

# Modelling Frameworks

## **Today's agenda:**

Discuss modelling frameworks,  
Software installation and setup

What are some of the model choices mentioned?

# What are some of the model choices mentioned?

General vs specific

Descriptive vs predictive

Mechanistic vs phenomenological

Analytical vs computational

Deterministic vs stochastic

Simple vs complex

Why are there so many different options?

# Why are there so many different options?

Trade-offs: models differ in when they're useful

E.g., mechanistic models can be linked to specific mechanisms,  
but may require more data!

You'll have to consider these trade-offs when selecting methods

Questions?

# Our goal for today is setting up software

We'll be installing:

R

RStudio

And, optionally, Git and Github

# R

```
FOREST+bmaitner@USFAAD-228TFW3 MINGW64 ~/Desktop/current_projects/BIEN_4.2_update_ms (main)  
$ R
```

```
R version 4.4.2 (2024-10-31 ucrt) -- "Pile of Leaves"  
Copyright (C) 2024 The R Foundation for Statistical Computing  
Platform: x86_64-w64-mingw32/x64
```

```
R is free software and comes with ABSOLUTELY NO WARRANTY.  
You are welcome to redistribute it under certain conditions.  
Type 'license()' or 'licence()' for distribution details.
```

```
  Natural language support but running in an English locale
```

```
R is a collaborative project with many contributors.  
Type 'contributors()' for more information and  
'citation()' on how to cite R or R packages in publications.
```

```
Type 'demo()' for some demos, 'help()' for on-line help, or  
'help.start()' for an HTML browser interface to help.  
Type 'q()' to quit R.
```

```
> library(BIEN)  
Loading required package: RPostgreSQL  
Loading required package: DBI  
Type vignette("BIEN") or vignette("BIEN_tutorial") to get started  
>
```



# RStudio

The screenshot displays the RStudio IDE interface. The top menu bar includes File, Edit, Code, View, Plots, Session, Build, Debug, Profile, Tools, and Help. Below the menu is a toolbar with icons for saving, running, and other functions. The main editor window shows a script titled '1\_BIEN\_stats.R' with the following R code:

```
1 # Code to generate BIEN annotation statistics
2
3 library(BIEN)
4 library(tidyverse)
5
6 # Total number of records in view_full_occurrence_individual
7
8 total <- BIEN:::.BIEN_sql(query = "SELECT count(*)
9                                FROM view_full_occurrence_individual ;")
10
11 #284466171 # Total number of records in vfoi
12
13
14 # Total of different observation types
15
16 occurrence_type_breakdown <-
17 BIEN:::.BIEN_sql(query = "SELECT observation_type, COUNT(*) AS total
18                          FROM view_full_occurrence_individual
19                          GROUP BY observation tvpe")
20
```

The console at the bottom shows the R version (4.4.2) and the path to the current project. The file explorer on the right shows the project structure, including files like .gitignore, .Rhistory, 1\_BIEN\_stats.R, 2\_BIEN\_metadata.R, 3\_UNESCO\_use\_case.R, 4\_BIEN\_complete\_citations.R, BIEN\_4.2\_update\_ms.Rproj, citations, figures, LICENSE, and output.

**Environment** History Connections Git Tutorial

R Global Environment

**Data**

total 1 obs. of 1 variable

**Files** Plots Packages Help Viewer Presentation

Folder File Delete Rename

C:\Users\bmaitner\Desktop\current\_projects\BIEN\_4.2\_update\_ms

Name	Size	Modified
..		
.gitignore	69 B	Feb 20, 2025, 12:07 PM
.Rhistory	0 B	May 2, 2025, 3:17 PM
1_BIEN_stats.R	22.7 KB	Feb 20, 2025, 11:48 AM
2_BIEN_metadata.R	208 B	Jan 24, 2025, 9:57 AM
3_UNESCO_use_case.R	2.8 KB	Feb 20, 2025, 11:26 AM
4_BIEN_complete_citations.R	1.8 KB	Jan 24, 2025, 9:57 AM
BIEN_4.2_update_ms.Rproj	267 B	Aug 26, 2025, 10:04 AM
citations		
figures		
LICENSE	1.1 KB	Jan 24, 2025, 9:57 AM
output		

