# SEACAR Nekton Analysis: Species Richness

Last compiled on 08 June, 2023

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## Important Notes

These scripts were created by J.E. Panzik (jepanzik@usf.edu) for SEACAR.

All scripts and outputs can be found on the SEACAR GitHub repository:

https://github.com/FloridaSEACAR/SEACAR_Trend_Analyses

This markdown file is designed to be compiled by SEACAR_Nekton_SpeciesRichness_ReportRender.R (https://github.com/FloridaSEACAR/SEACAR_Trend_Analyses/blob/main/Nekton/SEACAR_Nekton_SpeciesRichness_ReportRender.R).

Details on the determination of catch per unit effort can be found in the document SEACAR Nekton catch per unit effort.pdf (https://github.com/FloridaSEACAR/SEACAR_Trend_Analyses/blob/main/Nekton/SEACAR%20Nekton%20catch%20per%20unit%20effort.pdf).

## Libraries and Settings

Loads libraries used in the script. The inclusion of `scipen` option limits how frequently R defaults to scientific notation. Sets default settings for displaying warning and messages in created document, and sets figure dpi.

```
library(knitr)
library(data.table)
library(dplyr)
library(lubridate)
```

```r
library(ggplot2)
library(scales)
library(tidyr)
library(gridExtra)
#library(tidyverse)
library(ggpubr)
library(scales)
options(scipen=999)
knitr::opts_chunk$set(
   warning=FALSE,
   message=FALSE,
   dpi=200)
```

# File Import

Imports file that is determined in the SEACAR_Nekton_SpeciesRichness_ReportRender.R script.

The command `fread` is used because of its improved speed while handling large data files. Only columns that are used by the script are imported from the file, and are designated in the `select` input.

The script then gets the name of the parameter as it appears in the data file and units of the parameter.

The latest version of Nekton data is available at: https://usf.box.com/s/35sn0n0lrrxi9dtkik030nozbvnj9dyj

The file being used for the analysis is: **All_NEKTON_Parameters-2023-Jun-05.txt**

```r
#Import data from nekton file
data <- fread(file_in, sep="|", header=TRUE, stringsAsFactors=FALSE,
              na.strings=c("NULL","","NA"))

cat(paste("The data file used is:", file_short, sep="\n"))
```

```
## The data file used is:
## All_NEKTON_Parameters-2023-Jun-05.txt
```

# Data Filtering

Documentation on database filtering is provided here: SEACAR Documentation- Analysis Filters and Calculations.pdf (https://github.com/FloridaSEACAR/SEACAR_Trend_Analyses/blob/main/SEACAR%20Documentation%20-%20Analysis%20Filters%20and%20Calculations.pdf).

Imported data is initially filtered to only contain the parameter of interest.

The other filtering performed by the script at this point removes rows that are missing values for `ResultValue` and `EffortCorrection_100m2`, and removes any `EffortCorrection_100m2` that is 0 because it will cause an infinite number when determining Species Richness.

A group of unique `ManagedAreaName`, `ProgramID`, `ProgramName`, `ProgramLocationID`, `SampleDate`, and `GearSize_m` are being considered a “reference” for measurement. For each “reference”, the number of observed species is summed and then divided by the `EffortCorrection_100m2`to determine the Species Richness per 100 square meters.

The `ManagedAreaName` values from the data are actually shortened versions, and are merged with the full versions. The species richness data is then written to a file. And the list of Managed Areas with observations is stored.

```r
# Filter data for the desired parameter
data <- data[data$ParameterName==param_name,]

if (param_name=="Presence"){
         parameter <- "Species Richness"
      }
# Makes sure EffortCorrection is numeric value
data$EffortCorrection_100m2 <- as.numeric(data$EffortCorrection_100m2)

# Remove any data with missing EffortCorrection values
data <- data[!is.na(data$EffortCorrection_100m2),]

# Only keep data that has non-zero EffortCorrection values
data <- data[data$EffortCorrection_100m2!=0,]

# Remove any data with missing ResultValue entries
data <- data[!is.na(data$ResultValue),]

# Create Species Richness values for groups of unique combinations of
# ManagedAreaName, ProgramID, ProgramName, ProgramLocationID, SampleDate,
# GearType, and GearSize_m.
data <- data %>%
   group_by(ManagedAreaName, ProgramID, ProgramName, ProgramLocationID,
            SampleDate, GearType, GearSize_m) %>%
   summarise(ParameterName=parameter,
             Year=unique(Year), Month=unique(Month),
             N_Species=sum(ResultValue),
             EffortCorrection_100m2=as.numeric(unique(EffortCorrection_100m2)),
             SpeciesRichness=N_Species/unique(EffortCorrection_100m2))

# Adds AreaID for each managed area by combining the MA_All datatable to the
# data based on ManagedAreaName
data <- merge.data.frame(MA_All[,c("AreaID", "ManagedAreaName")],
                         data, by="ManagedAreaName", all=TRUE)

# Writes this data that is used by the rest of the script to a text file
fwrite(data, paste0(out_dir,"/Nekton_", param_file, "_UsedData.txt"), sep="|")

# Makes sure SampleDate is being stored as a Date object
data$SampleDate <- as.Date(data$SampleDate)

# Creates a variable with the names of all the managed areas that contain
# species observations
MA_Include <- unique(data$ManagedAreaName[!is.na(data$N_Species)])

# Puts the managed areas in alphabetical order
MA_Include <- MA_Include[order(MA_Include)]

# Determines the number of managed areas used
n <- length(MA_Include)
```

## Managed Area Statistics

Gets summary statistics for each managed area. Uses piping from dplyr package to feed into subsequent steps. The following steps are performed:

