, lib, recursive = TRUE):
## problem copying C:\Users\Parth\OneDrive\Documents\R\win-
## library\4.1\00LOCK\magrittr\libs\x64\magrittr.dll
## to C:\Users\Parth\OneDrive\Documents\R\win-
## library\4.1\magrittr\libs\x64\magrittr.dll: Permission denied

## Warning: restored 'magrittr'

##
## The downloaded binary packages are in
##   C:\Users\Parth\AppData\Local\Temp\RtmpgPNLyt\downloaded_packages

install.packages('dplyr')

## Installing package into 'C:/Users/Parth/OneDrive/Documents/R/win-li
brary/4.1'
## (as 'lib' is unspecified)

## package 'dplyr' successfully unpacked and MD5 sums checked

## Warning: cannot remove prior installation of package 'dplyr'

## Warning in file.copy(savedcopy, lib, recursive = TRUE):
## problem copying C:\Users\Parth\OneDrive\Documents\R\win-
## library\4.1\00LOCK\dplyr\libs\x64\dplyr.dll to C:
## \Users\Parth\OneDrive\Documents\R\win-library\4.1\dplyr\libs\x64\dp
lyr.dll:
## Permission denied

## Warning: restored 'dplyr'

##
## The downloaded binary packages are in
##   C:\Users\Parth\AppData\Local\Temp\RtmpgPNLyt\downloaded_packages

install.packages('tidyr')

## Installing package into 'C:/Users/Parth/OneDrive/Documents/R/win-li
brary/4.1'
## (as 'lib' is unspecified)

## package 'tidyr' successfully unpacked and MD5 sums checked

## Warning: cannot remove prior installation of package 'tidyr'

## Warning in file.copy(savedcopy, lib, recursive = TRUE):
## problem copying C:\Users\Parth\OneDrive\Documents\R\win-
## library\4.1\00LOCK\tidyr\libs\x64\tidyr.dll to C:
## \Users\Parth\OneDrive\Documents\R\win-library\4.1\tidyr\libs\x64\ti
```

```
dyr.dll:
## Permission denied

## Warning: restored 'tidyr'

##
## The downloaded binary packages are in
##   C:\Users\Parth\AppData\Local\Temp\RtmpgPNLyt\downloaded_packages
```

```r
install.packages('plyr')
```

```
## Installing package into 'C:/Users/Parth/OneDrive/Documents/R/win-li
brary/4.1'
## (as 'lib' is unspecified)

## package 'plyr' successfully unpacked and MD5 sums checked

## Warning: cannot remove prior installation of package 'plyr'

## Warning in file.copy(savedcopy, lib, recursive = TRUE): problem cop
ying C:
## \Users\Parth\OneDrive\Documents\R\win-library\4.1\00LOCK\plyr\libs\
x64\plyr.dll
## to C:\Users\Parth\OneDrive\Documents\R\win-library\4.1\plyr\libs\x6
4\plyr.dll:
## Permission denied

## Warning: restored 'plyr'

##
## The downloaded binary packages are in
##   C:\Users\Parth\AppData\Local\Temp\RtmpgPNLyt\downloaded_packages
```

```r
install.packages('tidyverse')
```

```
## Installing package into 'C:/Users/Parth/OneDrive/Documents/R/win-li
brary/4.1'
## (as 'lib' is unspecified)

## package 'tidyverse' successfully unpacked and MD5 sums checked
##
## The downloaded binary packages are in
##   C:\Users\Parth\AppData\Local\Temp\RtmpgPNLyt\downloaded_packages
```

```r
library(FSA)
```

```
## ## FSA v0.9.1. See citation('FSA') if used in publication.
## ## Run fishR() for related website and fishR('IFAR') for related bo
ok.
```

```
library(FSAdata)

## ## FSAdata v0.3.8. See ?FSAdata to find data for specific fisheries
analyses.

library(magrittr)
library(dplyr)

##
## Attaching package: 'dplyr'

## The following objects are masked from 'package:stats':
##
##     filter, lag

## The following objects are masked from 'package:base':
##
##     intersect, setdiff, setequal, union

library(tidyr)

##
## Attaching package: 'tidyr'

## The following object is masked from 'package:magrittr':
##
##     extract

library(plyr)

## --------------------------------------------------------------------
-----------

## You have loaded plyr after dplyr - this is likely to cause problems
.
## If you need functions from both plyr and dplyr, please load plyr fi
rst, then dplyr:
## library(plyr); library(dplyr)

## --------------------------------------------------------------------
-----------

##
## Attaching package: 'plyr'

## The following objects are masked from 'package:dplyr':
##
##     arrange, count, desc, failwith, id, mutate, rename, summarise,
##     summarize
```

```
## The following object is masked from 'package:FSA':
##
##      mapvalues

library(tidyverse)

## -- Attaching packages -------------------------------------- tidyv
erse 1.3.1 --

## v ggplot2 3.3.5     v purrr   0.3.4
## v tibble  3.1.6     v stringr 1.4.0
## v readr   2.1.1     v forcats 0.5.1

## -- Conflicts ----------------------------------------- tidyverse_c
onflicts() --
## x plyr::arrange()    masks dplyr::arrange()
## x purrr::compact()   masks plyr::compact()
## x plyr::count()      masks dplyr::count()
## x tidyr::extract()   masks magrittr::extract()
## x plyr::failwith()   masks dplyr::failwith()
## x dplyr::filter()    masks stats::filter()
## x plyr::id()         masks dplyr::id()
## x dplyr::lag()       masks stats::lag()
## x plyr::mutate()     masks dplyr::mutate()
## x plyr::rename()     masks dplyr::rename()
## x purrr::set_names() masks magrittr::set_names()
## x plyr::summarise()  masks dplyr::summarise()
## x plyr::summarize()  masks dplyr::summarize()
```

#2. Import the inchBio.csv and name the table <bio>

```
bio <- read.csv("C:/Users/Parth/OneDrive/Desktop/Introduction to Analy
tics/ALY6000_module3/inchBio.csv")
bio

##      netID fishID        species  tl      w      tag scale
## 1       12     16       Bluegill  61    2.9          FALSE
## 2       12     23       Bluegill  66    4.5          FALSE
## 3       12     30       Bluegill  70    5.2          FALSE
## 4       12     44       Bluegill  38    0.5          FALSE
## 5       12     50       Bluegill  42    1.0          FALSE
## 6       12     65       Bluegill  54    2.1          FALSE
## 7       12     66       Bluegill  27     NA          FALSE
## 8       13     68       Bluegill  36    0.5          FALSE
## 9       13     69       Bluegill  59    2.0          FALSE
## 10      13     70       Bluegill  39    0.5          FALSE
## 11      13     71       Bluegill  34    0.5          FALSE
```

```
## 12   13    73       Bluegill  40    1.0         FALSE
## 13   13    74       Bluegill  35    0.5         FALSE
## 14   13    75       Bluegill  32    1.0         FALSE
## 15   13    76       Bluegill  37    0.5         FALSE
## 16   13    77       Bluegill  38    1.0         FALSE
## 17   13    78       Bluegill  69    7.0         FALSE
## 18   13    80       Bluegill  39    1.0         FALSE
## 19   13    81       Bluegill  37    0.5         FALSE
## 20   13    82       Bluegill  38    1.0         FALSE
## 21   13    83       Bluegill  47     NA         FALSE
## 22   14    86       Bluegill  33    0.5         FALSE
## 23   14    87       Bluegill  31    1.5         FALSE
## 24   14    88       Bluegill  36    1.5         FALSE
## 25    4   118       Bluegill 150   60.0          TRUE
## 26    4   119       Bluegill 193  145.0          TRUE
## 27    4   120       Bluegill 185  123.0          TRUE
## 28    4   121       Bluegill 152   67.0          TRUE
## 29    4   122       Bluegill 160   75.0          TRUE
## 30    4   123       Bluegill 185  118.0          TRUE
## 31    4   124       Bluegill 170  100.0          TRUE
## 32    4   125       Bluegill 135   35.0          TRUE
## 33    4   126       Bluegill 183  120.0          TRUE
## 34    4   127       Bluegill 168   90.0          TRUE
## 35    4   128       Bluegill 165   85.0          TRUE
## 36    4   129       Bluegill 178  100.0          TRUE
## 37    4   130       Bluegill 193  155.0          TRUE
## 38    4   131       Bluegill 193  140.0          TRUE
## 39    4   132       Bluegill 201  180.0          TRUE
## 40    4   133       Bluegill 203  185.0          TRUE
## 41    4   134       Bluegill  99   15.0          TRUE
## 42    5   138       Bluegill 135   42.0          TRUE
## 43    5   139       Bluegill  38    2.0         FALSE
## 44    5   140       Bluegill  41     NA         FALSE
## 45    5   141       Bluegill  41     NA         FALSE
## 46    5   142       Bluegill  46     NA         FALSE
## 47    5   143       Bluegill 165   68.0          TRUE
## 48    5   144       Bluegill  43     NA         FALSE
## 49    5   145       Bluegill  51    4.0         FALSE
## 50    5   146       Bluegill 203  184.0          TRUE
## 51    5   147       Bluegill 168   98.0          TRUE
## 52    5   148       Bluegill 152   62.0          TRUE
## 53    5   149       Bluegill  64     NA         FALSE
## 54    5   150       Bluegill 157   76.0          TRUE
## 55   10   151       Bluegill 173  100.0          TRUE
## 56   10   152       Bluegill 173   95.0          TRUE
## 57   10   153       Bluegill 185  130.0          TRUE
```