**Console** Terminal Background Jobs

R 4.4.2 · C:\Users\bmaitner\Desktop\current\_projects\BIEN\_4.2\_update\_ms\

R version 4.4.2 (2024-10-31 ucrt) -- "Pile of Leaves"  
Copyright (C) 2024 The R Foundation for Statistical Computing  
Platform: x86\_64-w64-mingw32/x64

R is free software and comes with ABSOLUTELY NO WARRANTY.  
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18                          FROM view_full_occurrence_individual
19                          GROUP BY observation tvpe")
20
```

The Environment pane on the right shows the `Data` tab with a variable `total` containing 1 observation of 1 variable. The Files pane at the bottom right shows a directory listing for `BIEN_4.2_update_ms` with the following files:

Name	Size	Modified
..		
.gitignore	69 B	Feb 20, 2025, 12:07 PM
.Rhistory	0 B	May 2, 2025, 3:17 PM
1_BIEN_stats.R	22.7 KB	Feb 20, 2025, 11:48 AM
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citations		
figures		
LICENSE	1.1 KB	Jan 24, 2025, 9:57 AM
output		

The Console pane at the bottom shows the R version and copyright information:

```
R version 4.4.2 (2024-10-31 ucrt) -- "Pile of Leaves"
Copyright (C) 2024 The R Foundation for Statistical Computing
Platform: x86_64-w64-mingw32/x64

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A large blue arrow points from the letter **R** on the right towards the RStudio interface.

# RStudio

## Stuff to make R easier to use

The screenshot shows the RStudio IDE with several red arrows pointing to specific features:

- A red arrow points to the **Source** editor, which contains R code for generating BIEN annotation statistics.
- A red arrow points to the **Environment** pane, which shows the current environment and data.
- A red arrow points to the **Files** pane, which shows the project file structure.

The **Source** editor contains the following code:

```
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18                          FROM view_full_occurrence_individual
19                          GROUP BY observation tvpe")
20
```

The **Environment** pane shows the following data:

Object	Class	Attributes
total	numeric	1 obs. of 1 variable

The **Files** pane shows the following file structure:

Name	Size	Modified
..		
.gitignore	69 B	Feb 20, 2025, 12:07 PM
.Rhistory	0 B	May 2, 2025, 3:17 PM
1_BIEN_stats.R	22.7 KB	Feb 20, 2025, 11:48 AM
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BIEN_4.2_update_ms.Rproj	267 B	Aug 26, 2025, 10:04 AM
citations		
figures		
LICENSE	1.1 KB	Jan 24, 2025, 9:57 AM
output		