1. Group data that have the same `ManagedAreaName`, `Year`, `Month`, `GearType`, and `GearSize_m`.
   - Second summary statistics do not use the `Month` grouping and are only for `ManagedAreaName`, `Year`, `GearType`, and `GearSize_m`.
   - Third summary statistics do not use `Year` grouping and are only for `ManagedAreaName`, `Month`, `GearType`, and `GearSize_m`
   - Fourth summary statistics are only grouped based on `ManagedAreaName`, `GearType`, and `GearSize_m`
     - Determines the years that the minimum and maximum species richness occurred
2. For each group, provide the following information: Parameter Name (ParameterName), Number of Entries (N_Data), Lowest Value (Min), Largest Value (Max), Median, Mean, Standard Deviation, and a list of all Program IDs included in these measurements.
3. Sort the data in ascending (A to Z and 0 to 9) order based on `ManagedAreaName` then `Year` then `Month`
4. Write summary stats to a pipe-delimited .txt file in the output directory
   - [Nekton Output Files in SEACAR GitHub](https://github.com/FloridaSEACAR/SEACAR_Trend_Analyses/tree/main/Nekton/output) (https://github.com/FloridaSEACAR/SEACAR_Trend_Analyses/tree/main/Nekton/output)

```r
# Create summary statistics for each managed area based on Year and Month
# intervals, and each gear type and size.
MA_YM_Stats <- data %>%
   group_by(AreaID, ManagedAreaName, Year, Month, GearType, GearSize_m) %>%
   summarize(ParameterName=parameter,
             N_Data=length(na.omit(SpeciesRichness)),
             Min=min(SpeciesRichness),
             Max=max(SpeciesRichness),
             Median=median(SpeciesRichness),
             Mean=mean(SpeciesRichness),
             StandardDeviation=sd(SpeciesRichness),
             Programs=paste(sort(unique(ProgramName), decreasing=FALSE),
                            collapse=', '),
             ProgramIDs=paste(sort(unique(ProgramID), decreasing=FALSE),
                            collapse=', '))
# Puts the data in order based on ManagedAreaName, Year, Month, then GearSize
MA_YM_Stats <- as.data.table(MA_YM_Stats[order(MA_YM_Stats$ManagedAreaName,
                                               MA_YM_Stats$Year,
                                               MA_YM_Stats$Month,
                                               MA_YM_Stats$GearSize_m), ])
# Writes summary statistics to file
fwrite(MA_YM_Stats, paste0(out_dir,"/Nekton_", param_file,
                           "_MA_MMYY_Stats.txt"), sep="|")
# Removes variable storing data to improve computer memory
rm(MA_YM_Stats)

# Create summary statistics for each managed area based on Year intervals,
# and each gear type and size.
MA_Y_Stats <- data %>%
   group_by(AreaID, ManagedAreaName, Year, GearType, GearSize_m) %>%
   summarize(ParameterName=parameter,
```

```
             N_Data=length(na.omit(SpeciesRichness)),
             Min=min(SpeciesRichness),
             Max=max(SpeciesRichness),
             Median=median(SpeciesRichness),
             Mean=mean(SpeciesRichness),
             StandardDeviation=sd(SpeciesRichness),
             Programs=paste(sort(unique(ProgramName), decreasing=FALSE),
                              collapse=', '),
             ProgramIDs=paste(sort(unique(ProgramID), decreasing=FALSE),
                              collapse=', '))
# Puts the data in order based on ManagedAreaName, Year, then GearSize
MA_Y_Stats <- as.data.table(MA_Y_Stats[order(MA_Y_Stats$ManagedAreaName,
                                             MA_Y_Stats$Year,
                                             MA_Y_Stats$GearSize_m), ])
# Writes summary statistics to file
fwrite(MA_Y_Stats, paste0(out_dir,"/Nekton_", param_file,
                          "_MA_Yr_Stats.txt"), sep="|")

# Create summary statistics for each managed area based on Month intervals,
# and each gear type and size.
MA_M_Stats <- data %>%
   group_by(AreaID, ManagedAreaName, Month, GearType, GearSize_m) %>%
   summarize(ParameterName=parameter,
             N_Data=length(na.omit(SpeciesRichness)),
             Min=min(SpeciesRichness),
             Max=max(SpeciesRichness),
             Median=median(SpeciesRichness),
             Mean=mean(SpeciesRichness),
             StandardDeviation=sd(SpeciesRichness),
             Programs=paste(sort(unique(ProgramName), decreasing=FALSE),
                              collapse=', '),
             ProgramIDs=paste(sort(unique(ProgramID), decreasing=FALSE),
                              collapse=', '))
# Puts the data in order based on ManagedAreaName, Month, then GearSize
MA_M_Stats <- as.data.table(MA_M_Stats[order(MA_M_Stats$ManagedAreaName,
                                             MA_M_Stats$Month,
                                             MA_M_Stats$GearSize_m), ])
# Writes summary statistics to file
fwrite(MA_M_Stats, paste0(out_dir,"/Nekton_", param_file,
                          "_MA_Mo_Stats.txt"), sep="|")
# Removes variable storing data to improve computer memory
rm(MA_M_Stats)

# Create summary overall statistics for each managed area based each gear type
# and size.
MA_Ov_Stats <- data %>%
   group_by(AreaID, ManagedAreaName, GearType, GearSize_m) %>%
   summarize(ParameterName=parameter,
             N_Years=length(unique(na.omit(Year))),
             EarliestYear=min(Year),
             LatestYear=max(Year),
             N_Data=length(na.omit(SpeciesRichness)),
             Min=min(SpeciesRichness),
```

```
            Max=max(SpeciesRichness),
            Median=median(SpeciesRichness),
            Mean=mean(SpeciesRichness),
            StandardDeviation=sd(SpeciesRichness),
            Programs=paste(sort(unique(ProgramName), decreasing=FALSE),
                           collapse=', '),
            ProgramIDs=paste(sort(unique(ProgramID), decreasing=FALSE),
                             collapse=', '))
# Puts the data in order based on ManagedAreaName then GearSize
MA_Ov_Stats <- as.data.table(MA_Ov_Stats[order(MA_Ov_Stats$ManagedAreaName,
                                               MA_Ov_Stats$GearSize_m), ])
# Creates Year_MinRichness and Year_MaxRichness columns
MA_Ov_Stats$Year_MinRichness <- NA
MA_Ov_Stats$Year_MaxRichness <- NA

# Loops through each ManagedAreaName, GearType, and GearSize_m.
# determines what year the minimum and maximum species richness occurred
for(m in 1:nrow(MA_Ov_Stats)){
   # Stores ManagedAreaName, GearType, and GearSize_m for this row
   ma <- MA_Ov_Stats$ManagedAreaName[m]
   gear <- MA_Ov_Stats$GearType[m]
   size <- MA_Ov_Stats$GearSize_m[m]
   # Skips to next row if there are no data for this combination
   if(MA_Ov_Stats$N_Data[m]==0){
      next
   }
   # Gets subset of data from MA_Y_Stats (yearly summary stats) with this
   # combination of ManagedAreaName, GearType, and GearSize_m
   ds <- MA_Y_Stats[MA_Y_Stats$ManagedAreaName==ma &
                       MA_Y_Stats$GearType==gear &
                       MA_Y_Stats$GearSize_m==size,]
   # Gets the minimum and maximum Mean (yearly averages)
   min <- min(ds$Mean)
   max <- max(ds$Mean)
   #Determines what years those minimum and maximum values occured
   year_min <- ds$Year[ds$Mean==min]
   year_max <- ds$Year[ds$Mean==max]
   # Stores the occurrence years of the minimum and maximum into the overall
   # stats for this row
   MA_Ov_Stats$Year_MinRichness[m] <- year_min
   MA_Ov_Stats$Year_MaxRichness[m] <- year_max
}
# Replaces blank ProgramIDs with NA (missing values)
MA_Ov_Stats$ProgramIDs <- replace(MA_Ov_Stats$ProgramIDs,
                                  MA_Ov_Stats$ProgramIDs=="", NA)
MA_Ov_Stats$Programs <- replace(MA_Ov_Stats$Programs,
                                MA_Ov_Stats$Programs=="", NA)
# Write overall statistics to file
fwrite(MA_Ov_Stats, paste0(out_dir,"/Nekton_", param_file,
                           "_MA_Overall_Stats.txt"), sep="|")
# Removes entries from the overall statistics that do not have data.
# Based on presence or absence of EarliestYear
MA_Ov_Stats <- MA_Ov_Stats[!is.na(MA_Ov_Stats$EarliestYear), ]
```

# Appendix I: Managed Area Species Richness

The plots shown here are the species richness for each managed area with a yearly average, separated by gear size.

1. Set common plot theme.
2. Determine the earliest and latest year of the data to create x-axis scale and intervals
3. Determine the upper and lower limit of the plot for better y-axis labels
4. Determines what gear types are present and adjusts legend entries
5. Add the plot line
6. Set the plot type as a point plot with the size of the points
7. Create the title, x-axis, y-axis, and color fill labels
8. Set the y and x limits
9. Apply common plot theme
10. Add table with summary statistics below each figure

- Numerical non-integer values are rounded to 2 decimal places
- StandardDeviation is renamed StDev for space reasons