```
## 58       10     154          Bluegill 218    250.0              TRUE
## 59       10     155          Bluegill 206    197.0              TRUE
## 60       10     156          Bluegill 165     78.0              TRUE
## 61       10     157          Bluegill 152     72.0              TRUE
## 62       10     158          Bluegill 170     98.0              TRUE
## 63        9     161          Bluegill 206    175.0              TRUE
## 64        9     162          Bluegill 191    144.0              TRUE
## 65        9     163          Bluegill 193    148.0              TRUE
## 66        9     164          Bluegill 183    130.0              TRUE
## 67        9     165          Bluegill 201    185.0              TRUE
## 68        9     166          Bluegill 221    225.0              TRUE
## 69        9     167          Bluegill 165     80.0             FALSE
## 70        9     168          Bluegill 206    180.0              TRUE
## 71        9     169          Bluegill 203    175.0              TRUE
## 72        9     170          Bluegill 165      NA              TRUE
## 73        9     171          Bluegill 193    160.0             FALSE
## 74        9     172          Bluegill 173      NA             FALSE
## 75        6     176          Bluegill 213    200.0              TRUE
## 76        6     177          Bluegill 155     74.0              TRUE
## 77        6     178          Bluegill 157     62.0              TRUE
## 78        6     179          Bluegill 211    220.0              TRUE
## 79        6     180          Bluegill 188    149.0              TRUE
## 80        6     181          Bluegill 188    139.0              TRUE
## 81        6     182          Bluegill 196    132.0              TRUE
## 82        6     183          Bluegill 188    139.0              TRUE
## 83        6     184          Bluegill 160     73.0              TRUE
## 84        6     185          Bluegill 196    120.0              TRUE
## 85        6     186          Bluegill 221    242.0              TRUE
## 86        6     187          Bluegill 180    130.0              TRUE
## 87        6     188          Bluegill 152     70.0              TRUE
## 88        6     189          Bluegill 140     40.0              TRUE
## 89        6     190          Bluegill 203    170.0              TRUE
## 90        6     191          Bluegill 145     52.0              TRUE
## 91        6     192          Bluegill 147     32.0              TRUE
## 92       11     193          Bluegill 211    218.0              TRUE
## 93       11     194          Bluegill 147     60.0              TRUE
## 94       11     195          Bluegill 152     70.0              TRUE
## 95       17     196          Bluegill 203    192.0              TRUE
## 96       17     197          Bluegill 132     31.0              TRUE
## 97       17     199          Bluegill 142     59.0              TRUE
## 98       20     201          Bluegill 140     54.0              TRUE
## 99       15     203          Bluegill 142     40.0              TRUE
## 100      15     206          Bluegill 147     30.0              TRUE
## 101      15     207          Bluegill 119     20.0              TRUE
## 102      16     210          Bluegill 229    280.0              TRUE
## 103      16     211          Bluegill 224    260.0              TRUE
```