The **Console** pane shows the following output:

```
R version 4.4.2 (2024-10-31 ucrt) -- "Pile of Leaves"
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```

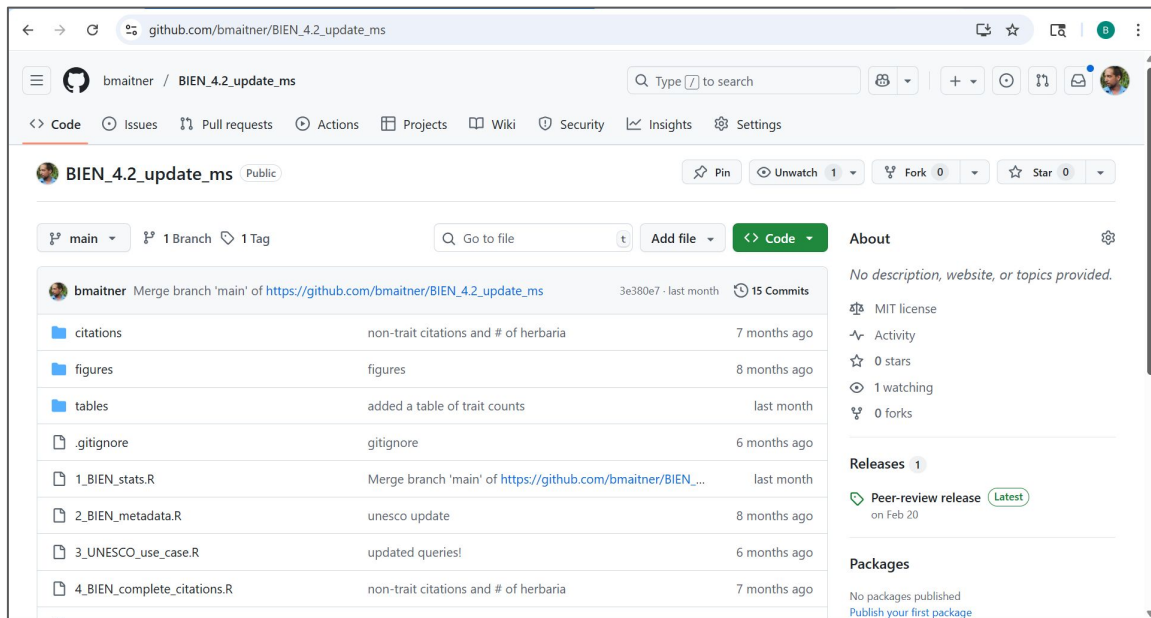
R

# Git

- Program that tracks changes in files
- Removes need for multiple versions of file (you can always go back)
- Tracks what is added or removed in each version
- Allows multiple users to work on files and combine their changes

# Github

- A repository for Git
- Stores your files
- Also can be used for editing files
- You can even set it up to run analyses for you!



# Why use Github?

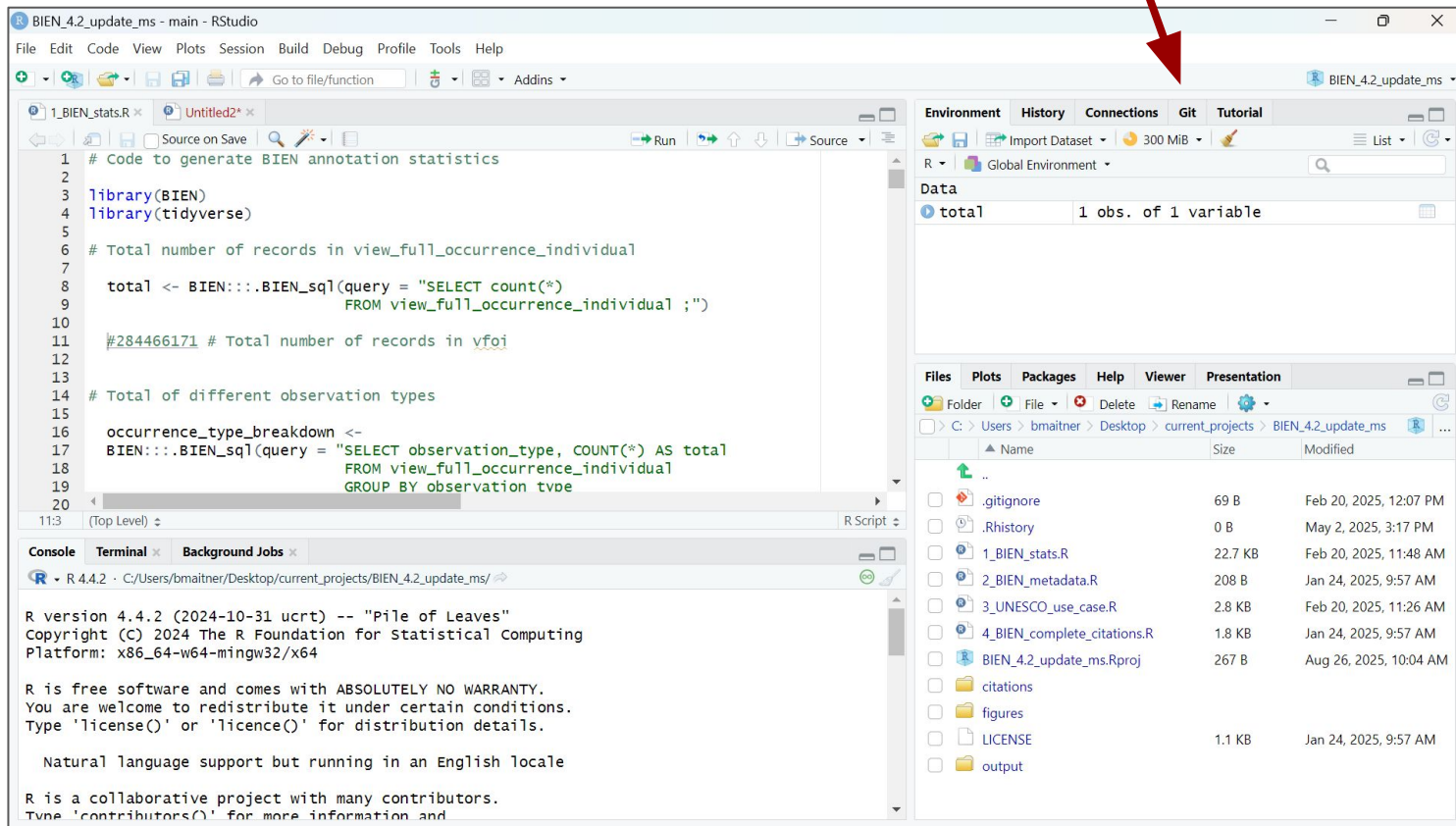
- Secure backup of code (in case your computer dies...)
- Helps when you use multiple computers
- Collaboration
- Transparency and reproducibility (if you make it public)
- Letting other people use your code (forking/copying)
- Increasingly expected of biologists
- Can be archived, cited (e.g., via Zenodo)
- Grad students have to, undergrads get extra credit

# Installing the needed software

- R (available for free at <https://www.r-project.org/> )
- RStudio (available for free at <https://posit.co/download/rstudio-desktop/> )