11. Create file name to save figure
12. Save figure as png file

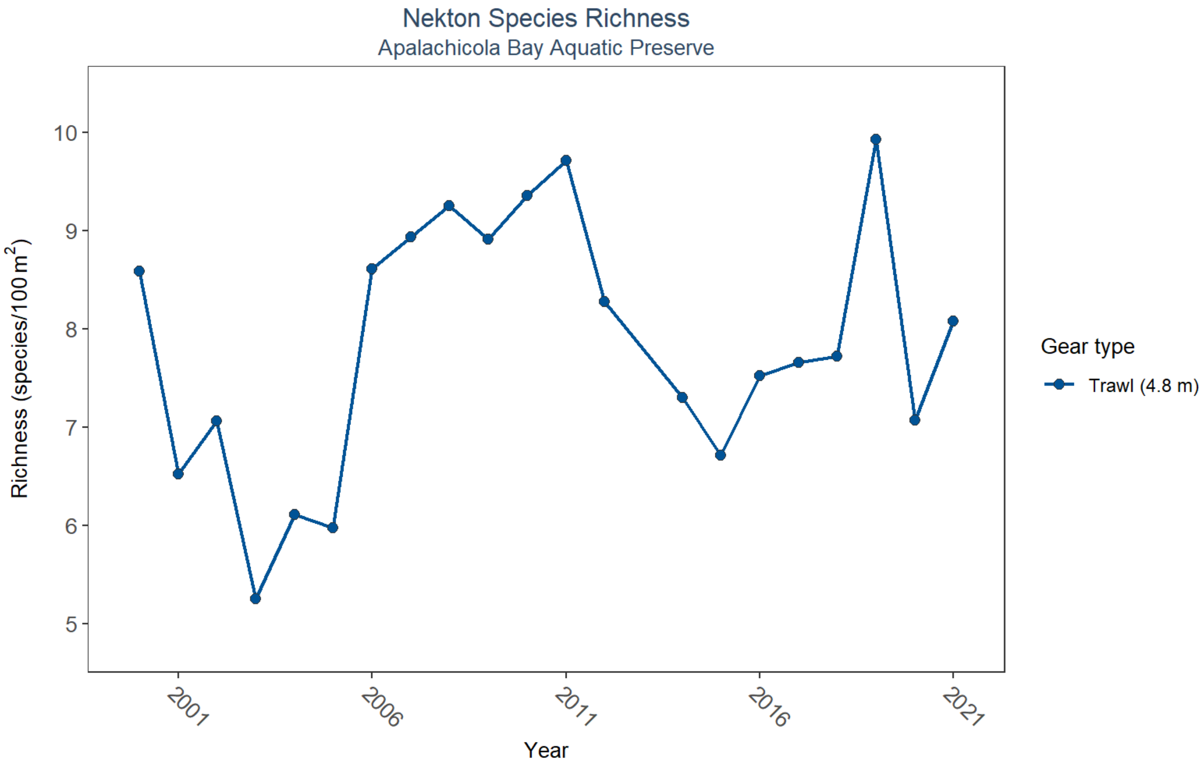
- Nekton Figures in SEACAR GitHub (https://github.com/FloridaSEACAR/SEACAR_Trend_Analyses/tree/main/Nekton/output/Figures)

```
# Defines standard plot theme: black and white, no major or minor grid lines,
# Arial font. Title is centered, size 12, and blue (hex coded). Subtitle is
# centered, size 10, and blue (hex coded). Legend title is size 10 and the
# legend is left-justified. X-axis title is size 10 and the margins are padded
# at the top and bottom to give more space for angled axis labels. Y-axis title
# is size 10 and margins are padded on the right side to give more space for
# axis labels. Axis labels are size 10 and the x-axis labels are rotated -45
# degrees with a horizontal justification that aligns them with the tick mark
plot_theme <- theme_bw() +
   theme(panel.grid.major = element_blank(),
         panel.grid.minor = element_blank(),
         text=element_text(family="Arial"),
         plot.title=element_text(hjust=0.5, size=12, color="#314963"),
         plot.subtitle=element_text(hjust=0.5, size=10, color="#314963"),
         legend.title=element_text(size=10),
         legend.text.align = 0,
         axis.title.x = element_text(size=10, margin = margin(t = 5, r = 0,
                                                              b = 10, l = 0)),
         axis.title.y = element_text(size=10, margin = margin(t = 0, r = 10,
                                                              b = 0, l = 0)),
         axis.text=element_text(size=10),
         axis.text.x=element_text(angle = -45, hjust = 0))

# Color palette for SEACAR
color_palette <- c("#005396", "#0088B1", "#00ADAE", "#65CCB3", "#AEE4C1", "#FDEBA8", "#F8CD6D", "#F5A80

# Defines and sets variable with standardized gear colors for plots
```

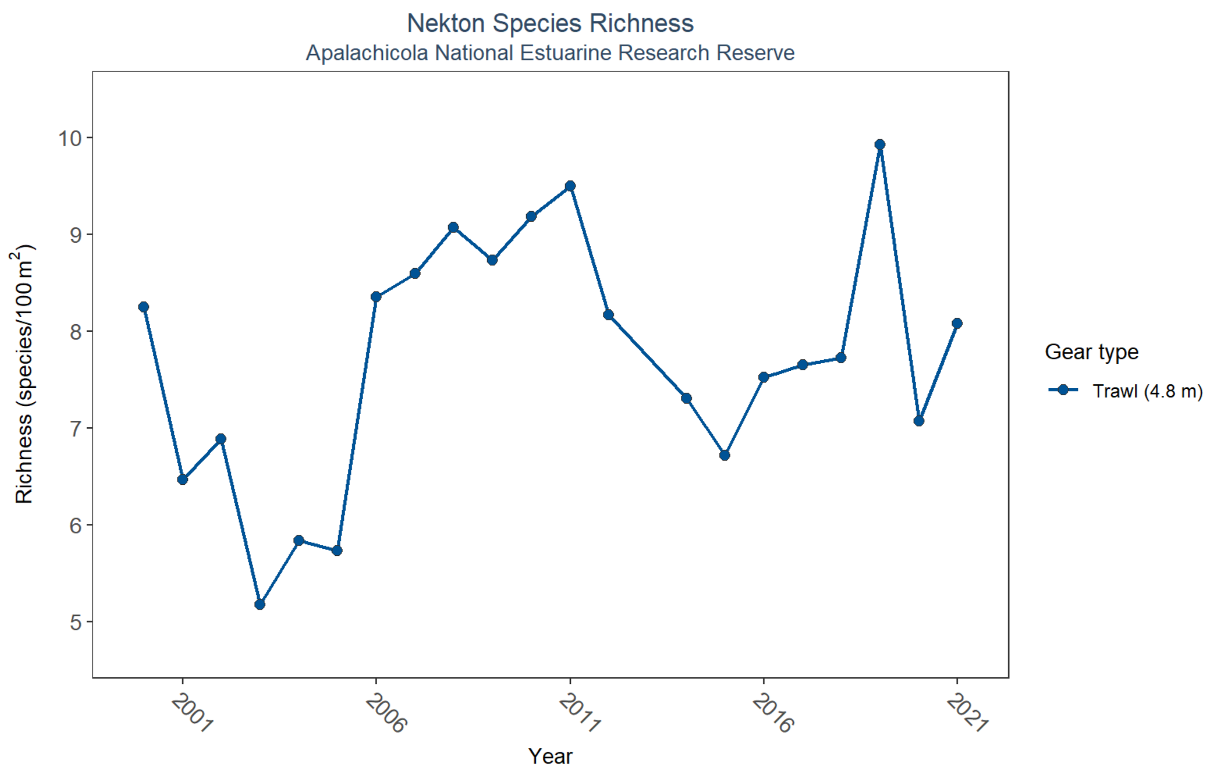
```r
gear_colors <- c("Trawl (4.8 m)"=color_palette[1],
                 "Trawl (6.1 m)"=color_palette[2],
                 "Seine (183 m)"=color_palette[3])

# Defines and sets variable with standardized gear shapes for plots
gear_shapes <- c("Trawl (4.8 m)"=21,
                 "Trawl (6.1 m)"=22,
                 "Seine (183 m)"=24)

# Loop that cycles through each managed area with data
if(n==0){
   # Prints a statement if there are no managed areas with appropriate data
   print("There are no monitoring locations that qualify.")
} else {
   for (i in 1:n) {
      # Gets data for target managed area
      plot_data <- MA_Y_Stats[MA_Y_Stats$ManagedAreaName==MA_Include[i]]
      # Gets the gear type(s) present for the managed area.
      # Combine type and size into one label for plots
      plot_data$GearType_Plot <- paste0(plot_data$GearType, " (",
                                        plot_data$GearSize_m, " m)")
      # Determines most recent year with available data for managed area
      t_max <- max(MA_Ov_Stats$LatestYear[MA_Ov_Stats$ManagedAreaName==
                                             MA_Include[i]])
      # Determines earliest recent year with available data for managed area
      t_min <- min(MA_Ov_Stats$EarliestYear[MA_Ov_Stats$ManagedAreaName==
                                               MA_Include[i]])
      # Determines how many years of data are present
      t <- t_max-t_min

      # Creates break intervals for plots based on number of years of data
      if(t>=30){
         # Set breaks to every 10 years if more than 30 years of data
         brk <- -10
      }else if(t<30 & t>=10){
         # Set breaks to every 5 years if between 30 and 10 years of data
         brk <- -5
      }else if(t<10 & t>=4){
         # Set breaks to every 2 years if between 10 and 4 years of data
         brk <- -2
      }else if(t<4){
         # Set breaks to every year if less than 4 years of data
         brk <- -1
      }
      # Determine range of data values for the managed area
      y_range <- max(plot_data$Mean) - min(plot_data$Mean)

      # Determines lower bound of y-axis based on data range. Set based on
      # relation of data range to minimum value. Designed to set lower boundary
      # to be 10% of the data range below the minimum value
      y_min <- if(min(plot_data$Mean)-(0.1*y_range)<0){
         # If 10% of the data range below the minimum value is less than 0,
         # set as 0
```

```
    y_min <- 0
  } else {
    # Otherwise set minimum bound as 10% data range below minimum value
    y_min <- min(plot_data$Mean)-(0.1*y_range)
  }

  # Sets upper bound of y-axis to be 10% of the data range above the
  # maximum value.
  y_max <- max(plot_data$Mean)+(0.1*y_range)

  # Determines what combination of gear are present for managed area
  # and subsets color and shape scheme to be used by plots.
  # Used so only gear combinations present for managed area appear in
  # the legend.
  gear_colors_plot <- gear_colors[unique(plot_data$GearType_Plot)]
  gear_shapes_plot <- gear_shapes[unique(plot_data$GearType_Plot)]

  # Creates plot object using plot_data and grouping by the plot gear types.
  # Data is plotted as symbols with connected lines.
  p1 <- ggplot(data=plot_data, group=as.factor(GearType_Plot)) +
    geom_line(aes(x=Year, y=Mean, color=as.factor(GearType_Plot)),
              size=0.75, alpha=1) +
    geom_point(aes(x=Year, y=Mean, fill=as.factor(GearType_Plot),
                   shape=as.factor(GearType_Plot)), size=2,
               color="#333333", alpha=1) +
    labs(title="Nekton Species Richness",
         subtitle=MA_Include[i],
         x="Year", y=bquote('Richness (species/100'*~m^{2}*')'),
         fill="Gear type", color="Gear type", shape="Gear type") +
    scale_x_continuous(limits=c(t_min-0.25, t_max+0.25),
                       breaks=seq(t_max, t_min, brk)) +
    scale_y_continuous(limits=c(y_min, y_max),
                       breaks=pretty_breaks(n=5)) +
    scale_fill_manual(values=gear_colors_plot) +
    scale_color_manual(values=gear_colors_plot) +
    scale_shape_manual(values=gear_shapes_plot) +
    plot_theme
  # Sets file name of plot created
  outname <- paste0("Nekton_", param_file, "_",
                    gsub(" ", "", MA_Include[i]), ".png")
  # Saves plot as a png image
  png(paste0(out_dir, "/Figures/", outname),
      width = 8,
      height = 4,
      units = "in",
      res = 200)
  print(p1)
  dev.off()

  # Creates a data table object to be shown underneath plots in report
  ResultTable <-
    MA_Ov_Stats[MA_Ov_Stats$ManagedAreaName==MA_Include[i],]
  # Removes location, gear, and parameter information because it is in plot
```