```
## 104    16   212         Bluegill 224  260.0              TRUE
## 105    16   213         Bluegill 224  240.0              TRUE
## 106    16   214         Bluegill 150   60.0              TRUE
## 107    16   215         Bluegill 137   60.0              TRUE
## 108    21   217         Bluegill  94   14.0              TRUE
## 109    21   219         Bluegill 130   38.0              TRUE
## 110    26   220         Bluegill 132   49.0              TRUE
## 111    26   221         Bluegill 137   41.0              TRUE
## 112    23   224         Bluegill 114   20.0              TRUE
## 113    27   226         Bluegill 127   20.0              TRUE
## 114    27   228         Bluegill 122   20.0              TRUE
## 115    28   230         Bluegill 137   50.0              TRUE
## 116    28   231         Bluegill 234  280.0              TRUE
## 117    37   322         Bluegill 152     NA              TRUE
## 118    37   356         Bluegill 201     NA              TRUE
## 119   206   501         Bluegill  38    0.7             FALSE
## 120   205   502         Bluegill  43    1.4             FALSE
## 121   205   503         Bluegill  56    1.5             FALSE
## 122   205   504         Bluegill  53    1.4             FALSE
## 123   205   505         Bluegill  38    1.0             FALSE
## 124   205   506         Bluegill  48    1.8             FALSE
## 125   205   507         Bluegill  48    1.4             FALSE
## 126   205   508         Bluegill  36    0.6             FALSE
## 127   205   509         Bluegill  30    0.3             FALSE
## 128   205   510         Bluegill  36    0.8             FALSE
## 129   205   511         Bluegill  51    1.3             FALSE
## 130   205   512         Bluegill  58    2.4             FALSE
## 131   205   513         Bluegill  33    0.7             FALSE
## 132   205   514         Bluegill  38    1.0             FALSE
## 133   205   515         Bluegill  33    0.6             FALSE
## 134   205   516         Bluegill  56    2.8             FALSE
## 135   205   517         Bluegill  33    1.1             FALSE
## 136   205   518         Bluegill  53    2.0             FALSE
## 137   205   519         Bluegill  66    4.5             FALSE
## 138   205   520         Bluegill  71    4.9             FALSE
## 139   101   533         Bluegill 213  190.0              TRUE
## 140   101   538         Bluegill 216  198.0       1021   TRUE
## 141   101   539         Bluegill 216  210.0       1022   TRUE
## 142   101   540         Bluegill 231  258.0       1023   TRUE
## 143   101   541         Bluegill 193  138.0              TRUE
## 144   101   542         Bluegill 226  236.0       1024   TRUE
## 145   101   543         Bluegill 163   75.0              TRUE
## 146   101   544         Bluegill 224  229.0       1025   TRUE
## 147   101   545         Bluegill 178  101.0              TRUE
## 148   101   546         Bluegill 180  110.0              TRUE
## 149   101   547         Bluegill 239  295.0       1015   TRUE
```

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## 150   101   548        Bluegill 183   113.0           TRUE
## 151   101   549        Bluegill 211   191.0      1018 TRUE
## 152   101   550        Bluegill 191   139.0           TRUE
## 153   101   552        Bluegill 191   137.0           TRUE
## 154   101   553        Bluegill 201   165.0           TRUE
## 155   101   554        Bluegill 178   103.0           TRUE
## 156   101   555        Bluegill 201   166.0           TRUE
## 157   101   556        Bluegill 180   115.0           TRUE
## 158   101   557        Bluegill 165    89.0           TRUE
## 159   101   558        Bluegill 191   121.0           TRUE
## 160   101   559        Bluegill 157    78.0           TRUE
## 161   101   560        Bluegill 152    63.0           TRUE
## 162   101   561        Bluegill 206   181.0      1075 TRUE
## 163   101   562        Bluegill 147    60.0           TRUE
## 164   101   563        Bluegill 163    74.0           TRUE
## 165   101   564        Bluegill 180   101.0           TRUE
## 166   101   565        Bluegill 193   141.0           TRUE
## 167   101   566        Bluegill 216   228.0      1074 TRUE
## 168   101   567        Bluegill 229   266.0      1073 TRUE
## 169   101   568        Bluegill 168    93.0           TRUE
## 170   101   569        Bluegill 163    74.0           TRUE
## 171   101   570        Bluegill 165    82.0           TRUE
## 172   101   571        Bluegill 231   274.0      1072 TRUE
## 173   101   572        Bluegill 201   151.0           TRUE
## 174   101   573        Bluegill 188   129.0           TRUE
## 175   101   574        Bluegill 175    98.0           TRUE
## 176   101   575        Bluegill 145    57.0           TRUE
## 177   101   576        Bluegill 152    62.0           TRUE
## 178   101   577        Bluegill 175   107.0           TRUE
## 179   101   578        Bluegill 221   240.0      1071 TRUE
## 180   101   580        Bluegill 178   110.0           TRUE
## 181   101   581        Bluegill 211   208.0      1069 TRUE
## 182   101   583        Bluegill 140    48.0           TRUE
## 183   101   585        Bluegill 173    96.0           TRUE
## 184   101   586        Bluegill 152    73.0           TRUE
## 185   101   587        Bluegill 213   198.0      1066 TRUE
## 186   107   621        Bluegill 203   156.0      1065 TRUE
## 187   107   622        Bluegill 221   242.0      1064 TRUE
## 188   107   623        Bluegill 203   187.0      1063 TRUE
## 189   107   624        Bluegill 229   242.0      1062 TRUE
## 190   107   625        Bluegill 170    83.0           TRUE
## 191   104   658        Bluegill 213   197.0      1099 TRUE
## 192   104   659        Bluegill 229   255.0      1098 TRUE
## 193   104   660        Bluegill 185   111.0           TRUE
## 194   103   689        Bluegill 206      NA      1107 TRUE
## 195   103   695        Bluegill 137    45.3           TRUE
```

```
## 196   103     697            Bluegill 147   50.9              TRUE
## 197   103     699            Bluegill  66    3.4              TRUE
## 198   103     700            Bluegill 150   54.5              TRUE
## 199   103     701            Bluegill 142   48.8              TRUE
## 200   103     703            Bluegill 150   50.9              TRUE
## 201   111     717            Bluegill 130   35.0              TRUE
## 202   111     718            Bluegill 137   45.0              TRUE
## 203   111     719            Bluegill 132   39.0              TRUE
## 204   111     722            Bluegill 137   43.0              TRUE
## 205   111     726            Bluegill 137   50.0              TRUE
## 206   113     742            Bluegill 135   39.0              TRUE
## 207   114     755            Bluegill  66    3.1             FALSE
## 208   116     761            Bluegill  97   10.9             FALSE
## 209   116     762            Bluegill  91   10.6             FALSE
## 210   112     774            Bluegill 203  171.0      1045   TRUE
## 211   112     780            Bluegill  76    6.1             FALSE
## 212   112     781            Bluegill 109   19.0             FALSE
## 213   120     802            Bluegill  94   10.7              TRUE
## 214   120     803            Bluegill  84    8.9              TRUE
## 215   120     804            Bluegill  91   10.6              TRUE
## 216   120     805            Bluegill  84    8.7              TRUE
## 217   120     806            Bluegill  86    9.3              TRUE
## 218   120     807            Bluegill  69    4.0              TRUE
## 219   119     824            Bluegill 119   25.0              TRUE
## 220   122     826            Bluegill 132   33.0              TRUE
## 221    12       7 Bluntnose Minnow  59    2.0             FALSE
## 222    12       8 Bluntnose Minnow  58    1.7             FALSE
## 223    12      10 Bluntnose Minnow  54    1.5             FALSE
## 224    12      11 Bluntnose Minnow  60    1.7             FALSE
## 225    12      12 Bluntnose Minnow  78    2.3             FALSE
## 226    12      14 Bluntnose Minnow  62    2.2             FALSE
## 227    12      17 Bluntnose Minnow  59    2.0             FALSE
## 228    12      18 Bluntnose Minnow  63    2.5             FALSE
## 229    12      19 Bluntnose Minnow  58    2.0             FALSE
## 230    12      21 Bluntnose Minnow  71    3.8             FALSE
## 231    12      22 Bluntnose Minnow  55    2.5             FALSE
## 232    12      24 Bluntnose Minnow  60    2.2             FALSE
## 233    12      25 Bluntnose Minnow  51    2.0             FALSE
## 234    12      26 Bluntnose Minnow  52    1.8             FALSE
## 235    12      27 Bluntnose Minnow  64    2.5             FALSE
## 236    12      28 Bluntnose Minnow  67    4.0             FALSE
## 237    12      29 Bluntnose Minnow  63    2.0             FALSE
## 238    12      31 Bluntnose Minnow  65    2.0             FALSE
## 239    12      32 Bluntnose Minnow  67    3.0             FALSE
## 240    12      33 Bluntnose Minnow  71    4.8             FALSE
## 241    12      34 Bluntnose Minnow  66    3.0             FALSE
```

```
