

Oliver Lab Manual

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1 Welcome

Welcome to our lab manual!

We are the Oliver Lab at UC Santa Barbara's Bren School of Environmental Science & Management. Our group works to create new perspectives on how humans and wildlife can coexist in an era of rapid change. More about our group's research activity can be found on [our website](#).

This lab manual is intended to provide an overview about how we do our work and expectations for our team. It is also a space to document institutional knowledge and available resources. If you have suggestions for additions or changes, please submit a [GitHub Issue](#).

Our lab manual is adapted from and inspired by the Fay Lab and Huckley Lab's own manuals as well as the [Bren Graduate Student Handbook](#).

2 Lab Culture and Philosophy

3 Onboarding

This chapter contains some resources to help you get settled into Bren and the Oliver Lab.

3.1 Timekeeping

Graduate students are expected to approve their timesheets via [UCSB's Timekeeping system](#).

3.2 Access Card

Access Cards are UCSB's photo identification method, which are used as proof of registration and employment. You will need to purchase an [Access Card](#) for 30 USD. This fee will be applied to the student's BARC account and staff need to complete a [recharge form](#).

3.3 Bren Hall

Fun fact: Bren Hall was the first laboratory building in the United States to receive the U.S. Green Building Council's Platinum LEED accreditation!

3.3.1 After-hours access

The Bren School labs and doors are open Monday to Friday from 8 AM to 5 PM.

Once you obtain your Access Card, you can request building access through this [Building Security form](#). You will then be granted 24/7 access.

3.3.2 Printing

At the start of the academic year, students are credited 30 USD for printing fees. The current costs are:

- Black and white prints: 0.03 USD per side
- Color prints: 0.20 USD per side

You can find a list of Bren printer locations [here](#).

3.3.3 Google Calendar

Lab members are expected to maintain and share their general availability using Google Calendar. All lab-related meetings should be scheduled through Google Calendar to ensure coordination.

General resource calendars include:

- [This Week at Bren](#)
- [Rec Cen Pools](#)

4 Expectations

This chapter contains information about how we work.

4.1 Communication

We communicate via Slack and email. The lab Slack channel is the preferred method of communication for a quick response. You should check your email or Slack at least once a day during the normal work week. You are not expected to be available 24/7 and should not expect responses to emails or messages after regular business hours on weekdays, or on weekends.

4.2 Lab meetings

Attendance is generally expected at weekly lab meetings (also known as **Wildlife @ Bren**). Here, we present research, discuss papers, troubleshoot code, host guest speakers, and undertake professional development activities. We decide on a schedule collaboratively at the start of each quarter. Lab meetings are hybrid to allow for full participation. We host our in-person meetings at Bren's Visitor Center.

4.3 Weekly meetings (1:1)

Ruth generally meets with lab members weekly. During this meeting, we'll review progress on the previous week's goals and set goals for the next week.

4.4 Mentorship

Ruth annually meets with students and staff to re-visit and hone their [Individual Development Plans \(IDPs\)](#) for their short-, medium-, and long-term goals. Each advisor-student relationship may look different depending on the career status, goals, and overall dynamics. IDPs help us align expectations in mentorship and facilitate communication between advisor/student.

5 Funding

Ruth does not typically accept students into the lab without being able to guarantee at least five years of funding. At Bren, five-year funding plans for PhD students are highly individualized. These can include a combination of external fellowships, internal fellowships, grants, donor funds, and academic employment (like Teaching Assistantships and Graduate Student Researcher positions).

You are encouraged to apply for external funding through graduate scholarships and fellowships, like:

- NSF Graduate Research Fellowship Program
- Ford Foundation
- GEM Fellowship
- NASA Future Investigators in NASA Earth and Space Science and Technology (FINESSST)

Additional resources like [the Society of Conservation Biology's opportunity document](#) exist.

Ruth will also share funding opportunities as they come up, either to the group or in individual meetings.

6 Academics

This chapter contains information pertaining to graduate students enrolled in the Bren School's PhD program.

6.1 Requirements

The PhD degree is not based on a unit count. PhD students must take three core ESM courses (10 units) and any other relevant coursework to achieve the academic goals set for the student by the faculty advisor and committee.

- [Year 1, Fall] ESM 512: Research Ethics and Conduct (2 units)
- [Year 2, Fall] ESM 513 Environmental Research Design (4 units)
- [Year 2, Winter] ESM 514 Collaborative Interdisciplinary Research (4 units)

If you are a Bren master's graduate continuing to a PhD, your academic clock will be reset to zero.

6.1.1 Timeline

The time-to-degree standards for the Bren School are:

- **Advancement to candidacy:** 3 years
- **Degree completion:** 5 years

There are general milestones/deadlines you will also need to complete:

Bren School PhD Annual Review Form, due every fall quarter Every winter quarter, a student's progress and performance is reviewed by the faculty chair of the PhD Program Committee. Before submitting the form, you must convene a meeting of your committee and present a progress report. PhD students in their first year who do not have formal committees meet with their advisor.