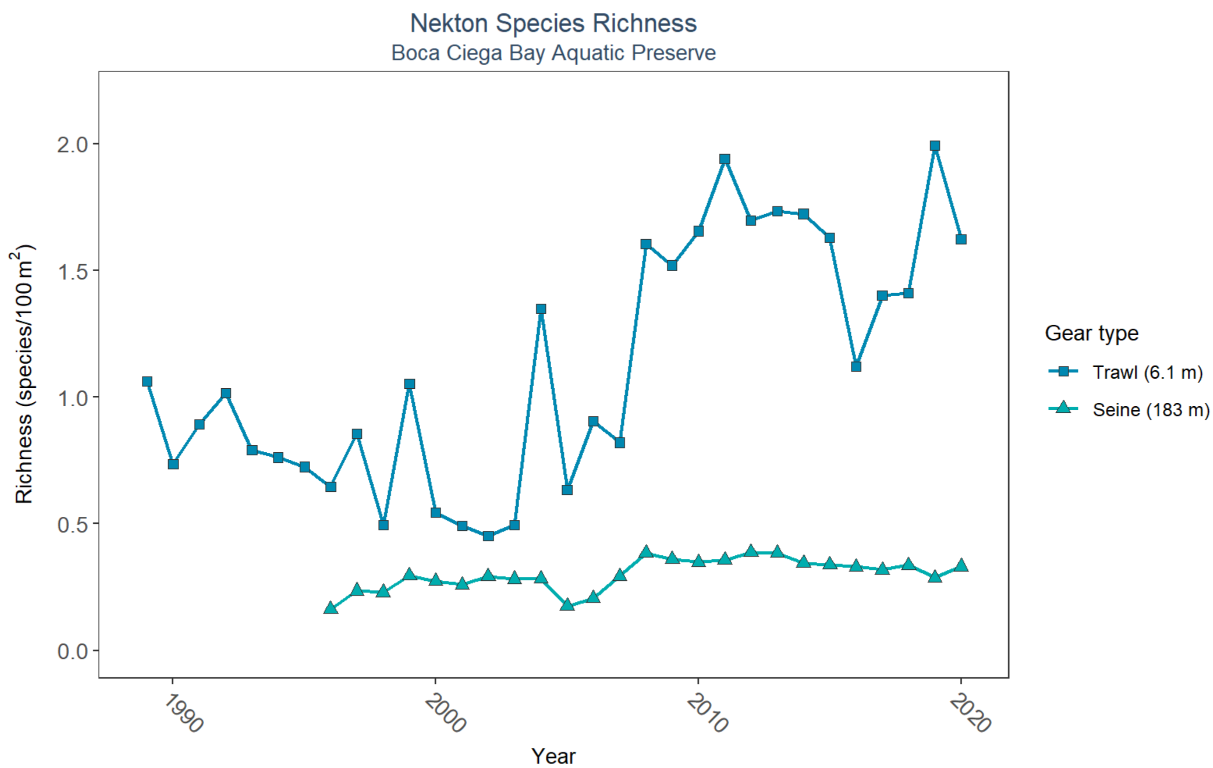
```
      # labels
      ResultTable <- ResultTable[,-c("AreaID", "ManagedAreaName",
                                     "ProgramIDs", "Programs", "GearType_Plot",
                                     "ParameterName")]
      # Renames StandardDeviation to StDev to save horizontal space
      ResultTable <- ResultTable %>%
         rename("StDev"="StandardDeviation")
      # Converts all non-integer values to 2 decimal places for space
      ResultTable$Min <- round(ResultTable$Min, digits=2)
      ResultTable$Max <- round(ResultTable$Max, digits=2)
      ResultTable$Median <- round(ResultTable$Median, digits=2)
      ResultTable$Mean <- round(ResultTable$Mean, digits=2)
      ResultTable$StDev <- round(ResultTable$StDev, digits=2)
      # Stores as plot table object
      t1 <- ggtexttable(ResultTable, rows = NULL,
                        theme=ttheme(base_size=7))
      # Combines plot and table into one figure
      print(ggarrange(p1, t1, ncol=1, heights=c(0.85, 0.15)))

      # Add extra space at the end to prevent the next figure from being too
      # close. Does not add space after last plot
      if(i!=n){
        cat("\n \n \n \n")
      }
   }
}
```