## 242    12    35 Bluntnose Minnow 73    4.0          FALSE
## 243    12    36 Bluntnose Minnow 67    4.0          FALSE
## 244    12    37 Bluntnose Minnow 51    2.5          FALSE
## 245    12    38 Bluntnose Minnow 58    1.5          FALSE
## 246    12    39 Bluntnose Minnow 71    3.8          FALSE
## 247    12    40 Bluntnose Minnow 52    1.5          FALSE
## 248    12    41 Bluntnose Minnow 61    1.5          FALSE
## 249    12    42 Bluntnose Minnow 58    1.5          FALSE
## 250    12    43 Bluntnose Minnow 72    3.0          FALSE
## 251    12    45 Bluntnose Minnow 68     NA          FALSE
## 252    12    46 Bluntnose Minnow 57    1.5          FALSE
## 253    12    47 Bluntnose Minnow 58    1.5          FALSE
## 254    12    48 Bluntnose Minnow 58    2.0          FALSE
## 255    12    49 Bluntnose Minnow 58    2.5          FALSE
## 256    12    51 Bluntnose Minnow 61    3.0          FALSE
## 257    12    52 Bluntnose Minnow 57    1.0          FALSE
## 258    12    53 Bluntnose Minnow 70    2.0          FALSE
## 259    12    54 Bluntnose Minnow 64    2.5          FALSE
## 260    12    55 Bluntnose Minnow 61    1.0          FALSE
## 261    12    56 Bluntnose Minnow 56    1.0          FALSE
## 262    12    57 Bluntnose Minnow 58     NA          FALSE
## 263    12    58 Bluntnose Minnow 66    4.0          FALSE
## 264    12    59 Bluntnose Minnow 59    2.0          FALSE
## 265    12    60 Bluntnose Minnow 62    1.5          FALSE
## 266    12    61 Bluntnose Minnow 64    2.5          FALSE
## 267    12    62 Bluntnose Minnow 63    1.5          FALSE
## 268    12    63 Bluntnose Minnow 61    1.8          FALSE
## 269    12    64 Bluntnose Minnow 64    3.0          FALSE
## 270    13    79 Bluntnose Minnow 72    5.0          FALSE
## 271    13    84 Bluntnose Minnow 71    4.0          FALSE
## 272   205   522 Bluntnose Minnow 61    2.1          FALSE
## 273   201   523 Bluntnose Minnow 56     NA          FALSE
## 274   101   589 Bluntnose Minnow 64    1.4          FALSE
## 275   101   590 Bluntnose Minnow 46    0.5          FALSE
## 276   101   591 Bluntnose Minnow 53    1.0          FALSE
## 277   101   592 Bluntnose Minnow 58    1.7          FALSE
## 278   101   593 Bluntnose Minnow 56    1.0          FALSE
## 279   101   594 Bluntnose Minnow 58    1.1          FALSE
## 280   101   595 Bluntnose Minnow 58    1.0          FALSE
## 281   101   596 Bluntnose Minnow 56    1.0          FALSE
## 282   101   597 Bluntnose Minnow 53    1.0          FALSE
## 283   101   598 Bluntnose Minnow 51    0.8          FALSE
## 284   101   599 Bluntnose Minnow 56    0.8          FALSE
## 285   101   600 Bluntnose Minnow 56    1.0          FALSE
## 286   101   601 Bluntnose Minnow 58    1.0          FALSE
## 287   101   603 Bluntnose Minnow 64    1.4          FALSE
```

```
## 288   101    605 Bluntnose Minnow   58    1.2         FALSE
## 289   101    606 Bluntnose Minnow   61    1.3         FALSE
## 290   101    607 Bluntnose Minnow   69    1.8         FALSE
## 291   101    608 Bluntnose Minnow   64    1.4         FALSE
## 292   101    609 Bluntnose Minnow   53    0.8         FALSE
## 293   101    610 Bluntnose Minnow   64    1.4         FALSE
## 294   101    611 Bluntnose Minnow   61    1.2         FALSE
## 295   101    612 Bluntnose Minnow   51    0.7         FALSE
## 296   101    613 Bluntnose Minnow   56    1.1         FALSE
## 297   101    614 Bluntnose Minnow   56    1.0         FALSE
## 298   101    615 Bluntnose Minnow   53    0.9         FALSE
## 299   101    616 Bluntnose Minnow   58    1.2         FALSE
## 300   101    617 Bluntnose Minnow   53    0.8         FALSE
## 301   101    618 Bluntnose Minnow   53    0.9         FALSE
## 302   101    619 Bluntnose Minnow   66    1.5         FALSE
## 303   101    620 Bluntnose Minnow   61    1.3         FALSE
## 304   102    638 Bluntnose Minnow   74    3.9         FALSE
## 305   102    639 Bluntnose Minnow   61    2.2         FALSE
## 306   102    640 Bluntnose Minnow   84    1.3         FALSE
## 307   102    642 Bluntnose Minnow   53    1.3         FALSE
## 308   102    643 Bluntnose Minnow   56    2.1         FALSE
## 309   102    644 Bluntnose Minnow   56    1.4         FALSE
## 310   102    645 Bluntnose Minnow   61    2.0         FALSE
## 311   111    727 Bluntnose Minnow   79    3.8         FALSE
## 312   116    763 Bluntnose Minnow   74    3.4         FALSE
## 313   121    816 Bluntnose Minnow   51    1.2         FALSE
## 314   121    817 Bluntnose Minnow   79    3.9         FALSE
## 315   121    818 Bluntnose Minnow   74    3.8         FALSE
## 316   121    819 Bluntnose Minnow   64    1.9         FALSE
## 317   121    820 Bluntnose Minnow   51    1.0         FALSE
## 318   121    821 Bluntnose Minnow   51    1.1         FALSE
## 319   121    822 Bluntnose Minnow   64    2.1         FALSE
## 320   121    823 Bluntnose Minnow   51    1.2         FALSE
## 321   125    832 Bluntnose Minnow   81    2.8         FALSE
## 322   125    833 Bluntnose Minnow   81    3.2         FALSE
## 323   125    834 Bluntnose Minnow   79    4.1         FALSE
## 324    13     72      Iowa Darter   61     NA         FALSE
## 325   205    521      Iowa Darter   53    1.1         FALSE
## 326   203    524      Iowa Darter   46    0.6         FALSE
## 327   203    525      Iowa Darter   44    0.6         FALSE
## 328   203    526      Iowa Darter   46    0.6         FALSE
## 329   203    527      Iowa Darter   43    0.4         FALSE
## 330   101    602      Iowa Darter   56    0.9         FALSE
## 331   101    604      Iowa Darter   51    0.8         FALSE
## 332   102    641      Iowa Darter   48    1.0         FALSE
## 333   106    646      Iowa Darter   38    0.6         FALSE
```

```
## 334   106   647      Iowa Darter   46   0.9              FALSE
## 335   106   648      Iowa Darter   43   0.8              FALSE
## 336   106   649      Iowa Darter   48   1.0              FALSE
## 337   106   650      Iowa Darter   41   0.5              FALSE
## 338   106   651      Iowa Darter   41   0.7              FALSE
## 339   106   652      Iowa Darter   43   0.6              FALSE
## 340   106   653      Iowa Darter   43   0.6              FALSE
## 341   106   654      Iowa Darter   46   0.9              FALSE
## 342   105   711      Iowa Darter   48   0.7              FALSE
## 343   105   712      Iowa Darter   46   0.7              FALSE
## 344   115   730      Iowa Darter   48   0.8              FALSE
## 345   115   731      Iowa Darter   48   0.8              FALSE
## 346   115   732      Iowa Darter   51   1.0              FALSE
## 347   115   733      Iowa Darter   51   1.1              FALSE
## 348   116   764      Iowa Darter   51   1.2              FALSE
## 349   116   765      Iowa Darter   48   0.9              FALSE
## 350   116   766      Iowa Darter   51   0.9              FALSE
## 351   116   767      Iowa Darter   43   0.5              FALSE
## 352   116   768      Iowa Darter   51   1.2              FALSE
## 353   116   769      Iowa Darter   56   1.2              FALSE
## 354   116   770      Iowa Darter   53   1.1              FALSE
## 355   116   771      Iowa Darter   43   0.9              FALSE
## 356    14    85  Largemouth Bass   68   3.5               TRUE
## 357     3    89  Largemouth Bass  338   NA    g0996       TRUE
## 358     1    90  Largemouth Bass  356   NA   y06073       TRUE
## 359     1    91  Largemouth Bass  328   NA    o0449       TRUE
## 360     1    92  Largemouth Bass  305   NA    o0448       TRUE
## 361     1    93  Largemouth Bass  386   NA    o0447       TRUE
## 362     1    94  Largemouth Bass  310   NA    g0985       TRUE
## 363     1    95  Largemouth Bass  262   NA                TRUE
## 364     1    96  Largemouth Bass  305   NA    g0986       TRUE
## 365     1    97  Largemouth Bass  315   NA    g0987       TRUE
## 366     1    98  Largemouth Bass  371   NA    g1000       TRUE
## 367     1    99  Largemouth Bass  338   NA    g0999       TRUE
## 368     1   100  Largemouth Bass  239   NA                TRUE
## 369     1   101  Largemouth Bass  236   NA                TRUE
## 370     1   102  Largemouth Bass  348   NA    g0997       TRUE
## 371     2   104  Largemouth Bass  307   NA    o0501       TRUE
## 372     2   105  Largemouth Bass  323   NA    o0506       TRUE
## 373     2   106  Largemouth Bass  231   NA                TRUE
## 374     2   107  Largemouth Bass  216   NA                TRUE
## 375     2   108  Largemouth Bass  325   NA    o0507       TRUE
## 376     2   109  Largemouth Bass  399   NA    o0510       TRUE
## 377     2   110  Largemouth Bass  333   NA    o0511       TRUE
## 378     2   111  Largemouth Bass  356   NA    o0512       TRUE
## 379     2   112  Largemouth Bass  274   NA                TRUE
```

```
## 380   17   198   Largemouth Bass 259   190.0          TRUE
## 381   27   227   Largemouth Bass 137    20.0          TRUE
## 382   29   232   Largemouth Bass 279      NA   o0516   TRUE
## 383   29   233   Largemouth Bass 351      NA   o0517   TRUE
## 384   29   234   Largemouth Bass 307      NA   o0518   TRUE
## 385   29   235   Largemouth Bass 325      NA   o0520   TRUE
## 386   29   237   Largemouth Bass 330      NA   o0521   TRUE
## 387   29   239   Largemouth Bass 282      NA   o0523   TRUE
## 388   29   240   Largemouth Bass 262      NA           TRUE
## 389   29   241   Largemouth Bass 391      NA   o0524   TRUE
## 390   29   242   Largemouth Bass 262      NA           TRUE
## 391   29   243   Largemouth Bass 295      NA   o0525   TRUE
## 392   30   244   Largemouth Bass 305      NA   o0550   TRUE
## 393   30   245   Largemouth Bass 193      NA           TRUE
## 394   30   246   Largemouth Bass 254      NA           TRUE
## 395   30   247   Largemouth Bass 246      NA           TRUE
## 396   30   248   Largemouth Bass 330      NA   o0549   TRUE
## 397   30   249   Largemouth Bass 300      NA           TRUE
## 398   30   250   Largemouth Bass 284      NA           TRUE
## 399   30   251   Largemouth Bass 371      NA   o0548   TRUE
## 400   30   252   Largemouth Bass 335      NA   o0547   TRUE
## 401   30   253   Largemouth Bass 305      NA   o0546   TRUE
## 402   30   254   Largemouth Bass 254      NA           TRUE
## 403   30   255   Largemouth Bass 318      NA   o0545   TRUE
## 404   30   256   Largemouth Bass 348      NA   o0544   TRUE
## 405   30   257   Largemouth Bass 343      NA   o0543   TRUE
## 406   30   258   Largemouth Bass 325      NA   o0542   TRUE
## 407   30   259   Largemouth Bass 333      NA   o0541   TRUE
## 408   30   260   Largemouth Bass 330      NA   o0540   TRUE
## 409   30   261   Largemouth Bass 381      NA   o0539   TRUE
## 410   30   262   Largemouth Bass 320      NA   o0538   TRUE
## 411   30   263   Largemouth Bass 272      NA           TRUE
## 412   30   264   Largemouth Bass 312      NA   o0536   TRUE
## 413   30   265   Largemouth Bass 310      NA   o0535   TRUE
## 414   30   266   Largemouth Bass 297      NA           TRUE
## 415   31   270   Largemouth Bass 307      NA   o0533   TRUE
## 416   31   271   Largemouth Bass 310      NA   o0532   TRUE
## 417   31   272   Largemouth Bass 277      NA           TRUE
## 418   33   273   Largemouth Bass 130      NA           TRUE
## 419   32   274   Largemouth Bass 140      NA           TRUE
## 420   35   275   Largemouth Bass 239      NA           TRUE
## 421   35   276   Largemouth Bass 236      NA           TRUE
## 422   35   277   Largemouth Bass 320      NA   o0519   TRUE
## 423   35   278   Largemouth Bass 241      NA           TRUE
## 424   35   279   Largemouth Bass 343      NA   g0988   TRUE
## 425   35   280   Largemouth Bass 226      NA           TRUE
```

