

Adding a directory and datafile

```
getwd()
```

```
## [1] "/Users/meghannadzam/Desktop/Datasets and Figs"
```

```
seasnail <- read.csv("~/praccomp2024/Praccomp2024/tidydata_SeaSnail_2024.csv")  
#seasnail
```

Checking to make sure each column variable is the correct type of data format.

```
typeof(seasnail$site_id)
```

```
## [1] "character"
```

```
#seasnail$site_id  
typeof(seasnail$date)
```

```
## [1] "integer"
```

```
#seasnail$date  
typeof(seasnail$visit_no)
```

```
## [1] "integer"
```

```
#seasnail$visit_no  
typeof(seasnail$season)
```

```
## [1] "character"
```

```
typeof(seasnail$sex)
```

```
## [1] "integer"
```

```
# 0 = male, 1 = female  
typeof(seasnail$shell_height_mm)
```

```
## [1] "double"
```

```
typeof(seasnail$infection_status)
```

```
## [1] "integer"
```

```
# 0 = uninfected, 1 = infected
typeof(seasnail$trematode_species)
```

```
## [1] "character"
```

```
typeof(seasnail$snail_quadrat_no)
```

```
## [1] "character"
```

```
typeof(seasnail$snail_density)
```

```
## [1] "integer"
```

```
typeof(seasnail$snail_density)
```

```
## [1] "integer"
```

```
typeof(seasnail$lt_height_ft)
```

```
## [1] "double"
```

```
typeof(seasnail$water_temp_C)
```

```
## [1] "double"
```

```
typeof(seasnail$air_temp_C)
```

```
## [1] "double"
```

```
typeof(seasnail$salinity_ppt)
```

```
## [1] "double"
```

```
typeof(seasnail$water_depth_cm)
```

```
## [1] "double"
```

```
typeof(seasnail$quadrat_distance_m)
```

```
## [1] "double"
```

```
typeof(seasnail$shoot_density)
```

```
## [1] "integer"
```

```
typeof(seasnail$grass_species_1)
```

```
## [1] "character"
```

```
typeof(seasnail$no_blades_1)
```

```
## [1] "character"
```

```
typeof(seasnail$grass_species_2)
```

```
## [1] "character"
```

```
typeof(seasnail$no_blades_2)
```

```
## [1] "integer"
```

```
#seasnail
```

Adding tidyverse

```
str(seasnail)
```

```
## 'data.frame': 2700 obs. of 43 variables:
## $ site_id : chr "HI" "HI" "HI" "HI" ...
## $ date : int 20240405 20240405 20240405 20240405 20240405 20240405 20240405 20240405 20240405 20240405 ...
## $ visit_no : int 1 1 1 1 1 1 1 1 1 1 ...
## $ season : chr "early summer" "early summer" "early summer" "early summer" ...
## $ location : chr "straits" "straits" "straits" "straits" ...
## $ snail_id : chr "HI_1_01" "HI_1_02" "HI_1_03" "HI_1_04" ...
## $ snail_no : int 1 2 3 4 5 6 7 8 9 10 ...
## $ sex : int 1 0 0 0 0 0 0 1 0 1 ...
## $ shell_height_mm : num 19.2 14 17.3 19.5 16.9 16.5 18.4 18 16.6 22.6 ...
## $ infection_status : int 0 0 0 0 0 0 0 0 0 0 ...
## $ trematode_species : chr "" "" "" "" ...
## $ snail_quadrat_no : chr "Q1" "Q2" "Q3" "" ...
## $ snail_density : int 9 32 40 NA NA NA NA NA NA ...
## $ lt_height_ft : num -0.06 NA NA NA NA NA NA NA NA ...
## $ water_temp_C : num 21.3 NA NA NA NA NA NA NA NA ...
## $ air_temp_C : num 17.2 NA NA NA NA NA NA NA NA ...
## $ salinity_ppt : num 30.4 NA NA NA NA NA NA NA NA ...
## $ grass_quadrat_no : chr "Q1" "Q2" "Q3" "" ...
## $ water_depth_cm : num 0 0 0 NA NA NA NA NA NA ...
## $ quadrat_distance_m : num 5.58 6.52 7.66 NA NA NA NA NA NA ...
## $ shoot_density : int 1 1 1 NA NA NA NA NA NA ...
## $ grass_species_1 : chr "zostera" "zostera" "zostera" "" ...
## $ no_blades_1 : chr "5" "5" "5" "" ...
## $ blade1_length_cm_1 : logi NA NA NA NA NA NA ...
## $ blade2_length_cm_1 : logi NA NA NA NA NA NA ...
```

```
## $ blade3_length_cm_1      : logi  NA NA NA NA NA NA ...
## $ blade4_length_cm_1      : logi  NA NA NA NA NA NA ...
## $ blade5_length_cm_1      : logi  NA NA NA NA NA NA ...
## $ grass_species_2         : chr   "" "" "" "" ...
## $ no_blades_2             : int   NA NA NA NA NA NA NA NA NA NA NA ...
## $ blade1_length_cm_2      : logi  NA NA NA NA NA NA ...
## $ blade2_length_cm_2      : logi  NA NA NA NA NA NA ...
## $ blade3_length_cm_2      : logi  NA NA NA NA NA NA ...
## $ blade4_length_cm_2      : logi  NA NA NA NA NA NA ...
## $ blade5_length_cm_2      : logi  NA NA NA NA NA NA ...
## $ tin_wt_g                : logi  NA NA NA NA NA NA ...
## $ dry_filter_wt_g         : logi  NA NA NA NA NA NA ...
## $ tin_dry_filter_wt_g     : logi  NA NA NA NA NA NA ...
## $ wet_filter_wt_g         : logi  NA NA NA NA NA NA ...
## $ tin_filter_epibiont_wt_g: logi  NA NA NA NA NA NA ...
## $ epibiont_biomass_mg     : logi  NA NA NA NA NA NA ...
## $ foil_wt_g               : logi  NA NA NA NA NA NA ...
## $ grass_dry_wt_g          : logi  NA NA NA NA NA NA ...
```

```
library(tidyverse)
```

```
## Warning: package 'ggplot2' was built under R version 4.3.2
```

```
## Warning: package 'tidyr' was built under R version 4.3.2
```

```
## -- Attaching core tidyverse packages ----- tidyverse 2.0.0 --
## v dplyr      1.1.4      v readr      2.1.5
## v forcats    1.0.0      v stringr    1.5.1
## v ggplot2    3.5.1      v tibble     3.2.1
## v lubridate  1.9.3      v tidyr      1.3.1
## v purrr      1.0.2
```

```
## -- Conflicts ----- tidyverse_conflicts() --
```

```
## x dplyr::filter() masks stats::filter()
```

```
## x dplyr::lag()     masks stats::lag()
```

```
## i Use the conflicted package (<http://conflicted.r-lib.org/>) to force all conflicts to become errors
```

Removal of all fully empty columns

```
#seasnail %>% dplyr::select(-blade1_length_cm_1, -blade2_length_cm_1, -blade3_length_cm_1, -blade4_leng
```

Filtering

Filtering for comparing salinity measurements across all sites in all sample seasons: early summer, late summer, and fall

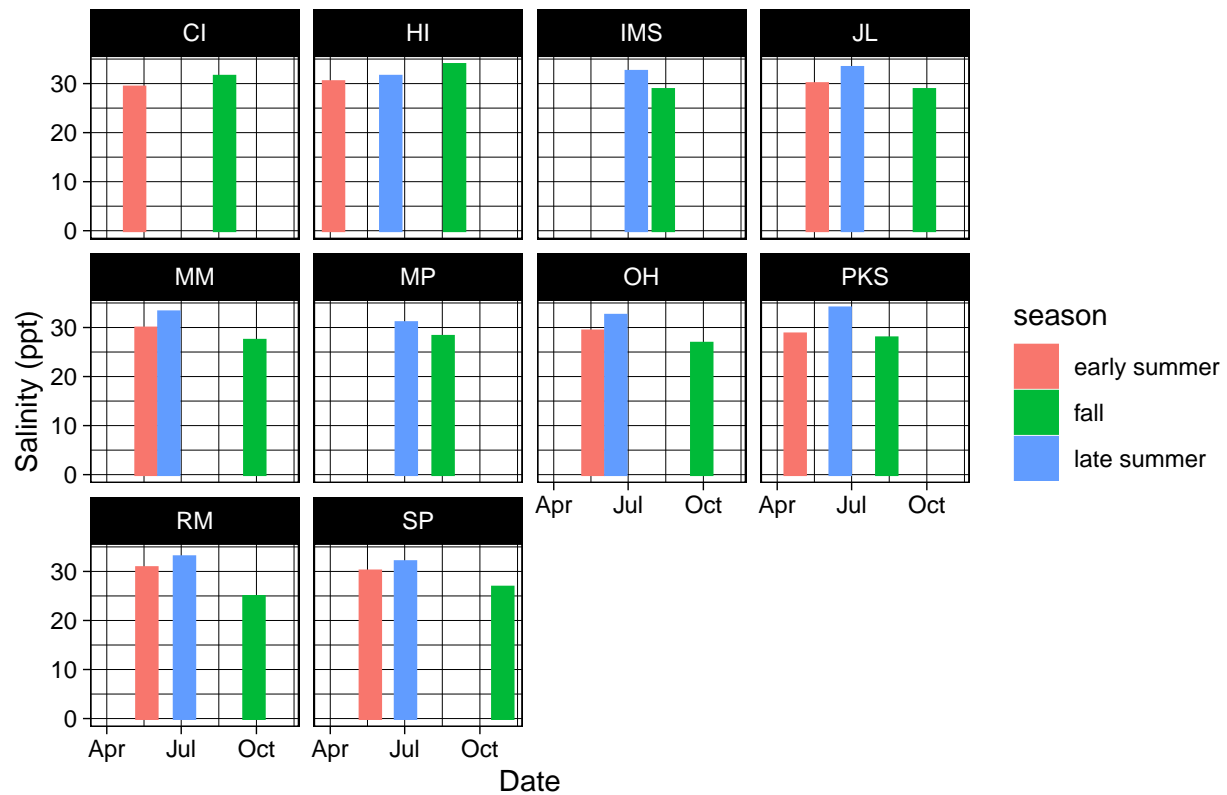
```
seasnail_season_salinity <- seasnail %>% dplyr::select(site_id, season, date, salinity_ppt) %>%
  filter(!is.na(salinity_ppt)) %>%
  mutate(date = ymd(date))
seasnail_season_salinity
```