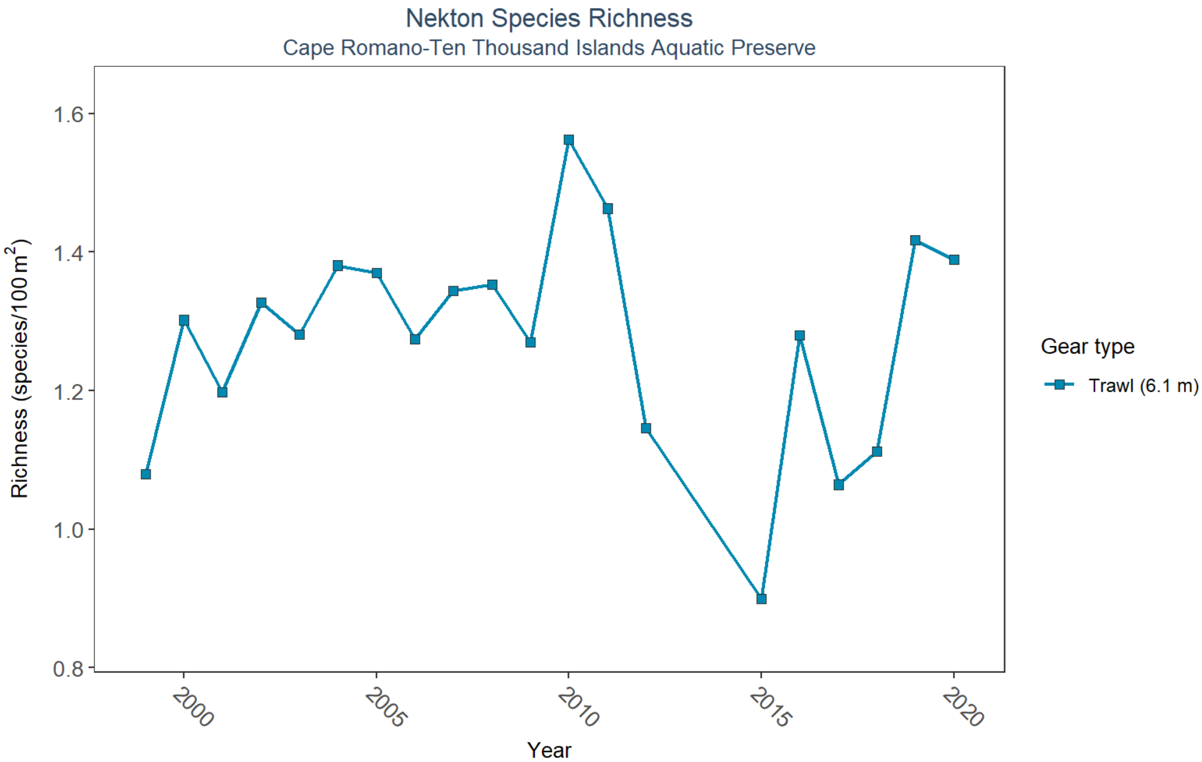

| GearType | GearSize_m | N_Years | EarliestYear | LatestYear | N_Data | Min | Max | Median | Mean | StDev | Year_MinRichness | Year_MaxRichness |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Trawl | 4.8 | 21 | 2000 | 2021 | 1664 | 0.19 | 24.81 | 7.78 | 7.79 | 3.62 | 2003 | 2019 |



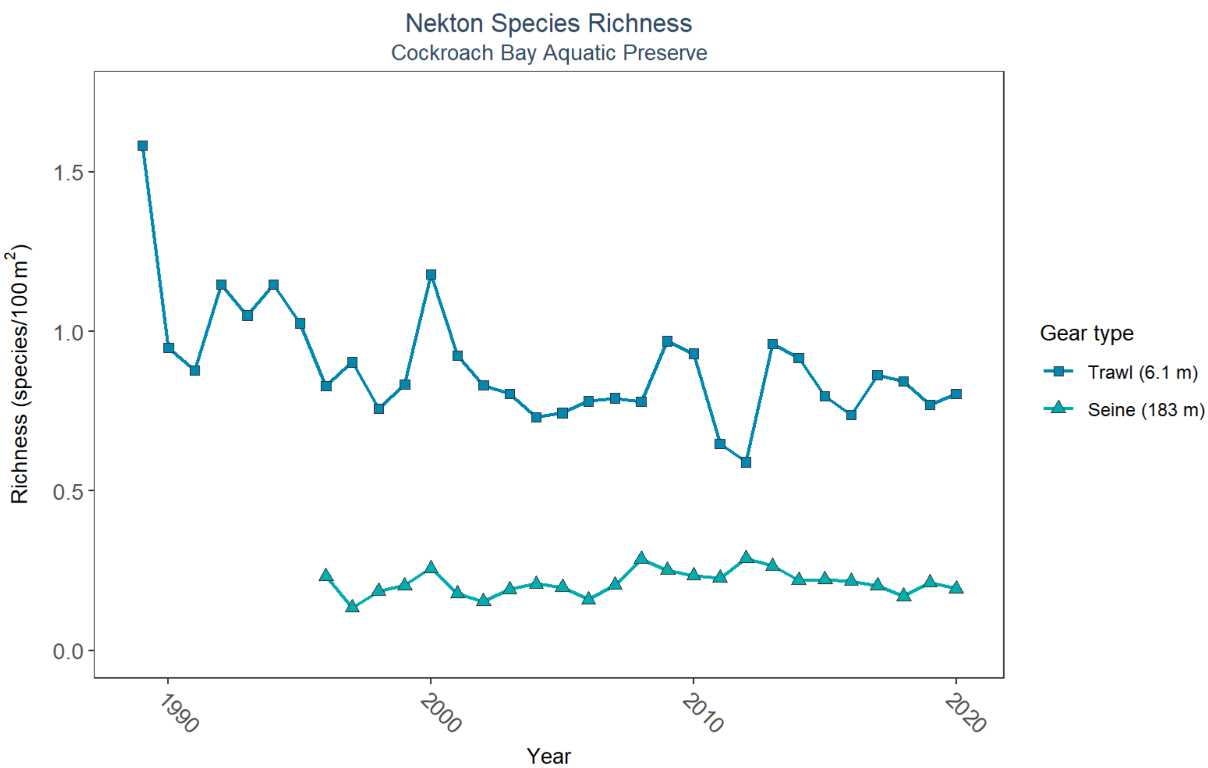

| GearType | GearSize_m | N_Years | EarliestYear | LatestYear | N_Data | Min | Max | Median | Mean | StDev | Year_MinRichness | Year_MaxRichness |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Trawl | 4.8 | 21 | 2000 | 2021 | 1931 | 0.19 | 24.81 | 7.41 | 7.62 | 3.72 | 2003 | 2019 |