- Git (optional for undergrads. Available for free at <https://git-scm.com/downloads> )
- Github account (optional for undergrads. Sign up for free at: <https://github.com/> )

# Did it work?

Should have a “Git” tab in RStudio



The screenshot shows the RStudio interface with the following components:

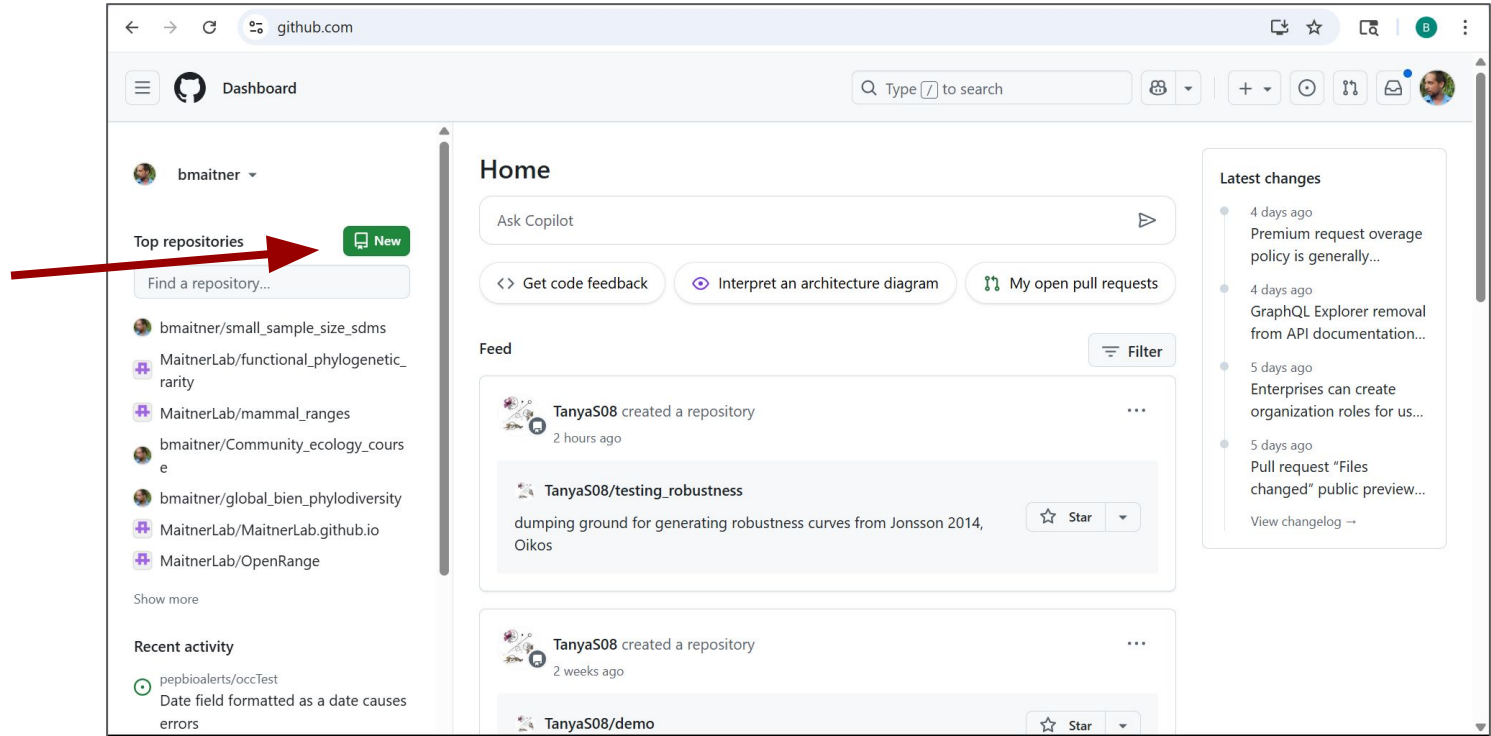
- Source Editor:** Contains R code for generating BIEN annotation statistics. The code includes library calls for `BIEN` and `tidyverse`, a query to count records in `view_full_occurrence_individual`, and a query to break down occurrence types.
- Console:** Displays the R version (4.4.2), copyright information, and a message about natural language support.
- Environment:** Shows the `total` variable with 1 observation.
- Files:** Lists files in the project directory, including `.gitignore`, `.Rhistory`, `1_BIEN_stats.R`, `2_BIEN_metadata.R`, `3_UNESCO_use_case.R`, `4_BIEN_complete_citations.R`, `BIEN_4.2_update_ms.Rproj`, `citations`, `figures`, `LICENSE`, and `output`.

A red arrow points to the top toolbar, highlighting the absence of a 'Git' tab, which is the subject of the text 'Should have a “Git” tab in RStudio'.



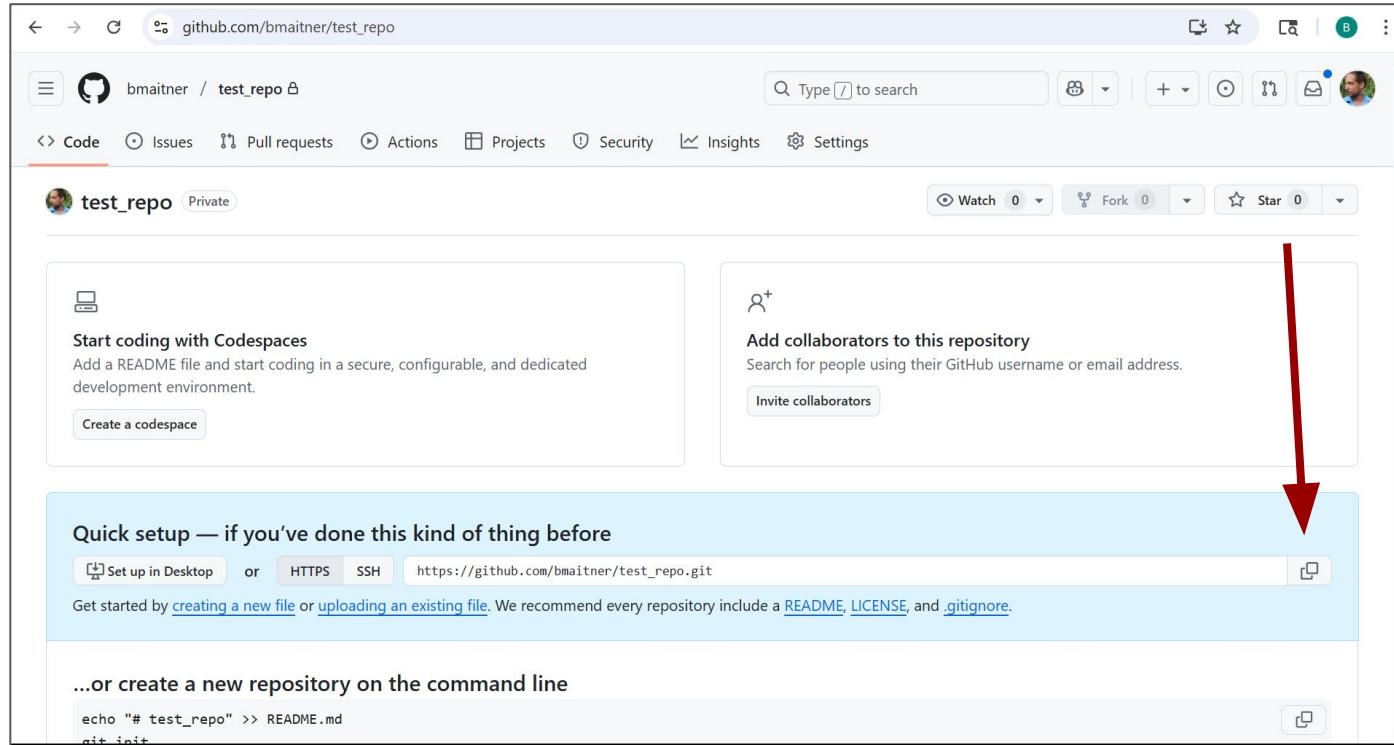