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## 426   35   281   Largemouth Bass 211   NA            TRUE
## 427   35   282   Largemouth Bass 409   NA    g0990   TRUE
## 428   35   284   Largemouth Bass 371   NA    o0991   TRUE
## 429   35   285   Largemouth Bass 312   NA    o0989   TRUE
## 430   35   286   Largemouth Bass 333   NA   y00003   TRUE
## 431   35   287   Largemouth Bass 338   NA   y00228   TRUE
## 432   35   288   Largemouth Bass 282   NA            TRUE
## 433   35   289   Largemouth Bass 302   NA            TRUE
## 434   35   290   Largemouth Bass 305   NA  y160016   TRUE
## 435   35   291   Largemouth Bass 376   NA    o0534   TRUE
## 436   35   292   Largemouth Bass 251   NA            TRUE
## 437   35   293   Largemouth Bass 338   NA    y2519   TRUE
## 438   35   294   Largemouth Bass 318   NA   y00034   TRUE
## 439   35   295   Largemouth Bass 312   NA   y00123   TRUE
## 440   35   296   Largemouth Bass 272   NA            TRUE
## 441   35   297   Largemouth Bass 394   NA    o0531   TRUE
## 442   35   298   Largemouth Bass 363   NA    o0530   TRUE
## 443   35   299   Largemouth Bass 320   NA   y01525  FALSE
## 444   36   300   Largemouth Bass 307   NA    o0529   TRUE
## 445   36   301   Largemouth Bass 330   NA    o0528   TRUE
## 446   36   302   Largemouth Bass 318   NA    o0527   TRUE
## 447   36   303   Largemouth Bass 302   NA            TRUE
## 448   36   304   Largemouth Bass 277   NA            TRUE
## 449   36   305   Largemouth Bass 241   NA            TRUE
## 450   36   306   Largemouth Bass 318   NA    o0526   TRUE
## 451   36   307   Largemouth Bass 297   NA            TRUE
## 452   36   308   Largemouth Bass 318   NA   y01598   TRUE
## 453   36   309   Largemouth Bass 373   NA   y01600   TRUE
## 454   36   310   Largemouth Bass 290   NA            TRUE
## 455   36   311   Largemouth Bass 300   NA            TRUE
## 456   36   312   Largemouth Bass 318   NA   y01603   TRUE
## 457   36   313   Largemouth Bass 333   NA   y01604   TRUE
## 458   36   314   Largemouth Bass 356   NA   y01605   TRUE
## 459   36   315   Largemouth Bass 180   NA            TRUE
## 460   36   316   Largemouth Bass 305   NA   y01606   TRUE
## 461   37   317   Largemouth Bass 211   NA            TRUE
## 462   37   318   Largemouth Bass 320   NA   y00385   TRUE
## 463   37   320   Largemouth Bass 236   NA            TRUE
## 464   37   321   Largemouth Bass 193   NA            TRUE
## 465   37   323   Largemouth Bass 249   NA            TRUE
## 466   37   324   Largemouth Bass 318   NA   y01601   TRUE
## 467   37   325   Largemouth Bass 211   NA            TRUE
## 468   37   326   Largemouth Bass 254   NA            TRUE
## 469   37   327   Largemouth Bass 318   NA   y00023   TRUE
## 470   37   328   Largemouth Bass 427   NA   y00316   TRUE
## 471   37   329   Largemouth Bass 345   NA   y00220   TRUE
```

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## 472    37    330    Largemouth Bass 330    NA    y00011    TRUE
## 473    37    331    Largemouth Bass 320    NA    y01534    TRUE
## 474    37    332    Largemouth Bass 356    NA    y00028    TRUE
## 475    37    333    Largemouth Bass 325    NA    y00009    TRUE
## 476    37    336    Largemouth Bass 297    NA              TRUE
## 477    37    337    Largemouth Bass 201    NA              TRUE
## 478    37    338    Largemouth Bass 257    NA              TRUE
## 479    37    339    Largemouth Bass 206    NA              TRUE
## 480    37    340    Largemouth Bass 201    NA              TRUE
## 481    37    341    Largemouth Bass 251    NA              TRUE
## 482    37    342    Largemouth Bass 239    NA              TRUE
## 483    37    343    Largemouth Bass 203    NA              TRUE
## 484    37    344    Largemouth Bass 262    NA              TRUE
## 485    37    345    Largemouth Bass 272    NA              TRUE
## 486    37    346    Largemouth Bass 353    NA    y00025    TRUE
## 487    37    347    Largemouth Bass 318    NA    y00229    TRUE
## 488    37    348    Largemouth Bass 330    NA    y00409    TRUE
## 489    37    349    Largemouth Bass 292    NA              TRUE
## 490    37    352    Largemouth Bass 318    NA    y00006    TRUE
## 491    37    353    Largemouth Bass 335    NA    y00015    TRUE
## 492    37    354    Largemouth Bass 295    NA              TRUE
## 493    37    355    Largemouth Bass 323    NA    y00027    TRUE
## 494   101    536    Largemouth Bass 318   407.0    1019    TRUE
## 495   101    551    Largemouth Bass 178    60.0            TRUE
## 496   101    588    Largemouth Bass 221   117.0            TRUE
## 497   102    630    Largemouth Bass 429  1070.0    1058    TRUE
## 498   102    631    Largemouth Bass 394   737.0    1057    TRUE
## 499   102    632    Largemouth Bass 361   548.0    1056    TRUE
## 500   104    656    Largemouth Bass 251   172.0            TRUE
## 501   104    657    Largemouth Bass 386   688.0    1100    TRUE
## 502   103    702    Largemouth Bass 361   579.0    1115    TRUE
## 503   111    713    Largemouth Bass 348   556.0    1117    TRUE
## 504   114    759    Largemouth Bass 168    48.0            TRUE
## 505   116    760    Largemouth Bass  71     3.1           FALSE
## 506   112    801    Largemouth Bass 168    52.0           FALSE
## 507   109    836    Largemouth Bass 424   864.0    1518    TRUE
## 508   109    837    Largemouth Bass 328   410.0    1519    TRUE
## 509   109    838    Largemouth Bass 315   385.0    1520    TRUE
## 510   109    839    Largemouth Bass 325   338.0    1521    TRUE
## 511   109    840    Largemouth Bass 274   235.0            TRUE
## 512   109    841    Largemouth Bass 348    NA      1522    TRUE
## 513   109    842    Largemouth Bass 318   386.0   o6860    TRUE
## 514   109    843    Largemouth Bass 333   460.0    1523    TRUE
## 515   109    844    Largemouth Bass 386   547.0    1524    TRUE
## 516   109    845    Largemouth Bass 384   540.0    1525    TRUE
## 517   109    846    Largemouth Bass 249    NA              TRUE
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## 518   109   847   Largemouth Bass 307   320.0      1532   TRUE
## 519   109   848   Largemouth Bass 323   420.0      1776   TRUE
## 520   109   849   Largemouth Bass 315   406.0      1777   TRUE
## 521   109   850   Largemouth Bass 351   486.0      1778   TRUE
## 522   109   851   Largemouth Bass 249   274.0             TRUE
## 523   109   852   Largemouth Bass 287   265.0             TRUE
## 524   109   853   Largemouth Bass 307   338.0      1779   TRUE
## 525   109   854   Largemouth Bass 302   358.0             TRUE
## 526   109   855   Largemouth Bass 297   333.0             TRUE
## 527   109   856   Largemouth Bass 320   386.0     o0526   TRUE
## 528   109   857   Largemouth Bass 333   483.0      1780   TRUE
## 529   109   858   Largemouth Bass 333   426.0      1781   TRUE
## 530   109   859   Largemouth Bass 307   295.0      1782   TRUE
## 531   109   860   Largemouth Bass 229   132.0             TRUE
## 532   109   861   Largemouth Bass 201    92.0             TRUE
## 533   109   862   Largemouth Bass 201    88.0             TRUE
## 534   110   864   Largemouth Bass 325   436.0      1784   TRUE
## 535   110   865   Largemouth Bass 325   412.0      1785   TRUE
## 536   110   866   Largemouth Bass 323   444.0      1786   TRUE
## 537   110   867   Largemouth Bass 272   233.0             TRUE
## 538   129   868   Largemouth Bass 363   624.0      1787   TRUE
## 539   129   869   Largemouth Bass 353   561.0      1788   TRUE
## 540   129   871   Largemouth Bass 264   211.0             TRUE
## 541   129   872   Largemouth Bass 315   367.0      1790   TRUE
## 542   129   873   Largemouth Bass 239   157.0             TRUE
## 543   129   874   Largemouth Bass 330   433.0      1791   TRUE
## 544   129   875   Largemouth Bass 239   154.0             TRUE
## 545   129   876   Largemouth Bass 300   292.0             TRUE
## 546   129   877   Largemouth Bass 310   351.0             TRUE
## 547   129   878   Largemouth Bass 330   436.0     o0507   TRUE
## 548   129   880   Largemouth Bass 267   244.0             TRUE
## 549   129   881   Largemouth Bass 330   437.0      1793   TRUE
## 550   129   882   Largemouth Bass 234   133.0             TRUE
## 551   129   883   Largemouth Bass 315   409.0      1794   TRUE
## 552   129   884   Largemouth Bass 310   330.0      1795   TRUE
## 553   129   885   Largemouth Bass 251   187.0             TRUE
## 554   129   886   Largemouth Bass 226   132.0             TRUE
## 555   129   887   Largemouth Bass 254   168.0             TRUE
## 556   129   888   Largemouth Bass 320   385.0      1796   TRUE
## 557   129   889   Largemouth Bass 305   324.0      1797   TRUE
## 558   129   890   Largemouth Bass 333   461.0      1798   TRUE
## 559   129   891   Largemouth Bass 224   110.0             TRUE
## 560   130   892   Largemouth Bass 310   346.0      1799   TRUE
## 561   130   893   Largemouth Bass 345   450.0      1800   TRUE
## 562   130   894   Largemouth Bass 333   443.0      1701   TRUE
## 563   130   895   Largemouth Bass 348   537.0      1702   TRUE
```

```
## 564   130    896  Largemouth Bass 305   306.0      1703   TRUE
## 565   130    897  Largemouth Bass 343   485.0     o0997   TRUE
## 566   130    898  Largemouth Bass 318   383.0      1019  FALSE
## 567   130    899  Largemouth Bass 310   348.0      1704   TRUE
## 568   130    900  Largemouth Bass 292     NA              TRUE
## 569   130    901  Largemouth Bass 272   242.0              TRUE
## 570   130    902  Largemouth Bass 257   173.0              TRUE
## 571   130    903  Largemouth Bass 312   371.0    y00229   TRUE
## 572   130    904  Largemouth Bass 257   207.0              TRUE
## 573   130    905  Largemouth Bass 305   320.0      1705   TRUE
## 574   130    906  Largemouth Bass 312   349.0     o0529   TRUE
## 575   130    907  Largemouth Bass 378   723.0      1706   TRUE
## 576   130    908  Largemouth Bass 348   571.0      1707   TRUE
## 577   130    909  Largemouth Bass 295   315.0              TRUE
## 578   130    910  Largemouth Bass 338   462.0      1708   TRUE
## 579   131    911  Largemouth Bass 300   342.0              TRUE
## 580   131    912  Largemouth Bass 264   215.0              TRUE
## 581   131    913  Largemouth Bass 251   180.0              TRUE
## 582   131    914  Largemouth Bass 378   646.0      1709   TRUE
## 583   131    915  Largemouth Bass 325   377.0      1785  FALSE
## 584    12      9     Pumpkinseed  75     6.5             FALSE
## 585    12     13     Pumpkinseed  53     2.2             FALSE
## 586    12     15     Pumpkinseed  28     1.0             FALSE
## 587    12     20     Pumpkinseed  51     1.5             FALSE
## 588    12     67     Pumpkinseed  61     4.0             FALSE
## 589     9    159     Pumpkinseed 188   120.0              TRUE
## 590     9    160     Pumpkinseed 191   185.0              TRUE
## 591    20    200     Pumpkinseed 191   200.0              TRUE
## 592    21    216     Pumpkinseed 152    80.0              TRUE
## 593    23    223     Pumpkinseed 201   210.0              TRUE
## 594    27    225     Pumpkinseed 130    20.0              TRUE
## 595    24    229     Pumpkinseed 229   320.0              TRUE
## 596   124    835     Pumpkinseed 175   130.0              TRUE
## 597   203    528   Tadpole Madtom  41    0.5             FALSE
## 598   203    529   Tadpole Madtom  33    0.2             FALSE
## 599   203    530   Tadpole Madtom  30    0.2             FALSE
## 600   203    531   Tadpole Madtom  30    0.3             FALSE
## 601   106    655   Tadpole Madtom  46    1.3             FALSE
## 602   115    734   Tadpole Madtom  38    1.0             FALSE
## 603     4    113     Yellow Perch 239   150.0              TRUE
## 604     4    114     Yellow Perch 267   170.0              TRUE
## 605     4    115     Yellow Perch 262   175.0              TRUE
## 606     4    116     Yellow Perch 257   157.0              TRUE
## 607     4    117     Yellow Perch 257   160.0              TRUE
## 608     9    173     Yellow Perch 221   105.0              TRUE
## 609     9    174     Yellow Perch 226   150.0              TRUE
```

```
## 610     9   175    Yellow Perch 282   230.0          TRUE
## 611    20   202    Yellow Perch 226   122.0          TRUE
## 612    15   204    Yellow Perch 244   130.0          TRUE
## 613    15   205    Yellow Perch 272   200.0          TRUE
## 614    23   222    Yellow Perch 229   110.0          TRUE
## 615   102   633    Yellow Perch 249   164.0    1055   TRUE
## 616   102   634    Yellow Perch 264   208.0    1054   TRUE
## 617   102   635    Yellow Perch 254   173.0    1053   TRUE
## 618   102   636    Yellow Perch 249   158.0    1052   TRUE
## 619   105   704    Yellow Perch 114    14.1          TRUE
## 620   105   705    Yellow Perch 102     9.7          TRUE
## 621   105   706    Yellow Perch 119    13.6          TRUE
## 622   105   707    Yellow Perch  79     4.0          TRUE
## 623   105   708    Yellow Perch  81     4.3          TRUE
## 624   105   709    Yellow Perch  79     4.1          TRUE
## 625   105   710    Yellow Perch  74     3.4          TRUE
## 626   111   714    Yellow Perch 307   340.0    1118   TRUE
## 627   115   728    Yellow Perch  94     6.3         FALSE
## 628   115   729    Yellow Perch  79     4.2         FALSE
## 629   113   735    Yellow Perch 267   201.0    1026   TRUE
## 630   114   756    Yellow Perch 297   327.0    1043   TRUE
## 631   116   772    Yellow Perch  91     6.8          TRUE
## 632   116   773    Yellow Perch  84     4.5          TRUE
## 633   112   796    Yellow Perch 229   123.0    1046   TRUE
## 634   112   797    Yellow Perch 239   135.0    1047   TRUE
## 635   122   825    Yellow Perch 249   152.0    1156   TRUE
## 636   125   827    Yellow Perch 221   113.0    1696   TRUE
## 637   125   828    Yellow Perch  84     4.6          TRUE
## 638   125   829    Yellow Perch  91     7.1          TRUE
## 639   125   830    Yellow Perch  81     4.1          TRUE
## 640   125   831    Yellow Perch  71     2.1          TRUE
## 641     1   103    Black Crappie 284     NA   g0998   TRUE
## 642     5   135    Black Crappie 305     NA   o0513   TRUE
## 643     5   136    Black Crappie 305     NA   o0514   TRUE
## 644     5   137    Black Crappie 267   275.0   o0515   TRUE
## 645    16   208    Black Crappie 295   380.0   g0995   TRUE
## 646    16   209    Black Crappie 274   260.0   g0994   TRUE
## 647    21   218    Black Crappie 152    46.0          TRUE
## 648    29   238    Black Crappie 279     NA   o0522   TRUE
## 649    30   267    Black Crappie 290     NA   o0537   TRUE
## 650    24   268    Black Crappie 330   580.0          TRUE
## 651    24   269    Black Crappie 307   440.0          TRUE
## 652    35   283    Black Crappie 290     NA   o0408   TRUE
## 653    37   319    Black Crappie 300     NA  y00384   TRUE
## 654    37   334    Black Crappie 297     NA  y00020   TRUE
## 655    37   335    Black Crappie 297     NA  y00318   TRUE
```

```
## 656     37     350     Black Crappie 297      NA yunknown   TRUE
## 657     37     351     Black Crappie 290      NA  y09000    TRUE
## 658    101     532     Black Crappie 320   508.0     1014   TRUE
## 659    101     534     Black Crappie 305   443.0     1016   TRUE
## 660    101     535     Black Crappie 307   440.0     1017   TRUE
## 661    101     537     Black Crappie 287   379.0     1020   TRUE
## 662    102     626     Black Crappie 307   461.0   y00318   TRUE
## 663    102     627     Black Crappie 310   466.0     1061   TRUE
## 664    102     628     Black Crappie 315   536.0     1060   TRUE
## 665    102     629     Black Crappie 323   565.0     1059   TRUE
## 666    113     753     Black Crappie 155    47.0            TRUE
## 667    113     754     Black Crappie 147    37.0            TRUE
## 668    112     798     Black Crappie 188   102.0           FALSE
## 669    112     799     Black Crappie 330   606.0     1048   TRUE
## 670    112     800     Black Crappie 292   362.0     1049   TRUE
## 671    121     808     Black Crappie 323   509.0     1050   TRUE
## 672    121     809     Black Crappie 282   352.0     1700   TRUE
## 673    121     812     Black Crappie 142    37.0            TRUE
## 674    110     863     Black Crappie 307   415.0     1783   TRUE
## 675    129     870     Black Crappie 279   344.0     1789   TRUE
## 676    129     879     Black Crappie 302   397.0     1792   TRUE
```