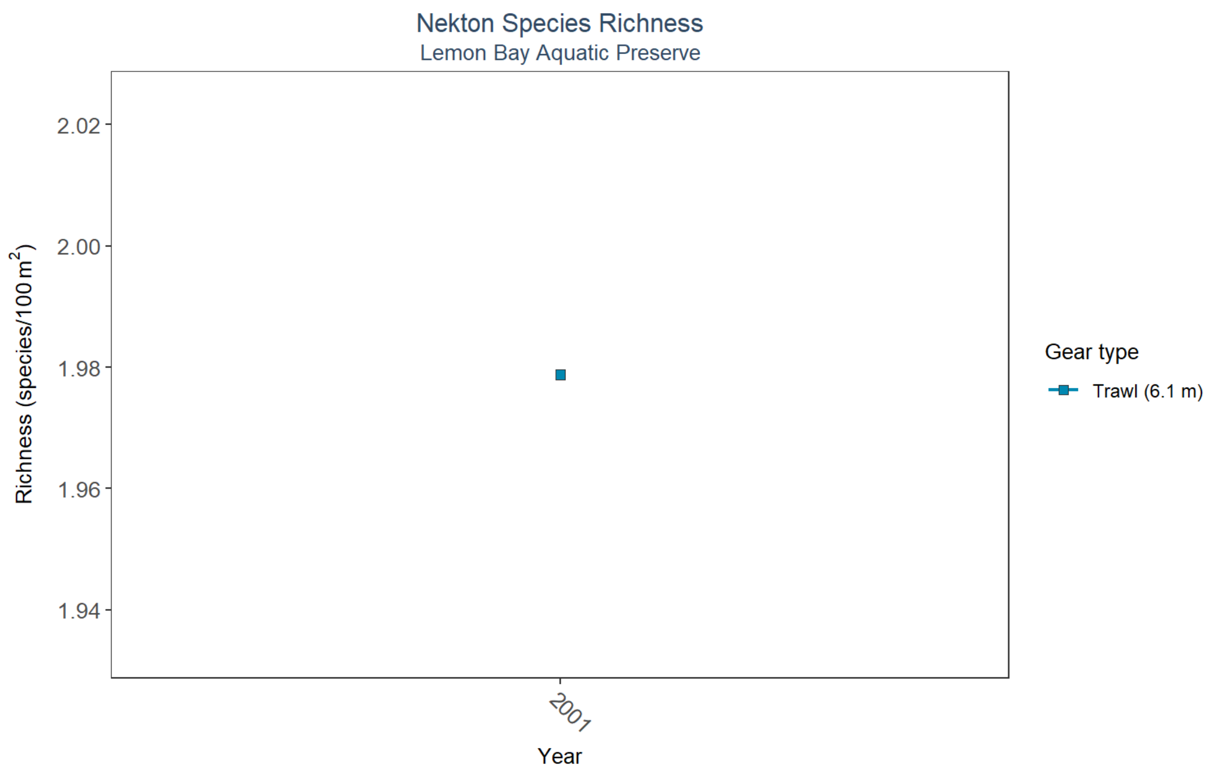

| GearType | GearSize_m | N_Years | EarliestYear | LatestYear | N_Data | Min | Max | Median | Mean | StDev | Year_MinRichness | Year_MaxRichness |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Trawl | 6.1 | 32 | 1989 | 2020 | 868 | 0 | 4.59 | 1.01 | 1.33 | 0.92 | 2002 | 2019 |
| Seine | 183.0 | 25 | 1996 | 2020 | 997 | 0 | 0.92 | 0.29 | 0.31 | 0.17 | 1996 | 2012 |



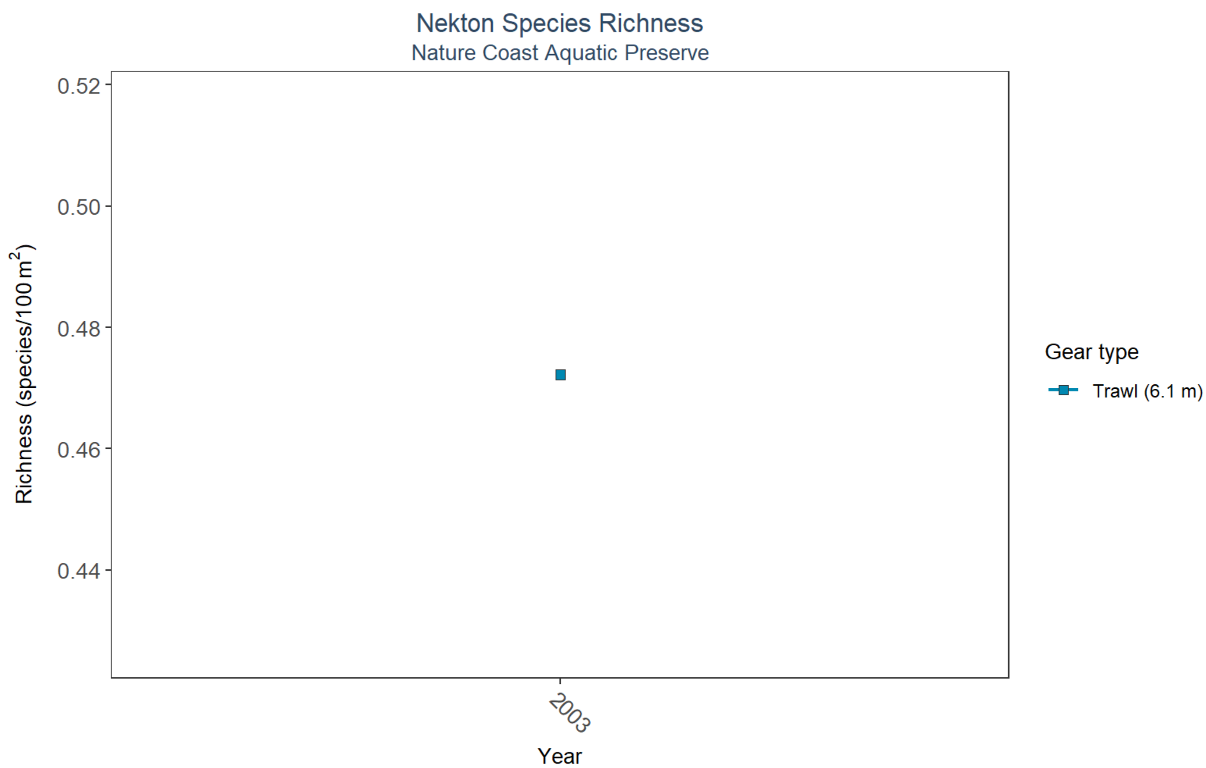

| GearType | GearSize_m | N_Years | EarliestYear | LatestYear | N_Data | Min | Max | Median | Mean | StDev | Year_MinRichness | Year_MaxRichness |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Trawl | 6.1 | 20 | 1999 | 2020 | 2555 | 0 | 3.37 | 1.35 | 1.31 | 0.53 | 2015 | 2010 |



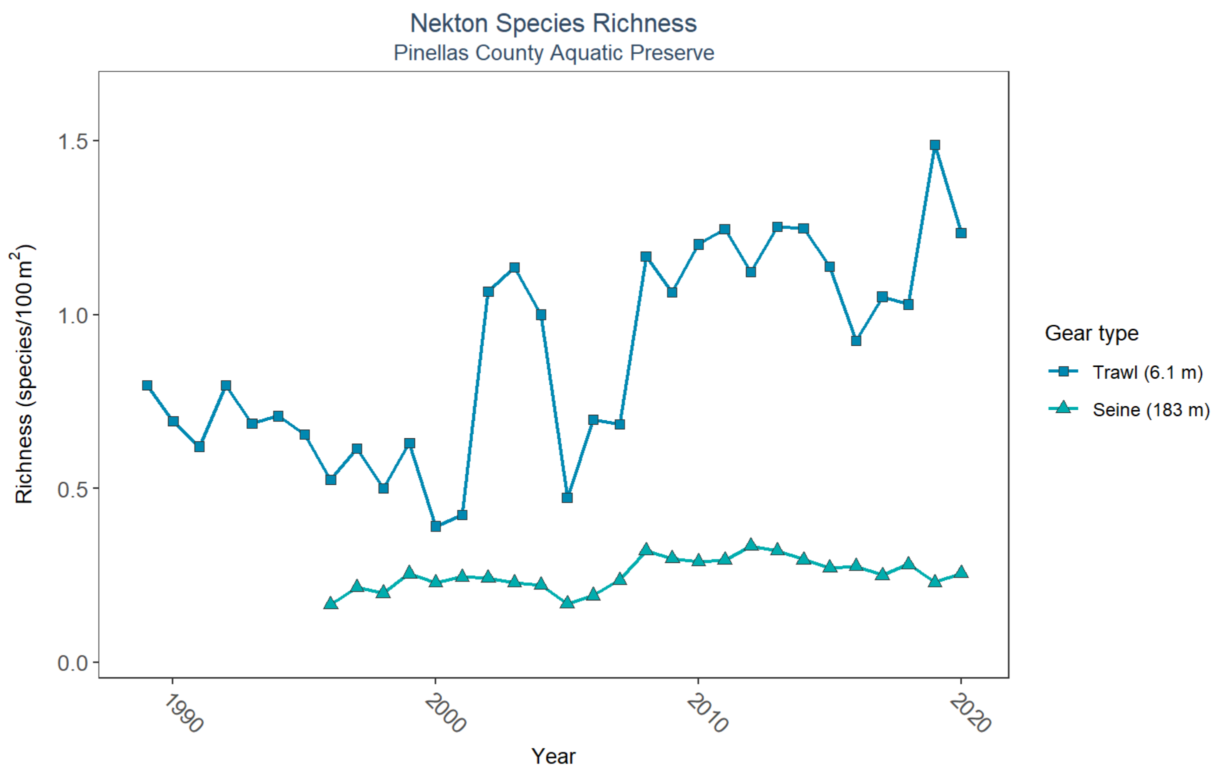

| GearType | GearSize_m | N_Years | EarliestYear | LatestYear | N_Data | Min | Max | Median | Mean | StDev | Year_MinRichness | Year_MaxRichness |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Trawl | 6.1 | 32 | 1989 | 2020 | 1666 | 0 | 3.75 | 0.75 | 0.84 | 0.54 | 2012 | 1989 |
| Seine | 183.0 | 25 | 1996 | 2020 | 476 | 0 | 0.78 | 0.19 | 0.21 | 0.12 | 1997 | 2012 |