##	site_id	season	date	salinity_ppt
## 1	HI	early summer	2024-04-05	30.40
## 2	PKS	early summer	2024-04-23	28.70
## 3	CI	early summer	2024-05-05	29.30
## 4	OH	early summer	2024-05-19	29.30
## 5	MM	early summer	2024-05-19	29.90
## 6	JL	early summer	2024-05-20	30.00
## 7	RM	early summer	2024-05-20	30.78
## 8	SP	early summer	2024-05-20	30.10
## 9	HI	late summer	2024-06-14	31.50
## 10	OH	late summer	2024-06-16	32.50
## 11	MM	late summer	2024-06-16	33.20
## 12	PKS	late summer	2024-06-17	34.00
## 13	JL	late summer	2024-07-02	33.30
## 14	SP	late summer	2024-07-02	32.00
## 15	MP	late summer	2024-07-03	31.00
## 16	RM	late summer	2024-07-05	33.00
## 17	IMS	late summer	2024-07-11	32.50
## 18	IMS	fall	2024-08-13	28.80
## 19	PKS	fall	2024-08-13	27.90
## 20	MP	fall	2024-08-17	28.20
## 21	CI	fall	2024-08-23	31.50
## 22	HI	fall	2024-08-31	33.90
## 23	JL	fall	2024-09-28	28.80
## 24	RM	fall	2024-09-28	24.90
## 25	MM	fall	2024-09-29	27.40
## 26	OH	fall	2024-09-29	26.80
## 27	SP	fall	2024-10-29	26.80

Plot salinity per season by date

```
seasnail_season_salinity_bars <- ggplot(seasnail_season_salinity, aes(x = date, y = salinity_ppt, fill = season)) +
  labs(x = "Date", y = "Salinity (ppt)", title = "Seasonal Salinity over Time") +
  geom_col(aes(color = season)) +
  theme_linedraw() +
  facet_wrap(~ site_id)
seasnail_season_salinity_bars
```

Seasonal Salinity over Time



```
ggsave("data/seasnail_season_salinity_bars.png")
```

```
## Saving 6.5 x 4.5 in image
```

```
library(ggplot2)
#install.packages("ggExtra")
library(ggExtra)
#install.packages("paletteer")
library(paletteer)
#install.packages("ggstatsplot")
library(ggstatsplot)
```

```
## Warning: package 'ggstatsplot' was built under R version 4.3.3
```

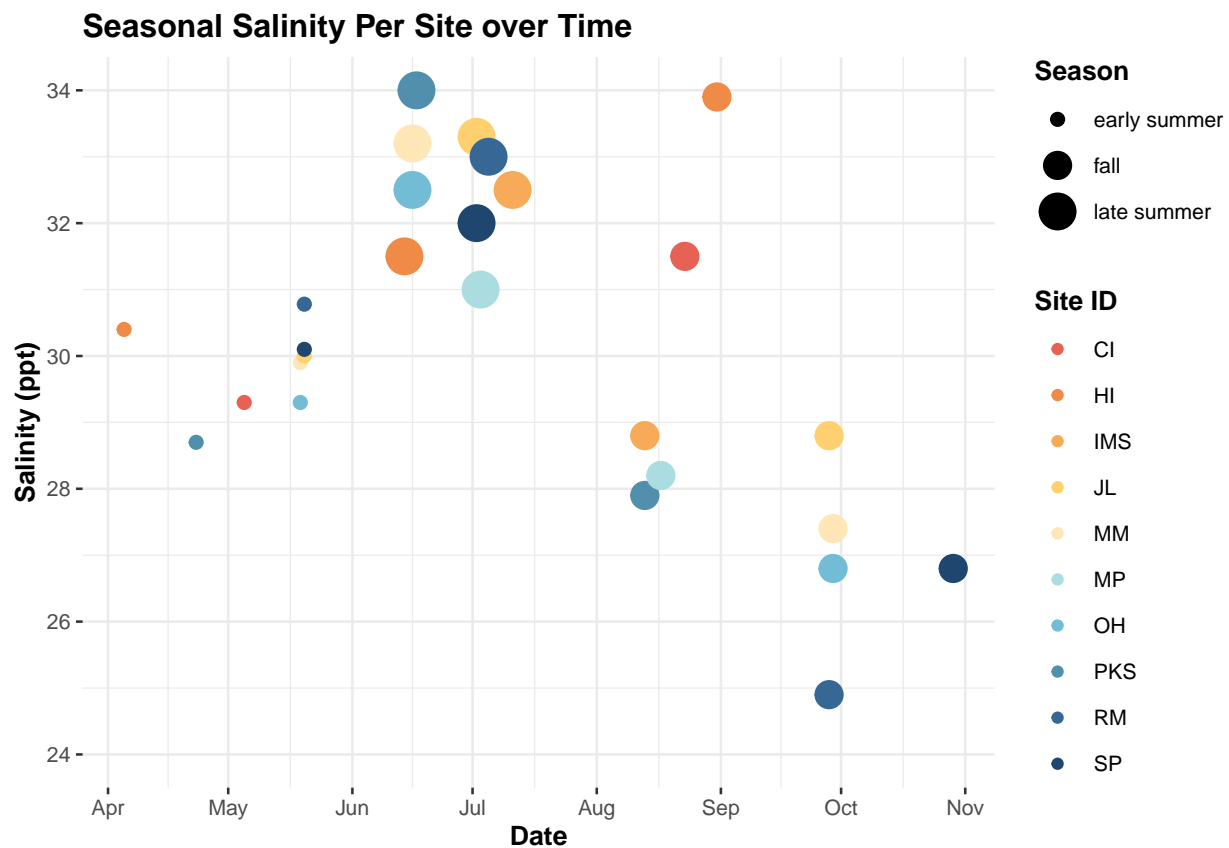
```
## You can cite this package as:
## Patil, I. (2021). Visualizations with statistical details: The 'ggstatsplot' approach.
## Journal of Open Source Software, 6(61), 3167, doi:10.21105/joss.03167
```

```
#install.packages("statsExpressions")
library(statsExpressions)
```

```
## Warning: package 'statsExpressions' was built under R version 4.3.3
```

```
ggplot(seasnaill_season_salinity, aes(x = date, y = salinity_ppt, color = site_id, size = season)) +
  geom_point() +
  theme_ggstatsplot() +
  scale_colour_paletteer_d("MetBrewer::Hiroshige") +
  labs(x = "Date", y = "Salinity (ppt)", title = "Seasonal Salinity Per Site over Time", size = "Season") +
  theme(legend.position="right") +
  scale_x_date(date_breaks = "1 month", date_labels = "%b") +
  scale_y_continuous(limits = c(24,34))
```

```
## Warning: Using size for a discrete variable is not advised.
```



```
ggsave("data/seasnaill_season_salinity.png")
```

```
## Saving 6.5 x 4.5 in image
```

```
## Warning: Using size for a discrete variable is not advised.
```

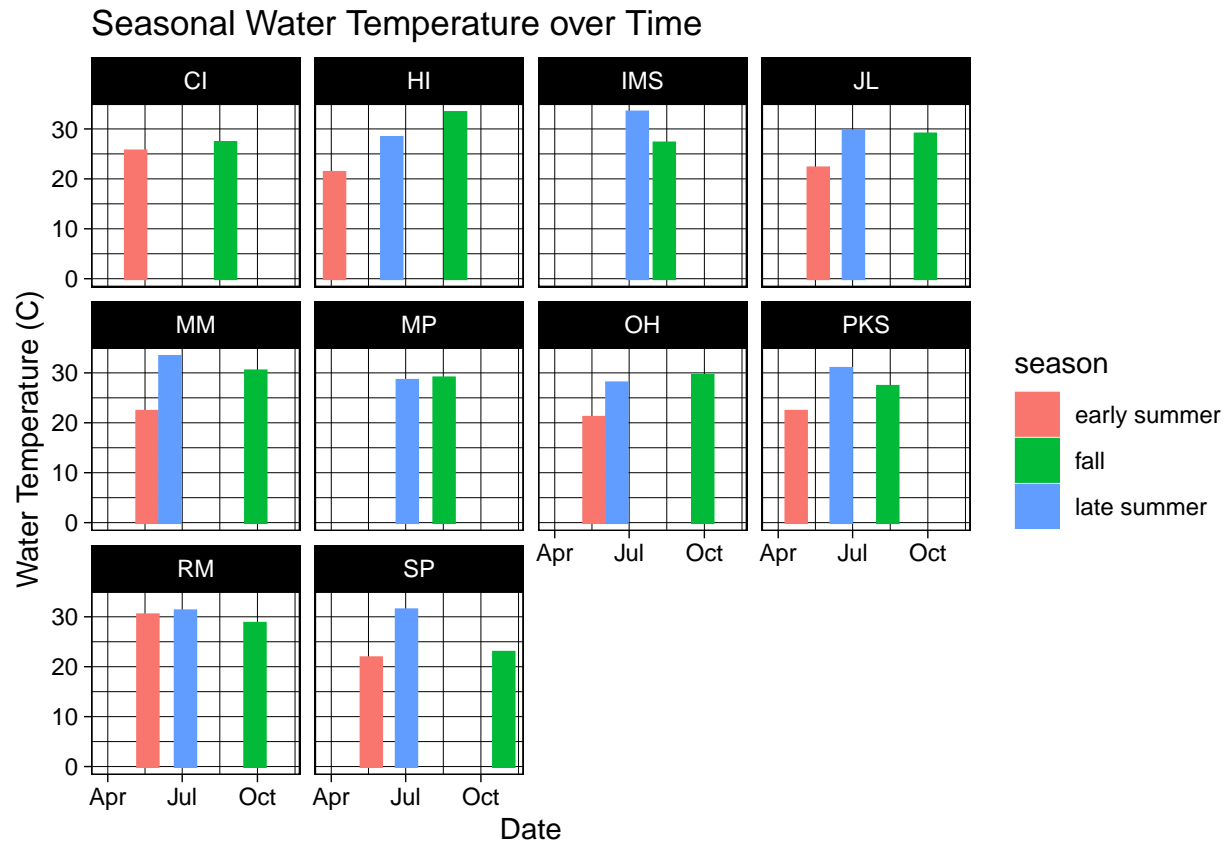
```
### Filtering and plotting for comparing water temperature measurements across all sites in all sample
```

```
seasnaill_season_watertemp <- seasnaill %>% dplyr::select(site_id, season, date, water_temp_C) %>%
  filter(!is.na(water_temp_C)) %>%
  mutate(date = ymd(date))
seasnaill_season_watertemp
```