#3. display the head, tail and structure of <bio>

```
headtail(bio)

##      netID fishID       species  tl      w  tag scale
## 1       12     16      Bluegill  61    2.9      FALSE
## 2       12     23      Bluegill  66    4.5      FALSE
## 3       12     30      Bluegill  70    5.2      FALSE
## 674    110     863 Black Crappie 307 415.0 1783  TRUE
## 675    129     870 Black Crappie 279 344.0 1789  TRUE
## 676    129     879 Black Crappie 302 397.0 1792  TRUE

str(bio)

## 'data.frame':    676 obs. of  7 variables:
##  $ netID  : int  12 12 12 12 12 12 12 13 13 13 ...
##  $ fishID : int  16 23 30 44 50 65 66 68 69 70 ...
##  $ species: chr  "Bluegill" "Bluegill" "Bluegill" "Bluegill" ...
##  $ tl     : int  61 66 70 38 42 54 27 36 59 39 ...
##  $ w      : num  2.9 4.5 5.2 0.5 1 2.1 NA 0.5 2 0.5 ...
##  $ tag    : chr  "" "" "" "" ...
##  $ scale  : logi  FALSE FALSE FALSE FALSE FALSE FALSE ...
```

*#4. Create an object, <counts>, that counts and lists all the species
records*

```
counts <- table(bio$species)
counts
```

```
##
##     Black Crappie           Bluegill Bluntnose Minnow       Iowa Darter
##               36                220              103                32
##  Largemouth Bass        Pumpkinseed   Tadpole Madtom      Yellow Perch
##              228                 13                6                38
```