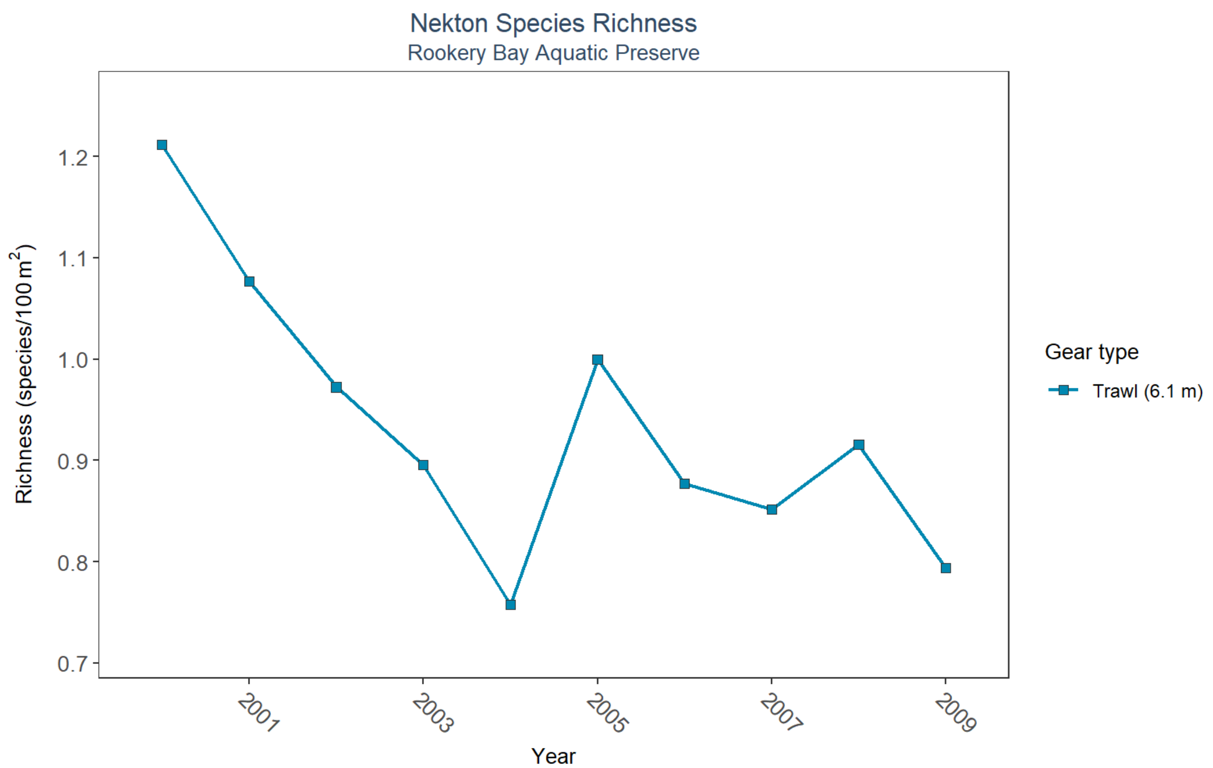

| GearType | GearSize_m | N_Years | EarliestYear | LatestYear | N_Data | Min | Max | Median | Mean | StDev | Year_MinRichness | Year_MaxRichness |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Trawl | 6.1 | 1 | 2001 | 2001 | 3 | 1.48 | 2.43 | 2.02 | 1.98 | 0.47 | 2001 | 2001 |



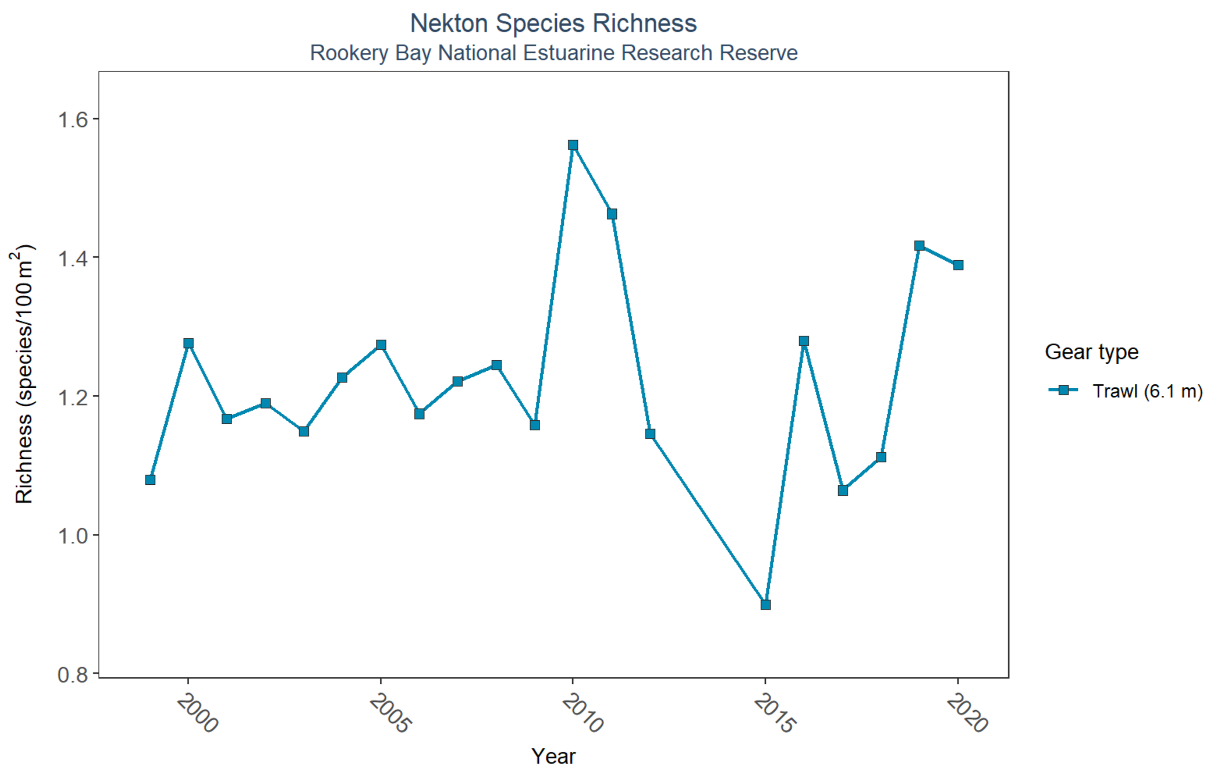

| GearType | GearSize_m | N_Years | EarliestYear | LatestYear | N_Data | Min | Max | Median | Mean | StDev | Year_MinRichness | Year_MaxRichness |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Trawl | 6.1 | 1 | 2003 | 2003 | 2 | 0 | 0.94 | 0.47 | 0.47 | 0.67 | 2003 | 2003 |