##	site_id	season	date	water_temp_C
## 1	HI	early summer	2024-04-05	21.3
## 2	PKS	early summer	2024-04-23	22.3
## 3	CI	early summer	2024-05-05	25.6
## 4	OH	early summer	2024-05-19	21.1
## 5	MM	early summer	2024-05-19	22.3
## 6	JL	early summer	2024-05-20	22.2
## 7	RM	early summer	2024-05-20	30.4
## 8	SP	early summer	2024-05-20	21.8
## 9	HI	late summer	2024-06-14	28.3
## 10	OH	late summer	2024-06-16	28.0
## 11	MM	late summer	2024-06-16	33.3
## 12	PKS	late summer	2024-06-17	30.9
## 13	JL	late summer	2024-07-02	29.6
## 14	SP	late summer	2024-07-02	31.4
## 15	MP	late summer	2024-07-03	28.5
## 16	RM	late summer	2024-07-05	31.2
## 17	IMS	late summer	2024-07-11	33.4
## 18	IMS	fall	2024-08-13	27.2
## 19	PKS	fall	2024-08-13	27.3
## 20	MP	fall	2024-08-17	29.0
## 21	CI	fall	2024-08-23	27.3
## 22	HI	fall	2024-08-31	33.3
## 23	JL	fall	2024-09-28	29.0
## 24	RM	fall	2024-09-28	28.7
## 25	MM	fall	2024-09-29	30.4
## 26	OH	fall	2024-09-29	29.5
## 27	SP	fall	2024-10-29	22.9

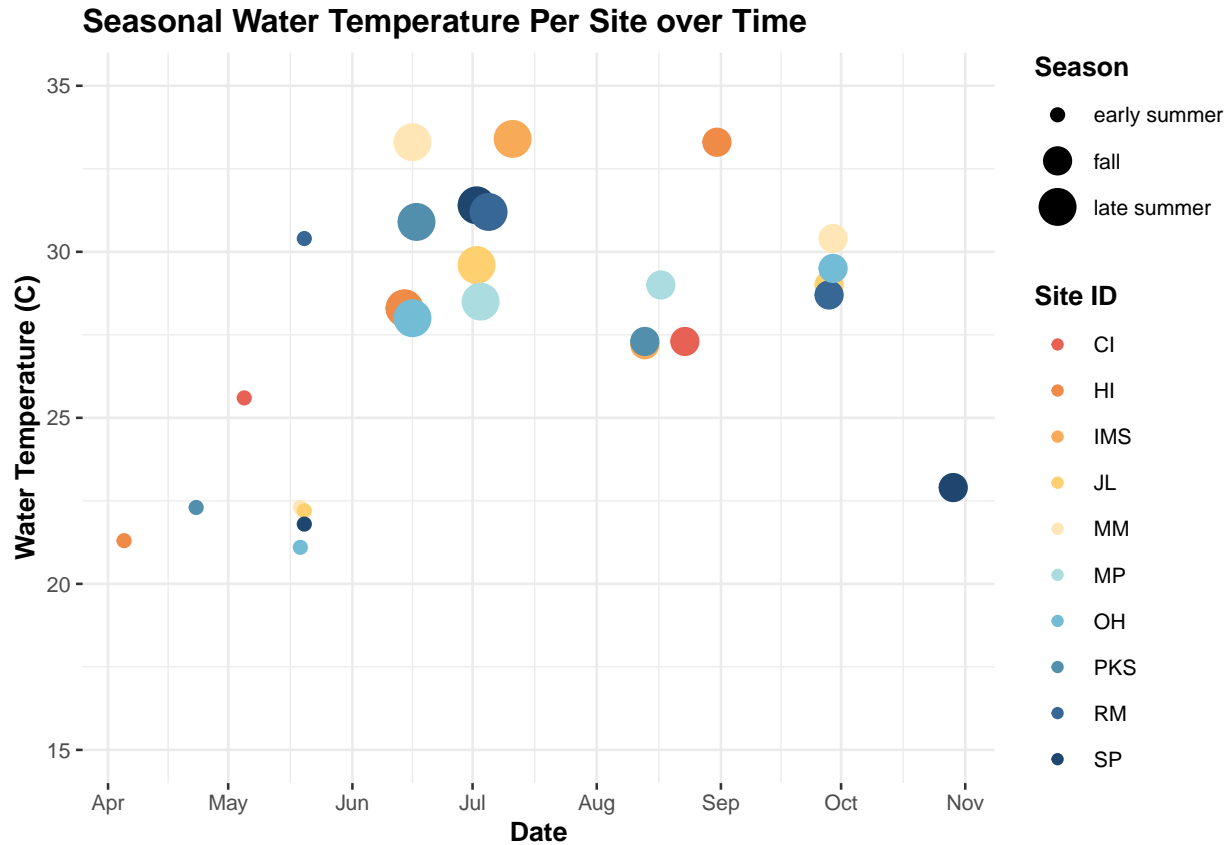
Plot water temperature per season by date

```
ggplot(seasnail_season_watertemp, aes(x = date, y = water_temp_C, fill = season)) +
  labs(x = "Date", y = "Water Temperature (C)", title = "Seasonal Water Temperature over Time") +
  geom_col(aes(color = season)) +
  theme_linedraw() +
  facet_wrap(~ site_id)
```

```
ggplot(seasnail_season_watertemp, aes(x = date, y = water_temp_C, color = site_id, size = season)) +
  geom_point() +
  theme_ggstatsplot() +
  scale_colour_paletteer_d("MetBrewer::Hiroshige") +
  labs(x = "Date", y = "Water Temperature (C)", title = "Seasonal Water Temperature Per Site over Time")
  theme(legend.position="right") +
  scale_x_date(date_breaks = "1 month", date_labels = "%b") +
  scale_y_continuous(limits = c(15,35))
```

Warning: Using size for a discrete variable is not advised.



```
ggsave("data/seasnail_season_watertemp.png")
```

```
## Saving 6.5 x 4.5 in image
```

```
## Warning: Using size for a discrete variable is not advised.
```

Filtering and plotting for comparing air temperature measurements across all sites in all sample seasons: early summer, late summer, and fall

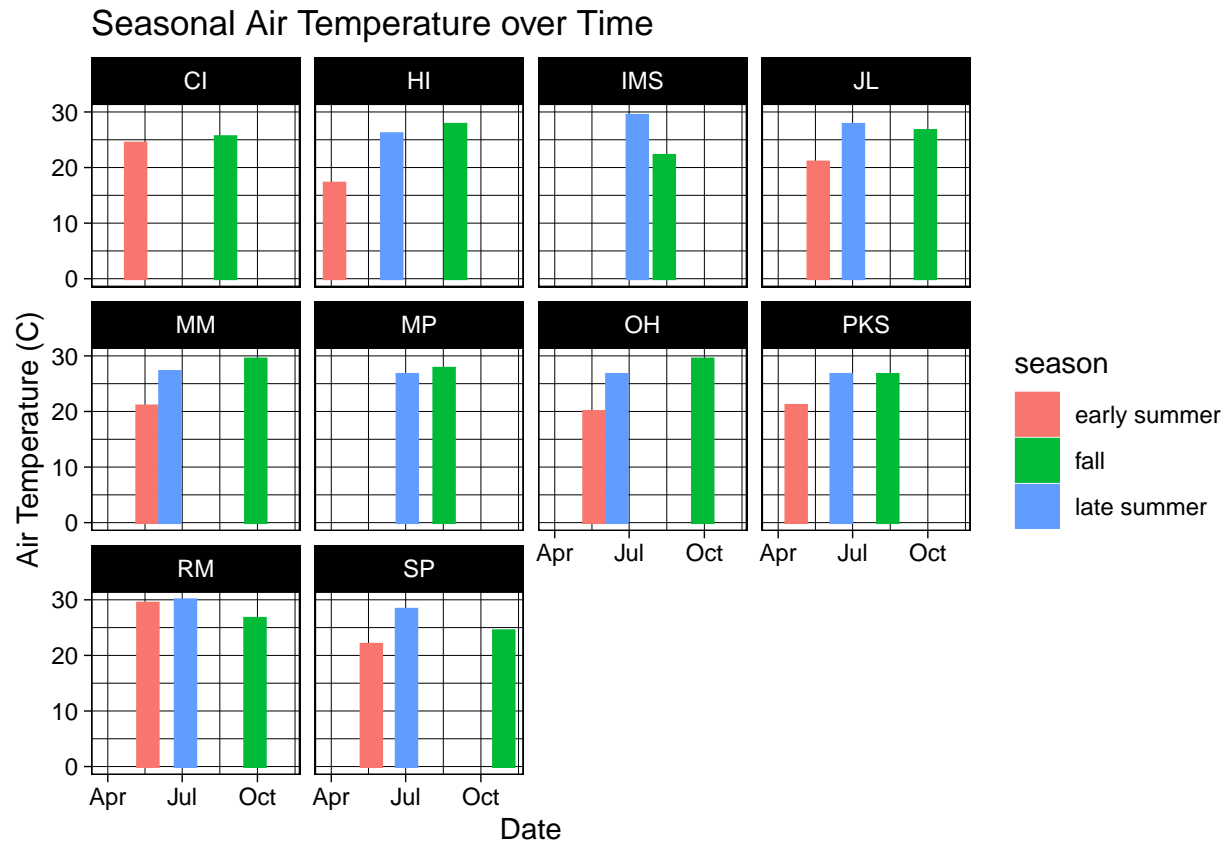
```
seasnail_season_airtemp <- seasnail %>% dplyr::select(site_id, season, date, air_temp_C) %>%
  filter(!is.na(air_temp_C)) %>%
  mutate(date = ymd(date))
seasnail_season_airtemp
```

```
##   site_id    season      date air_temp_C
## 1      HI early summer 2024-04-05    17.20
## 2     PKS early summer 2024-04-23    21.10
## 3      CI early summer 2024-05-05    24.40
## 4      OH early summer 2024-05-19    20.00
## 5      MM early summer 2024-05-19    21.00
## 6      JL early summer 2024-05-20    21.00
## 7      RM early summer 2024-05-20    29.40
## 8      SP early summer 2024-05-20    22.00
```