#5. Display just the 8 levels (names) of the species

```
unique(bio$species)
```

```
## [1] "Bluegill"        "Bluntnose Minnow" "Iowa Darter"      "Large
mouth Bass"
## [5] "Pumpkinseed"     "Tadpole Madtom"   "Yellow Perch"     "Black
Crappie"
```

#6. Create a <tmp> object that displays the different species and the
number of record of each species in the dataset. Include this informat
ion in your report.-

```
tmp <- counts
tmp
```

```
##
##     Black Crappie           Bluegill Bluntnose Minnow       Iowa Darter
##               36                220              103                32
##  Largemouth Bass        Pumpkinseed   Tadpole Madtom      Yellow Perch
##              228                 13                6                38
```

#7. Create a subset, <tmp2>, of just the species variable and display
the first five records

```
tmp2 <- bio$species
head(tmp2,n=5)
```

```
## [1] "Bluegill" "Bluegill" "Bluegill" "Bluegill" "Bluegill"
```

#8. Create a table, <w>, of the species variable. Display the class of
w

```
w <- table(bio$species)
w
```

```
##
##     Black Crappie           Bluegill Bluntnose Minnow       Iowa Darter
##               36                220              103                32
```

```
##    Largemouth Bass         Pumpkinseed    Tadpole Madtom       Yellow Perch
##               228                  13                 6                 38
```

#9. Convert <w> to a data frame named <t> and display the results

```
t <- as.data.frame(w)
t
```

```
##               Var1 Freq
## 1    Black Crappie   36
## 2         Bluegill  220
## 3 Bluntnose Minnow  103
## 4      Iowa Darter   32
## 5  Largemouth Bass  228
## 6      Pumpkinseed   13
## 7   Tadpole Madtom    6
## 8     Yellow Perch   38
```

#10. Extract and display the frequency values from the <t> data frame
```
t$Freq
```

```
## [1]  36 220 103  32 228  13   6  38
```

#11. Create a table named <cSpec> from the bio species attribute (variable) and confirm that you created a table which displays the number of species in the dataset <bio>

```
cSpec <- table(bio$species)
cSpec
```

```
##
##     Black Crappie            Bluegill Bluntnose Minnow       Iowa Darter
##               36                 220              103                32
##   Largemouth Bass         Pumpkinseed    Tadpole Madtom       Yellow Perch
##               228                  13                 6                38
```

#12. Create a table named <cSpecPct> that displays the species and percentage of records for each species. Confirm you created a table class.

```
?prop.table
```

```
## starting httpd help server ...
```

```
##   done
```

```
cSpecPct <- (table(bio$species)*100)/length(bio$species)
cSpecPct
```

```
##
##      Black Crappie            Bluegill Bluntnose Minnow        Iowa Darter
##          5.325444            32.544379        15.236686           4.733728
##   Largemouth Bass         Pumpkinseed    Tadpole Madtom       Yellow Perch
##         33.727811            1.923077         0.887574           5.621302
```

```
class(cSpecPct)
```

```
## [1] "table"
```

*#13. Convert the table, <cSpecPct>, to a data frame named <u> and conf
irm that <u> is a data frame*

```
u <- as.data.frame(cSpecPct)
u
```

```
##                 Var1      Freq
## 1     Black Crappie  5.325444
## 2          Bluegill 32.544379
## 3 Bluntnose Minnow 15.236686
## 4       Iowa Darter  4.733728
## 5   Largemouth Bass 33.727811
## 6       Pumpkinseed  1.923077
## 7    Tadpole Madtom  0.887574
## 8      Yellow Perch  5.621302
```

```
class(u)
```

```
## [1] "data.frame"
```

*#14. Create a barplot of <cSpec> with the following: titled Fish Coun
t with the following specifications:*
#Title: Fish Count
#Y axis is labeled "COUNTS"
#Color the bars Light Green
#Rotate Y axis to be horizontal
#Set the X axis font magnification to 60% of nominal

```
?barplot
barplot(cSpec, xlab="COUNTS", main = "Fish Count",horiz = TRUE, col="L
ight Green",
        las=2, cex.names = 0.45, cex.axis =0.60 )
```

Fish Count
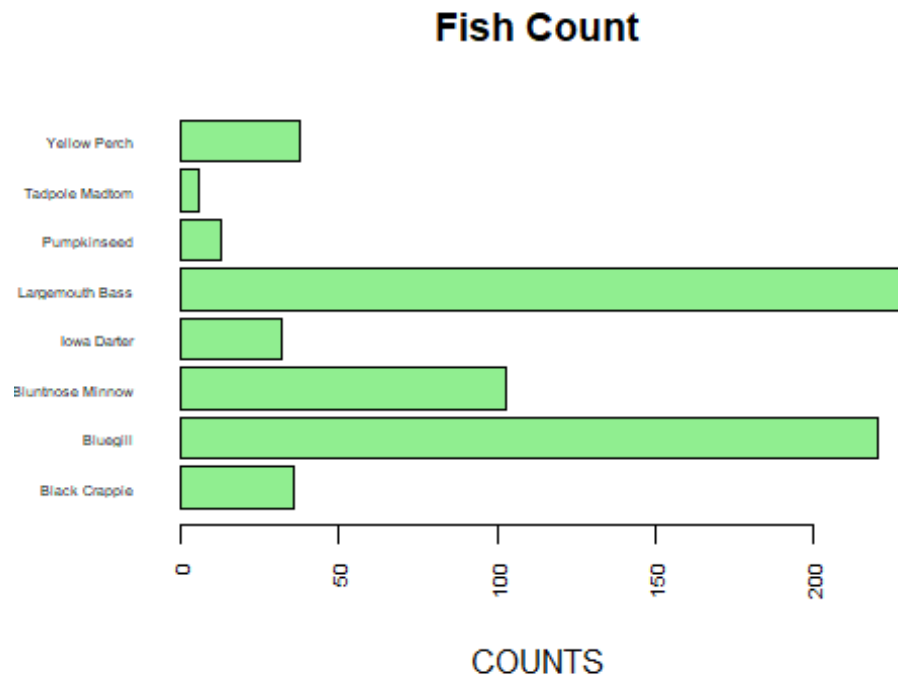
#15. Create a barplot of <cSpecPct>, with the following specifications
:
#Y axis limits of 0 to 4
#Y axis label color of Light Blue
#Title of "Fish Relative Frequency"

```
barplot(cSpecPct/10, ylim = c(0,4), col.axis="Light blue",col="Light Blue", main="Fish Relative Frequency", las=2,
        cex.axis = 0.70, cex.names = 0.60)
```

Fish Relative Frequency
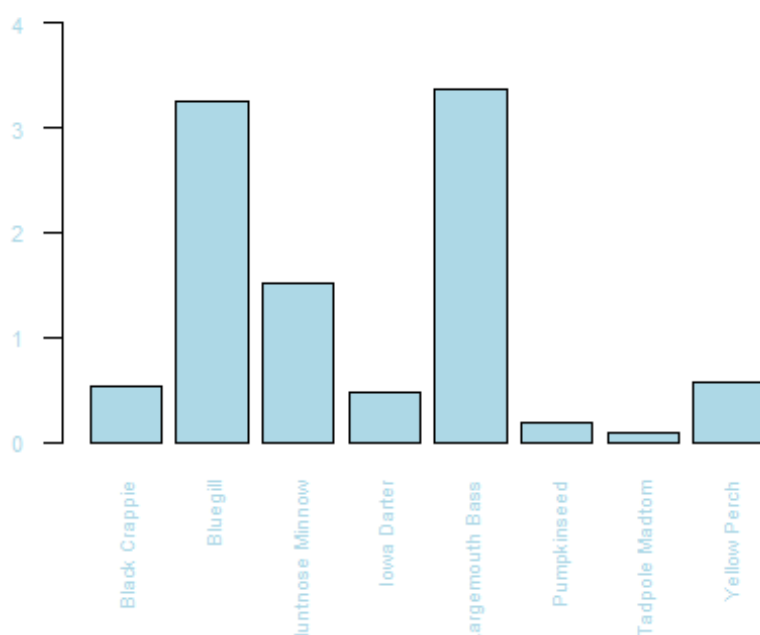
#16. Rearrange the <u> cSpec Pct data frame in descending order of relative frequency. Save the rearranged data frame as the object <d>

```
d <- u[order(-u$Freq),]
d

##               Var1       Freq
## 5  Largemouth Bass 33.727811
## 2         Bluegill 32.544379
## 3 Bluntnose Minnow 15.236686
## 8     Yellow Perch  5.621302
## 1    Black Crappie  5.325444
## 4      Iowa Darter  4.733728
## 6      Pumpkinseed  1.923077
## 7   Tadpole Madtom  0.887574
```