# Make sure it works

## Go to your Github page and make a new repo



# Make sure it works

## Copy the URL



The screenshot shows the GitHub interface for a repository named 'test\_repo' by user 'bmaitner'. The repository is private. The page includes navigation tabs for Code, Issues, Pull requests, Actions, Projects, Security, Insights, and Settings. Below the repository name, there are buttons for Watch (0), Fork (0), and Star (0). The main content area has two cards: 'Start coding with Codespaces' and 'Add collaborators to this repository'. Below these is a blue 'Quick setup' section with the text 'Quick setup — if you've done this kind of thing before'. It provides a link to 'Set up in Desktop' or 'HTTPS' or 'SSH' with the URL 'https://github.com/bmaitner/test\_repo.git'. A red arrow points to the copy icon next to the URL. Below the URL, it says 'Get started by [creating a new file](#) or [uploading an existing file](#). We recommend every repository include a [README](#), [LICENSE](#), and [.gitignore](#).' At the bottom, there is a section for '...or create a new repository on the command line' with a code block showing 'echo "# test\_repo" >> README.md' and 'git init'.

github.com/bmaitner/test\_repo

bmaitner / test\_repo

Type to search

<> Code Issues Pull requests Actions Projects Security Insights Settings

test\_repo Private

Watch 0 Fork 0 Star 0

Start coding with Codespaces

Add a README file and start coding in a secure, configurable, and dedicated development environment.

Create a codespace

Add collaborators to this repository

Search for people using their GitHub username or email address.

Invite collaborators

Quick setup — if you've done this kind of thing before

Set up in Desktop or HTTPS SSH https://github.com/bmaitner/test\_repo.git

Get started by [creating a new file](#) or [uploading an existing file](#). We recommend every repository include a [README](#), [LICENSE](#), and [.gitignore](#).

...or create a new repository on the command line

```
echo "# test_repo" >> README.md
git init
```

# Make sure it works

In RStudio:

- File > New Project...
- Select “Version Control”
- Select “Git”
- Paste the copied URL into the “Repository URL” box
- Pick a directory for it to be created in
- Click “Create Project”

# Next time:

Before class: read 1.4 - 1.6

During class:

- Discuss 1.4-1.6
- Work through 1.7