## 9	HI	late	summer	2024-06-14	26.10
## 10	OH	late	summer	2024-06-16	26.67
## 11	MM	late	summer	2024-06-16	27.20
## 12	PKS	late	summer	2024-06-17	26.67
## 13	JL	late	summer	2024-07-02	27.78
## 14	SP	late	summer	2024-07-02	28.30
## 15	MP	late	summer	2024-07-03	26.67
## 16	RM	late	summer	2024-07-05	30.00
## 17	IMS	late	summer	2024-07-11	29.40
## 18	IMS		fall	2024-08-13	22.20
## 19	PKS		fall	2024-08-13	26.67
## 20	MP		fall	2024-08-17	27.78
## 21	CI		fall	2024-08-23	25.56
## 22	HI		fall	2024-08-31	27.78
## 23	JL		fall	2024-09-28	26.67
## 24	RM		fall	2024-09-28	26.67
## 25	MM		fall	2024-09-29	29.44
## 26	OH		fall	2024-09-29	29.44
## 27	SP		fall	2024-10-29	24.44

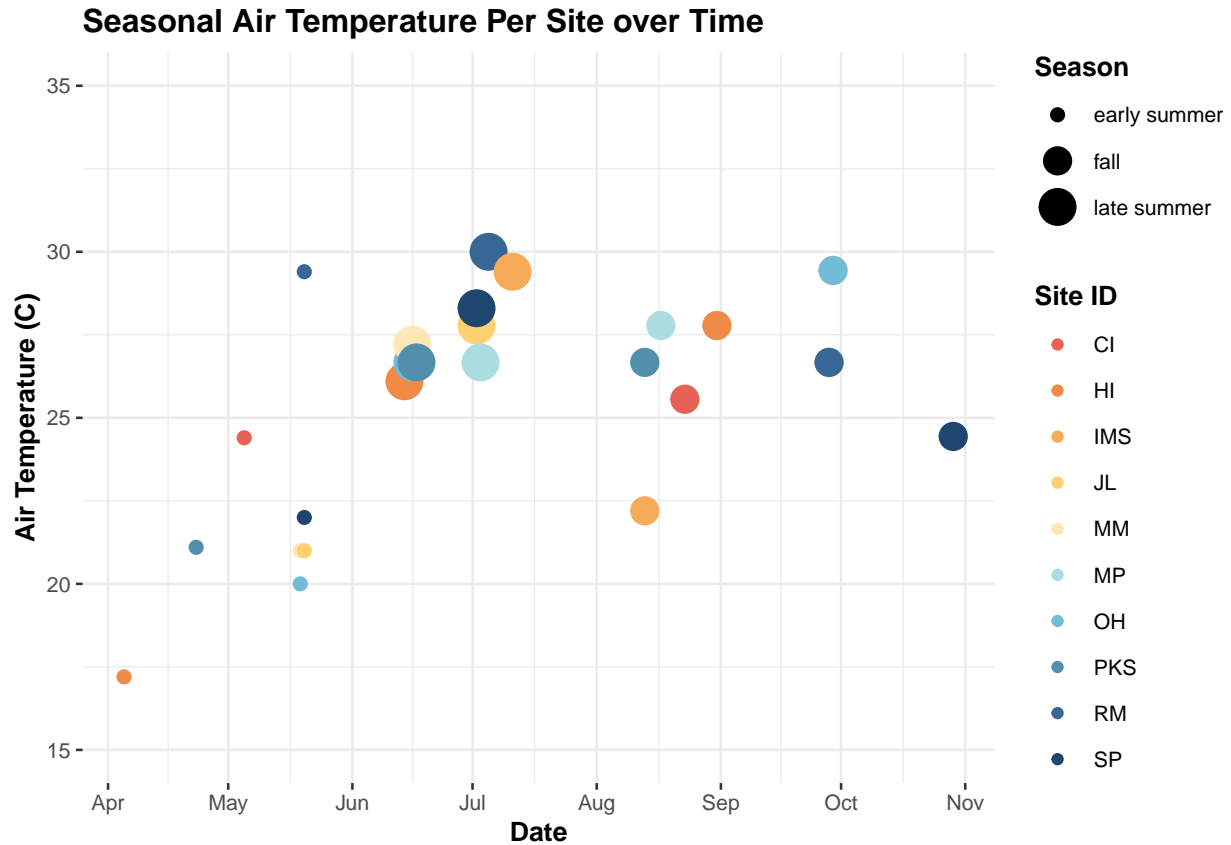
Plot water temperature per season by date

```
ggplot(seasnail_season_airtemp, aes(x = date, y = air_temp_C, fill = season)) +
  labs(x = "Date", y = "Air Temperature (C)", title = "Seasonal Air Temperature over Time") +
  geom_col(aes(color = season)) +
  theme_linedraw() +
  facet_wrap( ~ site_id)
```



```
ggplot(seasnail_season_airtemp, aes(x = date, y = air_temp_C, color = site_id, size = season)) +
  geom_point() +
  theme_ggstatsplot() +
  scale_colour_paletteer_d("MetBrewer::Hiroshige") +
  labs(x = "Date", y = "Air Temperature (C)", title = "Seasonal Air Temperature Per Site over Time", size = "season") +
  theme(legend.position="right") +
  scale_x_date(date_breaks = "1 month", date_labels = "%b") +
  scale_y_continuous(limits = c(15,35))
```

```
## Warning: Using size for a discrete variable is not advised.
```



```
ggsave("data/seasnail_season_airtemp.png")
```

```
## Saving 6.5 x 4.5 in image
```

```
## Warning: Using size for a discrete variable is not advised.
```

Filtering and plotting for comparing low tide height across all sites in all sample seasons: early summer, late summer, and fall

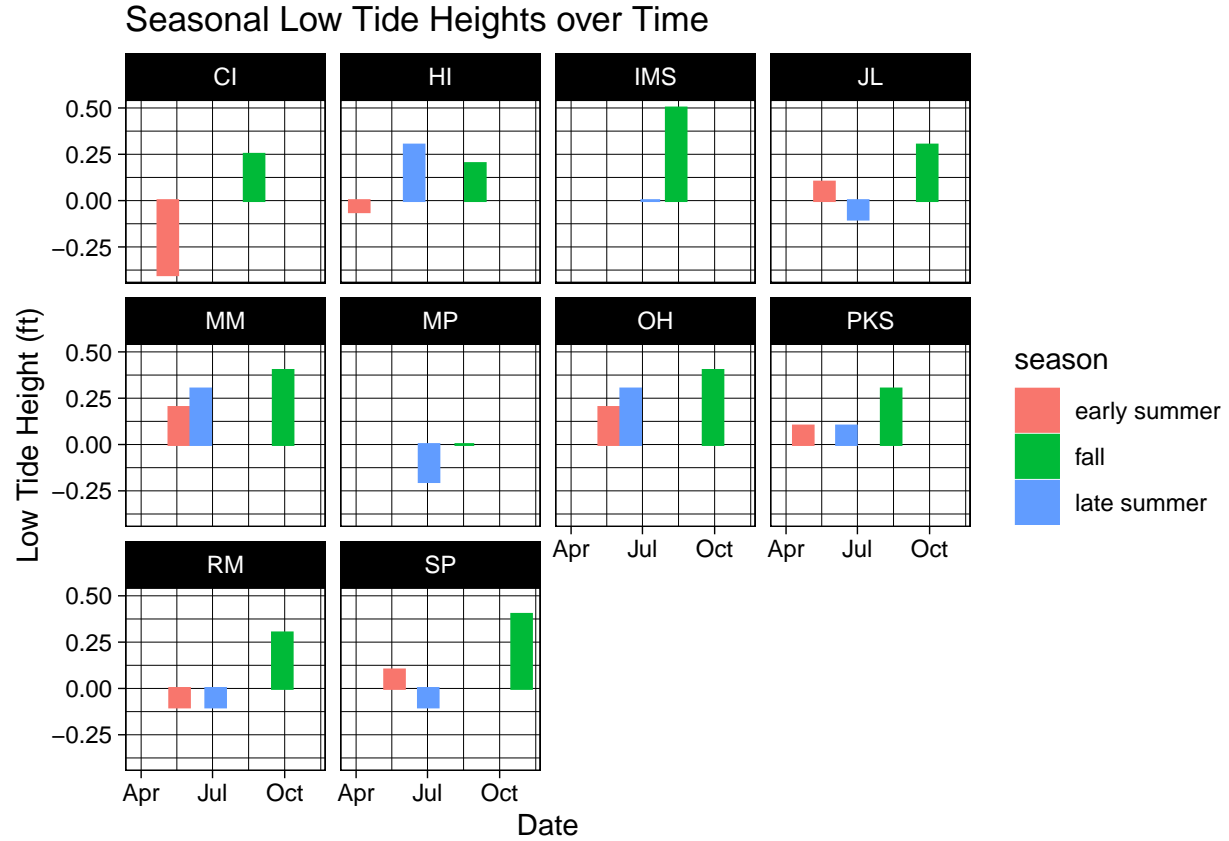
```
seasnail_season_ltheight <- seasnail %>% dplyr::select(site_id, season, date, lt_height_ft) %>%
  filter(!is.na(lt_height_ft)) %>%
  mutate(date = ymd(date))
seasnail_season_ltheight
```

```
##   site_id    season    date lt_height_ft
## 1      HI early summer 2024-04-05    -0.06
## 2     PKS early summer 2024-04-23     0.10
## 3      CI early summer 2024-05-05    -0.40
## 4      OH early summer 2024-05-19     0.20
## 5      MM early summer 2024-05-19     0.20
## 6      JL early summer 2024-05-20     0.10
## 7      RM early summer 2024-05-20    -0.10
## 8      SP early summer 2024-05-20     0.10
```