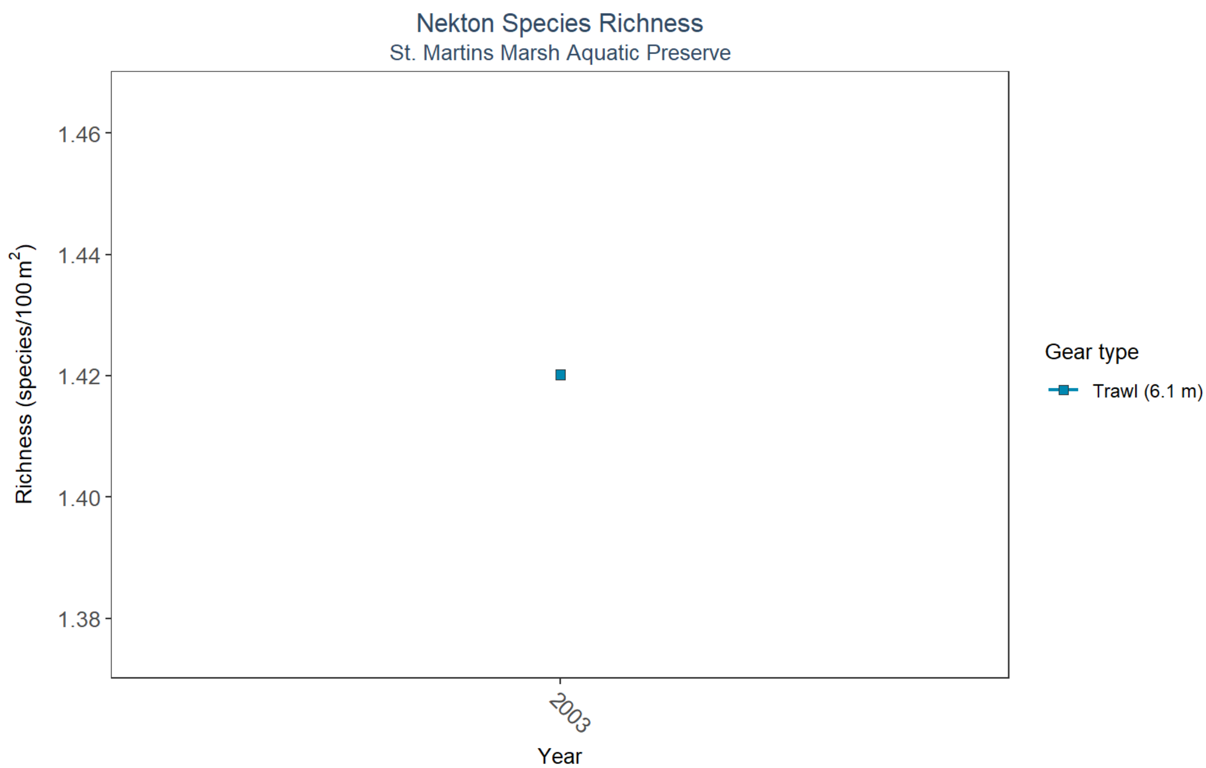

| GearType | GearSize_m | N_Years | EarliestYear | LatestYear | N_Data | Min | Max | Median | Mean | StDev | Year_MinRichness | Year_MaxRichness |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Trawl | 6.1 | 32 | 1989 | 2020 | 2903 | 0 | 6.21 | 0.71 | 0.95 | 0.78 | 2000 | 2019 |
| Seine | 183.0 | 25 | 1996 | 2020 | 2621 | 0 | 0.92 | 0.22 | 0.26 | 0.15 | 1996 | 2012 |



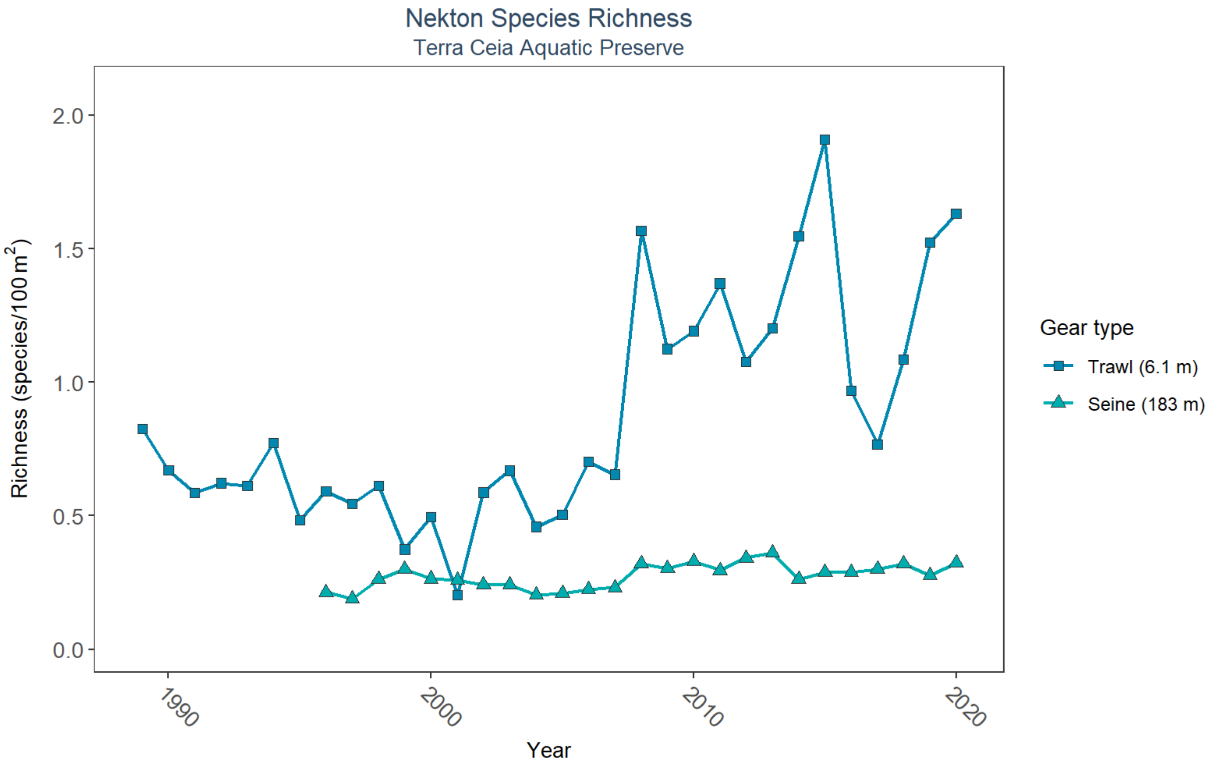

| GearType | GearSize_m | N_Years | EarliestYear | LatestYear | N_Data | Min | Max | Median | Mean | StDev | Year_MinRichness | Year_MaxRichness |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Trawl | 6.1 | 10 | 2000 | 2009 | 535 | 0 | 2.56 | 0.94 | 0.94 | 0.42 | 2004 | 2000 |




| GearType | GearSize_m | N_Years | EarliestYear | LatestYear | N_Data | Min | Max | Median | Mean | StDev | Year_MinRichness | Year_MaxRichness |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Trawl | 6.1 | 20 | 1999 | 2020 | 3098 | 0 | 3.37 | 1.21 | 1.24 | 0.53 | 2015 | 2010 |




| GearType | GearSize_m | N_Years | EarliestYear | LatestYear | N_Data | Min | Max | Median | Mean | StDev | Year_MinRichness | Year_MaxRichness |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Trawl | 6.1 | 1 | 2003 | 2003 | 1 | 1.42 | 1.42 | 1.42 | 1.42 | NA | 2003 | 2003 |




| GearType | GearSize_m | N_Years | EarliestYear | LatestYear | N_Data | Min | Max | Median | Mean | StDev | Year_MinRichness | Year_MaxRichness |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Trawl | 6.1 | 32 | 1989 | 2020 | 709 | 0 | 4.22 | 0.74 | 1.03 | 0.84 | 2001 | 2015 |
| Seine | 183.0 | 25 | 1996 | 2020 | 921 | 0 | 0.75 | 0.27 | 0.28 | 0.13 | 1997 | 2013 |