#17. Rename the <d> columns Var 1 to Species, and Freq to RelFreq

```
colnames(d)[1] <- "Species"
colnames(d)[2] <- "RelFreq"
d

##            Species    RelFreq
## 5  Largemouth Bass 33.727811
## 2         Bluegill 32.544379
```

```
## 3 Bluntnose Minnow 15.236686
## 8      Yellow Perch  5.621302
## 1     Black Crappie  5.325444
## 4       Iowa Darter  4.733728
## 6       Pumpkinseed  1.923077
## 7    Tadpole Madtom  0.887574
```

#18. Add new variables to <d> and call them cumfreq, counts, and cumcounts

```
counts
```

```
##
##     Black Crappie          Bluegill Bluntnose Minnow      Iowa Darter
##              36               220              103               32
##  Largemouth Bass       Pumpkinseed    Tadpole Madtom     Yellow Perch
##             228                13                 6               38
```

```
tdesc <- t[order(-t$Freq),]
tdesc$Freq
```

```
## [1] 228 220 103  38  36  32  13   6
```

```
d <- d %>% mutate(cumfreq=cumsum(d$RelFreq), counts=tdesc$Freq, cumcounts=cumsum(tdesc$Freq))
d
```

```
##            Species    RelFreq   cumfreq counts cumcounts
## 5  Largemouth Bass 33.727811  33.72781    228       228
## 2         Bluegill 32.544379  66.27219    220       448
## 3 Bluntnose Minnow 15.236686  81.50888    103       551
## 8     Yellow Perch  5.621302  87.13018     38       589
## 1    Black Crappie  5.325444  92.45562     36       625
## 4      Iowa Darter  4.733728  97.18935     32       657
## 6      Pumpkinseed  1.923077  99.11243     13       670
## 7   Tadpole Madtom  0.887574 100.00000      6       676
```

#19. Create a parameter variable <def_par> to store parameter variables

```
def_par <- as.data.frame(names(d))
```

#20. Create a barplot, <pc>, with the following specifications:
#d$counts of width 1, spacing of .15
#no boarder
#Axes: F
*#Yaxis limit 0,3.05*max*
#d$counts na.rm is true

```r
#y label is Cummulative Counts
#scale x axis to 70%
#names.arg: d$Species
#Title of the barplot is "Species Pareto"

par(mar=c(8,4,4,4))
pc <- barplot(d$counts, width = 1, space = 0.15, border = NA, axes = F
,
ylim = c(0,3.05*228),ylab ="Cummulative Counts",cex.axis = 0.7, cex.na
mes = 0.55,
names.arg = d$Species,las=2,col="Yellow", main = "Species Pareto")

#21. Add a cumulative counts line to the <pc> plot with the following:
#Spec line type is b
#Scale plotting text at 70%
#Data values are solid circles with color cyan4

lines(pc, d$cumcounts, type = 'b', cex=0.70, col="cyan4" )

#22. Place a grey box around the pareto plot

box(which = "plot", lty = "solid", col="grey")


#23.  Add a left side axis with the following specifications
#Horizontal values at tick marks at cumcounts on side 2
#Tickmark color of grey62
#Color of axis is grey62
#Axis scaled to 80% of normal

axis(side = 2,col.axis="grey62", col.ticks = "grey62", cex.axis=0.80,
at=c(0,d$cumcounts ))

#24. Add axis details on right side of box with the specifications:
#Spec: Side 4
#Tickmarks at cumcounts with labels from 0 to cumfreq with %,
#Axis color of cyan5 and label color of cyan4
#Axis font scaled to 80% of nominal

axis(side = 4, at=c(0,d$cumcounts), labels =c(0,d$cumfreq), col.axis="
cyan3", col="cyan4",
cex.axis=0.60)
```
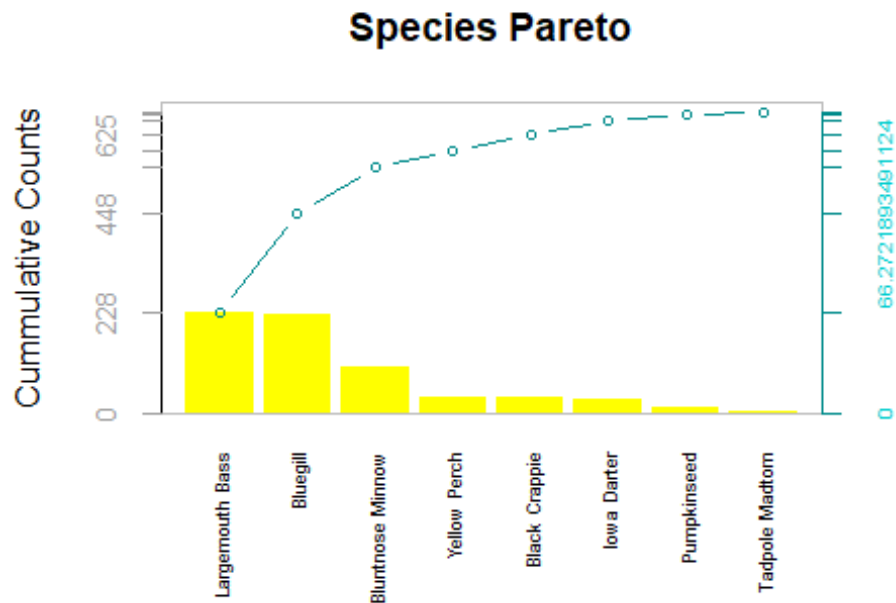
Species Pareto

#25. *Display the finished Species Pareto Plot (without the star water marks). Have your last name on the plot*

```
d$cumfreq <- format(round(d$cumfreq, 3), nsmall = 3)
d$cumfreq

## [1] " 33.728" " 66.272" " 81.509" " 87.130" " 92.456" " 97.189" " 9
9.112"
## [8] "100.000"

par(mar=c(8,4,4,4))
pc <- barplot(d$counts, width = 1, space = 0.15, border = NA, axes = F
,
              ylim = c(0,3.05*max(d$counts, na.rm = TRUE)),ylab ="Cumm
ulative Counts",cex.axis = 0.7,
              names.arg = d$Species,cex.names = 0.55, las=2,col="Yello
w",main = "Species Pareto : Sawant")
lines(pc, d$cumcounts, type = 'b', cex=0.70, col="cyan4" )
box(which = "plot", lty = "solid", col="grey")
axis(side = 2,col.axis="grey62", col.ticks = "grey62", cex.axis=0.80,
at=c(0,d$cumcounts ))
axis(side = 4,las=1, at=c(0,d$cumcounts), labels =c(0,d$cumfreq), col.
axis="cyan3", col="cyan4",
     cex.axis=0.80)
```
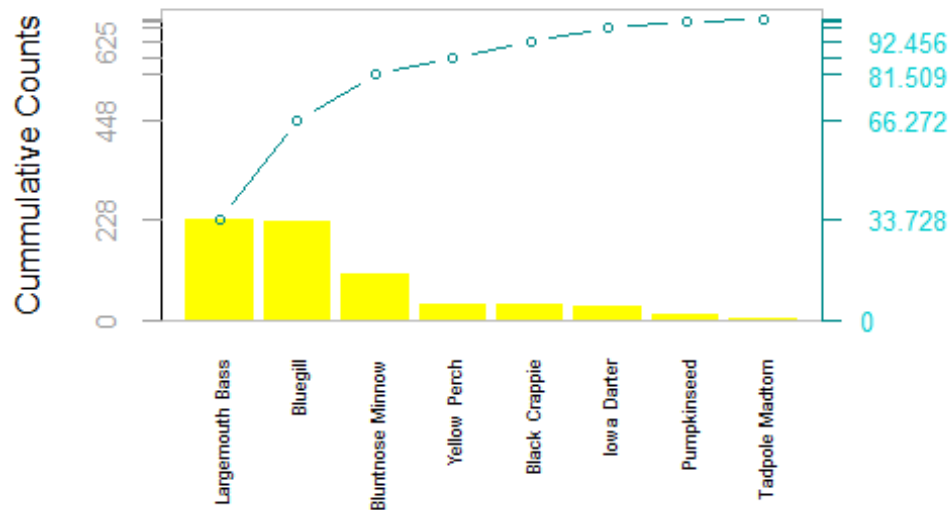
Species Pareto : Sawant


```
install.packages('tinytex')

## Installing package into 'C:/Users/Parth/OneDrive/Documents/R/win-li
brary/4.1'
## (as 'lib' is unspecified)

## package 'tinytex' successfully unpacked and MD5 sums checked
##
## The downloaded binary packages are in
##   C:\Users\Parth\AppData\Local\Temp\RtmpgPNLyt\downloaded_packages

tinytex::install_tinytex()
```