## 9	HI	late	summer	2024-06-14	0.30
## 10	OH	late	summer	2024-06-16	0.30
## 11	MM	late	summer	2024-06-16	0.30
## 12	PKS	late	summer	2024-06-17	0.10
## 13	JL	late	summer	2024-07-02	-0.10
## 14	SP	late	summer	2024-07-02	-0.10
## 15	MP	late	summer	2024-07-03	-0.20
## 16	RM	late	summer	2024-07-05	-0.10
## 17	IMS	late	summer	2024-07-11	0.00
## 18	IMS		fall	2024-08-13	0.50
## 19	PKS		fall	2024-08-13	0.30
## 20	MP		fall	2024-08-17	0.00
## 21	CI		fall	2024-08-23	0.25
## 22	HI		fall	2024-08-31	0.20
## 23	JL		fall	2024-09-28	0.30
## 24	RM		fall	2024-09-28	0.30
## 25	MM		fall	2024-09-29	0.40
## 26	OH		fall	2024-09-29	0.40
## 27	SP		fall	2024-10-29	0.40

Plot a general linear model for low tide height per season by date

```
ggplot(seasnail_season_ltheight, aes(x = date, y = lt_height_ft, fill = season)) +
  labs(x = "Date", y = "Low Tide Height (ft)", title = "Seasonal Low Tide Heights over Time") +
  geom_col(aes(color = season)) +
  theme_linedraw() +
  facet_wrap( ~ site_id)
```



Filtering and plotting for comparing water depth across all sites in all sample seasons: early summer, late summer, and fall

```
seasnail_season_waterdepth <- seasnail %>% dplyr::select(site_id, season, date, water_depth_cm) %>%
  filter(!is.na(water_depth_cm)) %>%
  mutate(date = ymd(date))
seasnail_season_waterdepth
```

##	site_id	season	date	water_depth_cm
## 1	HI	early summer	2024-04-05	0.0
## 2	HI	early summer	2024-04-05	0.0
## 3	HI	early summer	2024-04-05	0.0
## 4	PKS	early summer	2024-04-23	23.2
## 5	PKS	early summer	2024-04-23	12.0
## 6	PKS	early summer	2024-04-23	21.0
## 7	PKS	early summer	2024-04-23	19.4
## 8	PKS	early summer	2024-04-23	20.2
## 9	CI	early summer	2024-05-05	4.0
## 10	CI	early summer	2024-05-05	8.0
## 11	CI	early summer	2024-05-05	11.0
## 12	CI	early summer	2024-05-05	12.0
## 13	CI	early summer	2024-05-05	5.0
## 14	OH	early summer	2024-05-19	33.0
## 15	OH	early summer	2024-05-19	37.0
## 16	OH	early summer	2024-05-19	41.0
## 17	OH	early summer	2024-05-19	32.0

## 18	OH	early	summer	2024-05-19	34.0
## 19	MM	early	summer	2024-05-19	26.0
## 20	MM	early	summer	2024-05-19	27.0
## 21	MM	early	summer	2024-05-19	20.0
## 22	MM	early	summer	2024-05-19	23.0
## 23	MM	early	summer	2024-05-19	22.0
## 24	JL	early	summer	2024-05-20	43.0
## 25	JL	early	summer	2024-05-20	45.0
## 26	JL	early	summer	2024-05-20	44.0
## 27	JL	early	summer	2024-05-20	40.0
## 28	JL	early	summer	2024-05-20	42.0
## 29	RM	early	summer	2024-05-20	37.0
## 30	RM	early	summer	2024-05-20	33.0
## 31	RM	early	summer	2024-05-20	39.0
## 32	RM	early	summer	2024-05-20	35.0
## 33	RM	early	summer	2024-05-20	22.0
## 34	SP	early	summer	2024-05-20	40.0
## 35	SP	early	summer	2024-05-20	36.0
## 36	SP	early	summer	2024-05-20	37.0
## 37	SP	early	summer	2024-05-20	36.0
## 38	SP	early	summer	2024-05-20	35.0
## 39	HI	late	summer	2024-06-14	5.0
## 40	HI	late	summer	2024-06-14	14.0
## 41	HI	late	summer	2024-06-14	7.0
## 42	OH	late	summer	2024-06-16	24.0
## 43	OH	late	summer	2024-06-16	28.0
## 44	OH	late	summer	2024-06-16	19.0
## 45	OH	late	summer	2024-06-16	24.0
## 46	OH	late	summer	2024-06-16	29.0
## 47	MM	late	summer	2024-06-16	15.0
## 48	MM	late	summer	2024-06-16	17.0
## 49	MM	late	summer	2024-06-16	14.0
## 50	MM	late	summer	2024-06-16	26.0
## 51	MM	late	summer	2024-06-16	9.0
## 52	PKS	late	summer	2024-06-17	18.0
## 53	PKS	late	summer	2024-06-17	28.0
## 54	PKS	late	summer	2024-06-17	32.0
## 55	PKS	late	summer	2024-06-17	4.0
## 56	PKS	late	summer	2024-06-17	7.0
## 57	JL	late	summer	2024-07-02	24.0
## 58	JL	late	summer	2024-07-02	23.0
## 59	JL	late	summer	2024-07-02	22.0
## 60	JL	late	summer	2024-07-02	23.0
## 61	JL	late	summer	2024-07-02	26.0
## 62	SP	late	summer	2024-07-02	14.0
## 63	SP	late	summer	2024-07-02	17.0
## 64	SP	late	summer	2024-07-02	22.0
## 65	SP	late	summer	2024-07-02	24.0
## 66	SP	late	summer	2024-07-02	15.0
## 67	MP	late	summer	2024-07-03	33.1
## 68	MP	late	summer	2024-07-03	21.0
## 69	MP	late	summer	2024-07-03	22.2
## 70	MP	late	summer	2024-07-03	14.0
## 71	MP	late	summer	2024-07-03	23.0

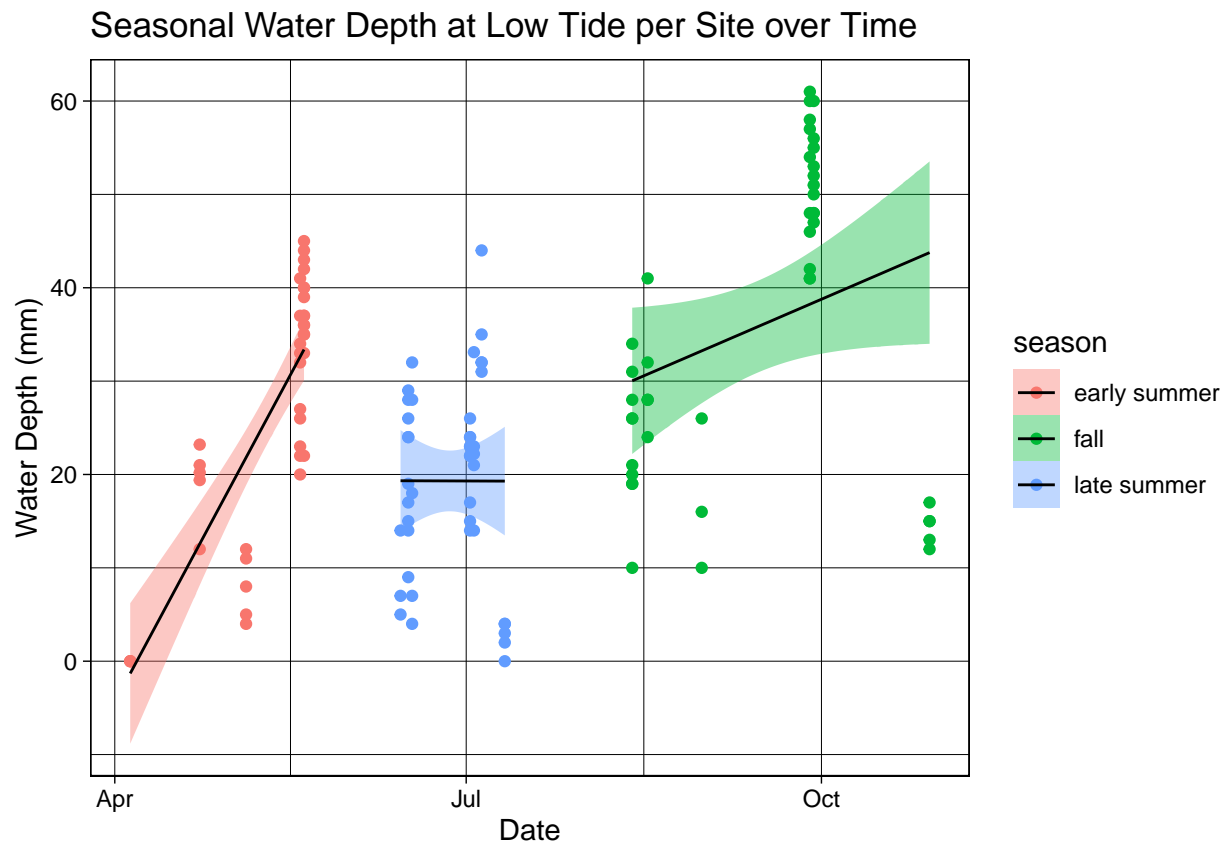
## 72	RM	late summer	2024-07-05	31.0
## 73	RM	late summer	2024-07-05	32.0
## 74	RM	late summer	2024-07-05	32.0
## 75	RM	late summer	2024-07-05	44.0
## 76	RM	late summer	2024-07-05	35.0
## 77	IMS	late summer	2024-07-11	3.0
## 78	IMS	late summer	2024-07-11	0.0
## 79	IMS	late summer	2024-07-11	4.0
## 80	IMS	late summer	2024-07-11	4.0
## 81	IMS	late summer	2024-07-11	2.0
## 82	IMS	fall	2024-08-13	19.0
## 83	IMS	fall	2024-08-13	10.0
## 84	IMS	fall	2024-08-13	21.0
## 85	IMS	fall	2024-08-13	34.0
## 86	IMS	fall	2024-08-13	26.0
## 87	PKS	fall	2024-08-13	19.0
## 88	PKS	fall	2024-08-13	31.0
## 89	PKS	fall	2024-08-13	20.0
## 90	PKS	fall	2024-08-13	28.0
## 91	PKS	fall	2024-08-13	26.0
## 92	MP	fall	2024-08-17	28.0
## 93	MP	fall	2024-08-17	41.0
## 94	MP	fall	2024-08-17	24.0
## 95	MP	fall	2024-08-17	32.0
## 96	MP	fall	2024-08-17	28.0
## 97	HI	fall	2024-08-31	26.0
## 98	HI	fall	2024-08-31	16.0
## 99	HI	fall	2024-08-31	10.0
## 100	JL	fall	2024-09-28	42.0
## 101	JL	fall	2024-09-28	41.0
## 102	JL	fall	2024-09-28	46.0
## 103	JL	fall	2024-09-28	48.0
## 104	JL	fall	2024-09-28	41.0
## 105	RM	fall	2024-09-28	57.0
## 106	RM	fall	2024-09-28	54.0
## 107	RM	fall	2024-09-28	58.0
## 108	RM	fall	2024-09-28	60.0
## 109	RM	fall	2024-09-28	61.0
## 110	MM	fall	2024-09-29	48.0
## 111	MM	fall	2024-09-29	53.0
## 112	MM	fall	2024-09-29	52.0
## 113	MM	fall	2024-09-29	50.0
## 114	MM	fall	2024-09-29	51.0
## 115	OH	fall	2024-09-29	47.0
## 116	OH	fall	2024-09-29	56.0
## 117	OH	fall	2024-09-29	48.0
## 118	OH	fall	2024-09-29	60.0
## 119	OH	fall	2024-09-29	55.0
## 120	SP	fall	2024-10-29	13.0
## 121	SP	fall	2024-10-29	12.0
## 122	SP	fall	2024-10-29	15.0
## 123	SP	fall	2024-10-29	15.0
## 124	SP	fall	2024-10-29	17.0

Plot a general linear model for water depth per season by date

```
ggplot(seasnail_season_waterdepth, aes(x = date, y = water_depth_cm, fill = season)) +  
  labs(x = "Date", y = "Water Depth (mm)", title = "Seasonal Water Depth at Low Tide per Site over Time") +  
  geom_point(aes(color = season)) +  
  geom_smooth(method = "lm", color="black", size=0.5) +  
  theme_linedraw()
```

```
## Warning: Using 'size' aesthetic for lines was deprecated in ggplot2 3.4.0.  
## i Please use 'linewidth' instead.  
## This warning is displayed once every 8 hours.  
## Call 'lifecycle::last_lifecycle_warnings()' to see where this warning was  
## generated.
```

```
## 'geom_smooth()' using formula = 'y ~ x'
```



```
###Linear Models
```

```
getwd()
```

```
## [1] "/Users/meghannadzam/Desktop/Datasets and Figs"
```

```
setwd("/Users/meghannadzam/Desktop/Datasets and Figs")
```

```
seasnail_lm <- read.csv("seasnail_2024_lm_prevalence_temp_salinity.csv")
```

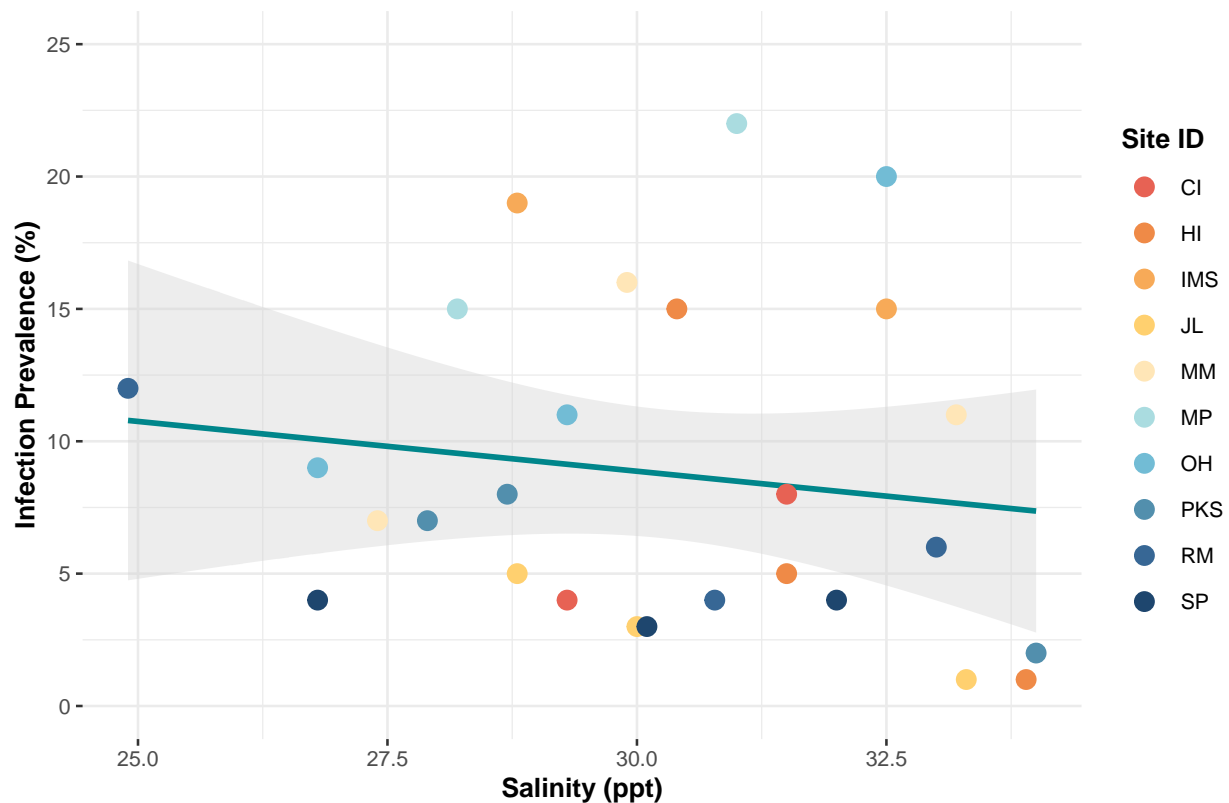
```
seasnail_lm_prev_sal <- seasnail_lm %>% dplyr::select(site_id, date, infection_prevalence, salinity_ppt,
  filter(!is.na(salinity_ppt)) %>%
  mutate(date = ymd(date))
seasnail_lm_prev_sal
```

##	site_id	date	infection_prevalence	salinity_ppt
## 1	HI	2024-04-05	15	30.40
## 2	PKS	2024-04-23	8	28.70
## 3	CI	2024-05-05	4	29.30
## 4	OH	2024-05-19	11	29.30
## 5	MM	2024-05-19	16	29.90
## 6	JL	2024-05-20	3	30.00
## 7	RM	2024-05-20	4	30.78
## 8	SP	2024-05-20	3	30.10
## 9	HI	2024-06-14	5	31.50
## 10	OH	2024-06-16	20	32.50
## 11	MM	2024-06-16	11	33.20
## 12	PKS	2024-06-17	2	34.00
## 13	JL	2024-07-02	1	33.30
## 14	SP	2024-07-02	4	32.00
## 15	MP	2024-07-03	22	31.00
## 16	RM	2024-07-05	6	33.00
## 17	IMS	2024-07-11	15	32.50
## 18	IMS	2024-08-13	19	28.80
## 19	PKS	2024-08-13	7	27.90
## 20	MP	2024-08-17	15	28.20
## 21	CI	2024-08-23	8	31.50
## 22	HI	2024-08-31	1	33.90
## 23	JL	2024-09-28	5	28.80
## 24	RM	2024-09-28	12	24.90
## 25	MM	2024-09-29	7	27.40
## 26	OH	2024-09-29	9	26.80
## 27	SP	2024-10-29	4	26.80

```
library(ggplot2)
ggplot(seasnail_lm_prev_sal, aes(x = salinity_ppt, y = infection_prevalence)) +
  geom_smooth(method='lm', se=TRUE, color='turquoise4', fill = "lightgrey") +
  geom_point(aes(color = site_id), size=3) +
  theme_ggstatsplot() +
  labs(x='Salinity (ppt)', y='Infection Prevalence (%)', title='Linear Regression of 2024 Water Tempera
  theme(plot.title = element_text(hjust=0.5, size=13, face='bold')) +
  theme(legend.position="right") +
  scale_colour_paletteer_d("MetBrewer::Hiroshige") +
  scale_y_continuous(limits = c(0,25))
```

```
## 'geom_smooth()' using formula = 'y ~ x'
```

Linear Regression of 2024 Water Temperature and Trematode Prevalence



```
summary(seasnail_lm_prev_sal)
```

```
##      site_id      date      infection_prevalence  salinity_ppt
## Length:27      Min.   :2024-04-05      Min.   : 1.000      Min.   :24.90
## Class :character 1st Qu.:2024-05-20      1st Qu.: 4.000      1st Qu.:28.75
## Mode  :character Median :2024-07-02      Median : 7.000      Median :30.10
##                      Mean   :2024-07-10      Mean   : 8.778      Mean   :30.24
##                      3rd Qu.:2024-08-20      3rd Qu.:13.500      3rd Qu.:32.25
##                      Max.   :2024-10-29      Max.   :22.000      Max.   :34.00
```

```
model <- lm(infection_prevalence ~ salinity_ppt, data=seasnail_lm_prev_sal)
summary(model)
```

```
##
## Call:
## lm(formula = infection_prevalence ~ salinity_ppt, data = seasnail_lm_prev_sal)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -6.627  -4.853  -1.740   4.395  13.508
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)  20.1536    15.2482   1.322   0.198
```

```
## salinity_ppt -0.3762      0.5027 -0.748      0.461
##
## Residual standard error: 6.137 on 25 degrees of freedom
## Multiple R-squared:  0.02191,    Adjusted R-squared:  -0.01722
## F-statistic: 0.5599 on 1 and 25 DF,  p-value: 0.4613
```

```
ggsave("Datasets and Figs/seasnail_lm_prev_sal.png")
```

```
## Saving 6.5 x 4.5 in image
## 'geom_smooth()' using formula = 'y ~ x'
```

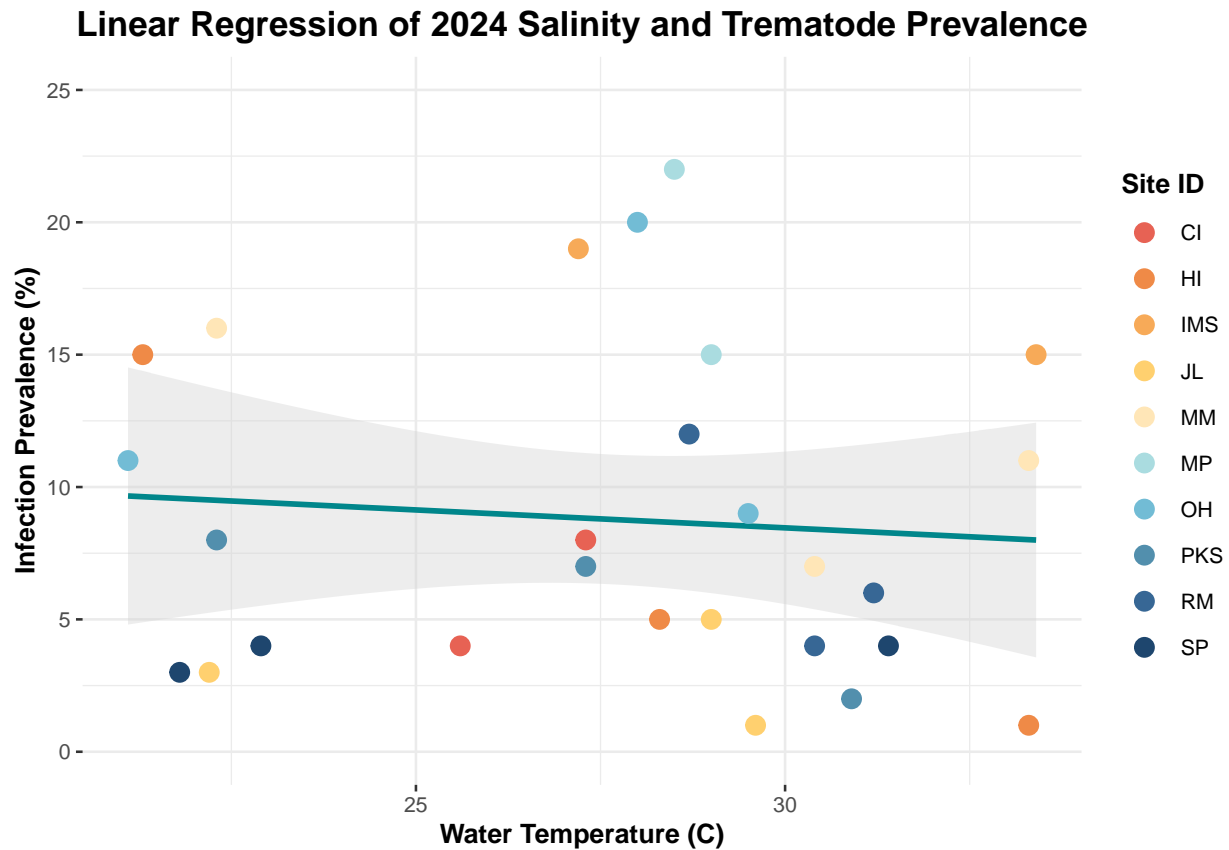
```
seasnail_lm_prev_temp <- seasnail_lm %>% dplyr::select(site_id, date, infection_prevalence, water_temp_C) %>%
  filter(!is.na(water_temp_C)) %>%
  mutate(date = ymd(date))
seasnail_lm_prev_temp
```

##	site_id	date	infection_prevalence	water_temp_C
## 1	HI	2024-04-05	15	21.3
## 2	PKS	2024-04-23	8	22.3
## 3	CI	2024-05-05	4	25.6
## 4	OH	2024-05-19	11	21.1
## 5	MM	2024-05-19	16	22.3
## 6	JL	2024-05-20	3	22.2
## 7	RM	2024-05-20	4	30.4
## 8	SP	2024-05-20	3	21.8
## 9	HI	2024-06-14	5	28.3
## 10	OH	2024-06-16	20	28.0
## 11	MM	2024-06-16	11	33.3
## 12	PKS	2024-06-17	2	30.9
## 13	JL	2024-07-02	1	29.6
## 14	SP	2024-07-02	4	31.4
## 15	MP	2024-07-03	22	28.5
## 16	RM	2024-07-05	6	31.2
## 17	IMS	2024-07-11	15	33.4
## 18	IMS	2024-08-13	19	27.2
## 19	PKS	2024-08-13	7	27.3
## 20	MP	2024-08-17	15	29.0
## 21	CI	2024-08-23	8	27.3
## 22	HI	2024-08-31	1	33.3
## 23	JL	2024-09-28	5	29.0
## 24	RM	2024-09-28	12	28.7
## 25	MM	2024-09-29	7	30.4
## 26	OH	2024-09-29	9	29.5
## 27	SP	2024-10-29	4	22.9

```
ggplot(seasnail_lm_prev_temp, aes(x =water_temp_C, y = infection_prevalence)) +
  geom_smooth(method='lm', se=TRUE, color='turquoise4', fill = "lightgrey") +
  geom_point(aes(color = site_id), size=3) +
  theme_ggstatsplot() +
  labs(x='Water Temperature (C)', y='Infection Prevalence (%)', title='Linear Regression of 2024 Salinity',
  theme(plot.title = element_text(hjust=0.5, size=13, face='bold')) +
  theme(legend.position="right") +
```

```
scale_colour_paletteer_d("MetBrewer::Hiroshige") +
scale_y_continuous(limits = c(0,25))
```

```
## 'geom_smooth()' using formula = 'y ~ x'
```



```
summary(seasnail_lm_prev_temp)
```

```
##      site_id      date      infection_prevalence  water_temp_C
## Length:27      Min.   :2024-04-05      Min.   : 1.000      Min.   :21.10
## Class :character 1st Qu.:2024-05-20      1st Qu.: 4.000      1st Qu.:24.25
## Mode  :character Median :2024-07-02      Median : 7.000      Median :28.50
##                      Mean  :2024-07-10      Mean  : 8.778      Mean  :27.64
##                      3rd Qu.:2024-08-20      3rd Qu.:13.500      3rd Qu.:30.40
##                      Max.   :2024-10-29      Max.   :22.000      Max.   :33.40
```

```
model <- lm(infection_prevalence ~ water_temp_C, data=seasnail_lm_prev_temp)
summary(model)
```

```
##
## Call:
## lm(formula = infection_prevalence ~ water_temp_C, data = seasnail_lm_prev_temp)
##
## Residuals:
```

```
##      Min      1Q Median      3Q      Max
## -7.512 -4.729 -1.499  4.366 13.339
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)  12.5140     8.6883   1.440   0.162
## water_temp_C -0.1352     0.3114  -0.434   0.668
##
## Residual standard error: 6.182 on 25 degrees of freedom
## Multiple R-squared:  0.007482,    Adjusted R-squared:  -0.03222
## F-statistic: 0.1885 on 1 and 25 DF,  p-value: 0.6679
```

```
ggsave("Datasets and Figs/seasnail_lm_prev_temp.png")
```

```
## Saving 6.5 x 4.5 in image
## 'geom_smooth()' using formula = 'y ~ x'
```

```
citation()
```

```
## To cite R in publications use:
##
## R Core Team (2023). _R: A Language and Environment for Statistical
## Computing_. R Foundation for Statistical Computing, Vienna, Austria.
## <https://www.R-project.org/>.
##
## A BibTeX entry for LaTeX users is
##
## @Manual{,
##   title = {R: A Language and Environment for Statistical Computing},
##   author = {{R Core Team}},
##   organization = {R Foundation for Statistical Computing},
##   address = {Vienna, Austria},
##   year = {2023},
##   url = {https://www.R-project.org/},
## }
##
## We have invested a lot of time and effort in creating R, please cite it
## when using it for data analysis. See also 'citation("pkgname")' for
## citing R packages.
```

```
version$version.string
```

```
## [1] "R version 4.3.1 (2023-06-16)"
```

```
citation("ggplot2")
```

```
## To cite ggplot2 in publications, please use
##
## H. Wickham. ggplot2: Elegant Graphics for Data Analysis.
## Springer-Verlag New York, 2016.
##
```

```
## A BibTeX entry for LaTeX users is
##
##   @Book{,
##     author = {Hadley Wickham},
##     title = {ggplot2: Elegant Graphics for Data Analysis},
##     publisher = {Springer-Verlag New York},
##     year = {2016},
##     isbn = {978-3-319-24277-4},
##     url = {https://ggplot2.tidyverse.org},
##   }
```

```
packageVersion("ggplot2")
```

```
## [1] '3.5.1'
```

```
devtools::session_info()
```

```
## - Session info -----
## setting value
## version R version 4.3.1 (2023-06-16)
## os macOS 15.1.1
## system x86_64, darwin20
## ui X11
## language (EN)
## collate en_US.UTF-8
## ctype en_US.UTF-8
## tz America/New_York
## date 2024-11-24
## pandoc 3.2 @ /Applications/RStudio.app/Contents/Resources/app/quarto/bin/tools/x86_64/ (via rmark
##
## - Packages -----
## package * version date (UTC) lib source
## bayestestR 0.15.0 2024-10-17 [1] CRAN (R 4.3.3)
## cachem 1.1.0 2024-05-16 [1] CRAN (R 4.3.3)
## callr 3.7.3 2022-11-02 [2] CRAN (R 4.3.0)
## cli 3.6.3 2024-06-21 [1] CRAN (R 4.3.3)
## colorspace 2.1-1 2024-07-26 [1] CRAN (R 4.3.3)
## correlation 0.8.6 2024-10-26 [1] CRAN (R 4.3.3)
## crayon 1.5.2 2022-09-29 [2] CRAN (R 4.3.0)
## datawizard 0.13.0 2024-10-05 [1] CRAN (R 4.3.3)
## devtools 2.4.5 2022-10-11 [1] CRAN (R 4.3.0)
## digest 0.6.33 2023-07-07 [2] CRAN (R 4.3.0)
## dplyr * 1.1.4 2023-11-17 [2] CRAN (R 4.3.0)
## effectsize 0.8.9 2024-07-03 [1] CRAN (R 4.3.3)
## ellipsis 0.3.2 2021-04-29 [2] CRAN (R 4.3.0)
## evaluate 0.22 2023-09-29 [2] CRAN (R 4.3.0)
## fansi 1.0.6 2023-12-08 [1] CRAN (R 4.3.0)
## farver 2.1.2 2024-05-13 [1] CRAN (R 4.3.3)
## fastmap 1.2.0 2024-05-15 [1] CRAN (R 4.3.3)
## forcats * 1.0.0 2023-01-29 [1] CRAN (R 4.3.0)
## fs 1.6.3 2023-07-20 [2] CRAN (R 4.3.0)
## generics 0.1.3 2022-07-05 [2] CRAN (R 4.3.0)
## ggExtra * 0.10.1 2023-08-21 [1] CRAN (R 4.3.0)
```


##	ggplot2	*	3.5.1	2024-04-23	[1]	CRAN	(R 4.3.2)
##	ggstatsplot	*	0.12.5	2024-11-01	[1]	CRAN	(R 4.3.3)
##	glue		1.8.0	2024-09-30	[1]	CRAN	(R 4.3.3)
##	gtable		0.3.5	2024-04-22	[1]	CRAN	(R 4.3.2)
##	hms		1.1.3	2023-03-21	[2]	CRAN	(R 4.3.0)
##	htmltools		0.5.8.1	2024-04-04	[1]	CRAN	(R 4.3.2)
##	htmlwidgets		1.6.4	2023-12-06	[1]	CRAN	(R 4.3.0)
##	httpuv		1.6.15	2024-03-26	[1]	CRAN	(R 4.3.2)
##	insight		0.20.5	2024-10-02	[1]	CRAN	(R 4.3.3)
##	knitr		1.44	2023-09-11	[2]	CRAN	(R 4.3.0)
##	labeling		0.4.3	2023-08-29	[2]	CRAN	(R 4.3.0)
##	later		1.3.2	2023-12-06	[1]	CRAN	(R 4.3.0)
##	lattice		0.21-9	2023-10-01	[2]	CRAN	(R 4.3.0)
##	lifecycle		1.0.4	2023-11-07	[1]	CRAN	(R 4.3.0)
##	lubridate	*	1.9.3	2023-09-27	[1]	CRAN	(R 4.3.0)
##	magrittr		2.0.3	2022-03-30	[2]	CRAN	(R 4.3.0)
##	Matrix		1.6-1.1	2023-09-18	[2]	CRAN	(R 4.3.0)
##	memoise		2.0.1	2021-11-26	[2]	CRAN	(R 4.3.0)
##	mgcv		1.9-0	2023-07-11	[2]	CRAN	(R 4.3.0)
##	mime		0.12	2021-09-28	[2]	CRAN	(R 4.3.0)
##	miniUI		0.1.1.1	2018-05-18	[1]	CRAN	(R 4.3.0)
##	munsell		0.5.1	2024-04-01	[1]	CRAN	(R 4.3.2)
##	nlme		3.1-163	2023-08-09	[2]	CRAN	(R 4.3.0)
##	paletteer	*	1.6.0	2024-01-21	[1]	CRAN	(R 4.3.0)
##	parameters		0.23.0	2024-10-18	[1]	CRAN	(R 4.3.3)
##	patchwork		1.3.0	2024-09-16	[1]	CRAN	(R 4.3.3)
##	pillar		1.9.0	2023-03-22	[2]	CRAN	(R 4.3.0)
##	pkgbuild		1.4.2	2023-06-26	[2]	CRAN	(R 4.3.0)
##	pkgconfig		2.0.3	2019-09-22	[2]	CRAN	(R 4.3.0)
##	pkgload		1.3.3	2023-09-22	[2]	CRAN	(R 4.3.0)
##	prettyunits		1.2.0	2023-09-24	[2]	CRAN	(R 4.3.0)
##	prismatic		1.1.2	2024-04-10	[1]	CRAN	(R 4.3.2)
##	processx		3.8.2	2023-06-30	[2]	CRAN	(R 4.3.0)
##	profvis		0.4.0	2024-09-20	[1]	CRAN	(R 4.3.3)
##	promises		1.3.0	2024-04-05	[1]	CRAN	(R 4.3.2)
##	ps		1.7.5	2023-04-18	[2]	CRAN	(R 4.3.0)
##	purrr	*	1.0.2	2023-08-10	[2]	CRAN	(R 4.3.0)
##	R6		2.5.1	2021-08-19	[2]	CRAN	(R 4.3.0)
##	ragg		1.3.3	2024-09-11	[1]	CRAN	(R 4.3.3)
##	Rcpp		1.0.13	2024-07-17	[1]	CRAN	(R 4.3.3)
##	readr	*	2.1.5	2024-01-10	[1]	CRAN	(R 4.3.0)
##	rematch2		2.1.2	2020-05-01	[2]	CRAN	(R 4.3.0)
##	remotes		2.4.2.1	2023-07-18	[2]	CRAN	(R 4.3.0)
##	rlang		1.1.4	2024-06-04	[1]	CRAN	(R 4.3.3)
##	rmarkdown		2.28	2024-08-17	[1]	CRAN	(R 4.3.3)
##	rstudioapi		0.16.0	2024-03-24	[1]	CRAN	(R 4.3.2)
##	scales		1.3.0	2023-11-28	[1]	CRAN	(R 4.3.0)
##	sessioninfo		1.2.2	2021-12-06	[1]	CRAN	(R 4.3.0)
##	shiny		1.9.1	2024-08-01	[1]	CRAN	(R 4.3.3)
##	statsExpressions	*	1.6.1	2024-10-31	[1]	CRAN	(R 4.3.3)
##	stringi		1.7.12	2023-01-11	[2]	CRAN	(R 4.3.0)
##	stringr	*	1.5.1	2023-11-14	[1]	CRAN	(R 4.3.0)
##	systemfonts		1.1.0	2024-05-15	[1]	CRAN	(R 4.3.3)
##	textshaping		0.4.0	2024-05-24	[1]	CRAN	(R 4.3.3)

```
## tibble          * 3.2.1   2023-03-20 [2] CRAN (R 4.3.0)
## tidyr           * 1.3.1   2024-01-24 [1] CRAN (R 4.3.2)
## tidyselect      1.2.1   2024-03-11 [1] CRAN (R 4.3.2)
## tidyverse       * 2.0.0   2023-02-22 [1] CRAN (R 4.3.0)
## timechange      0.3.0   2024-01-18 [1] CRAN (R 4.3.0)
## tzdb            0.4.0   2023-05-12 [1] CRAN (R 4.3.0)
## urlchecker      1.0.1   2021-11-30 [1] CRAN (R 4.3.0)
## usethis         3.0.0   2024-07-29 [1] CRAN (R 4.3.3)
## utf8            1.2.4   2023-10-22 [1] CRAN (R 4.3.0)
## vctrs           0.6.5   2023-12-01 [1] CRAN (R 4.3.0)
## withr           3.0.2   2024-10-28 [1] CRAN (R 4.3.3)
## xfun            0.40    2023-08-09 [2] CRAN (R 4.3.0)
## xtable          1.8-4   2019-04-21 [1] CRAN (R 4.3.0)
## yaml            2.3.7   2023-01-23 [2] CRAN (R 4.3.0)
## zeallot         0.1.0   2018-01-28 [1] CRAN (R 4.3.0)
##
## [1] /Users/meghannadzam/Library/R/x86_64/4.3/library
## [2] /Library/Frameworks/R.framework/Versions/4.3-x86_64/Resources/library
##
## -----
```

```
tinytex::install_tinytex(force = TRUE)
```