Form I: Justification of Proposed PhD Committee, due fall quarter of 2nd year By the fall quarter of the second year of study, students must confirm their advisor(s) and select members of their committee. To nominate a committee, you must (1) start the "Create Committee" workflow in GradPoint and (2) complete the Form 1.

PhD Written Exam Form, due 2nd year The PhD committee will recommend a reading list as a guide for study and describe the nature of the exam. You must submit the **PhD Written Exam Form** to the Student Affairs staff within 30 days of the examination.

Form II: Report on Doctoral Degree Qualifying Examinations, due spring quarter of 3rd year

To advance to candidacy, students must develop and defend a comprehensive dissertation proposal and take an oral qualifying examination by the spring quarter of their 3rd year. You must complete the Form II. Students must complete all PhD core courses prior to scheduling their oral exams.

Form III: Report on Doctoral Degree Final Defense

This is a general guideline. Each PhD student at Bren follows a unique timeline.

6.2 Course Registration

Course registration at UCSB is done through [Gaucho On-Line Data \(GOLD\)](#). Registration for each quarter takes place about mid-way through the previous quarter. It your responsibility to keep track of registration pass times and enroll in courses accurately and on time. Before registering for each quarter, you will meet with Ruth to discuss registration plans for the forthcoming quarter (courses and/or research credits).

The Bren School philosophy is to accommodate all Bren students who want to take a particular Bren course. However, some courses may have limited capacity. If GOLD indicates that a course is full, please email academics@bren.ucsb.edu to inquire about the possibility of adding the course or being added to a waitlist.

PhD students must be enrolled in a minimum of 12 units per quarter to maintain full-time status and opportunities for financial support.

6.3 Courses

Graduate courses at UCSB are numbered 200-599. Upper-division undergraduate courses are numbered 100-199. Lower-division undergraduate courses, numbered <100, can never count towards satisfying graduate degree requirements.

Broadly, Ruth has recommended the following courses:

Ecological Theory

- EEMB 508: Levels of Biological Organization I: Individuals and Populations
- EEMB 595A: Ecology and Evolution
- EEMB 595FF: Foundations and Frontiers in Ecology
- EEMB 280: Evolutionary Theory and Models of Behavioral Processes

Methods

- EEMB 247: Quantitative Methods in Biology
- EEMB 274: Advanced Biostatistics using Bayesian Methods
- EEMB 279: Ecological Modeling
- GEOG 286: Analysis and Modeling of Movement

Remote Sensing and Earth Science

- EARTH 205: Earth's Climate: Past and Present
- GEOG 202A: Remote Sensing and Environmental Optics
- GEOG 214A: Advanced Remote Sensing: Passive
- GEOG 266: Introduction to Atmospheric Sciences

Science Communication

- EEMB 511: Writing Science

7 Lab Data Access

7.1 SSH key pairs

SSH = “secure shell”, a network protocol that establishes encrypted connections between machines for remote access

SSH key pairs are 2 files you generate on your machine that authenticate you on another machine via encryption and then decryption. One file is only stored locally, and the other is your “public” key that you upload to the destination server.

- SSH keys are optional on many servers, but required for others like GRIT. When they are optional, you can alternatively login by being prompted for your password in your IDE.
- An extra step of creating a passkey for your authentication is optional, just an extra layer of security. When you are prompted for this, your password is hidden.
- When you SSH to the destination server, the encryption & decryption of the key files authenticates you.

7.1.1 Generate a key pair

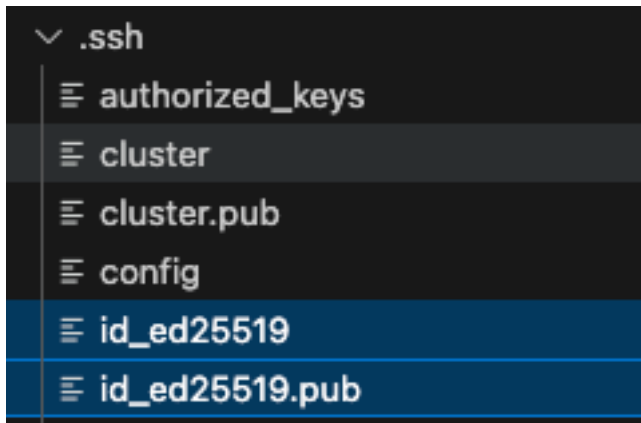
[ssh-keygen man page](#)

Generate a key pair on your source machine (laptop or server).

- The string portion will be tagged onto the end of the public key, insert something that will help the destination server admins attribute this key to you, like your email. (-C = “comment”)
- The “ed25519” part represents the algorithm used to generate the key: Edwards-curve Digital Signature Algorithm. It’s newer and stronger than old algorithms like “RSA”, produces smaller keys, generates keys faster, and importantly is supported by both Linux and Mac

```
cd ~  
ssh-keygen -t ed25519 -C "some_string"
```

2 files are generated: `~/.ssh/id_ed25519` and `~/.ssh/id_ed25519.pub`



You can use the same key pair for multiple destination machines, making it easier to manage because you don't have to keep track of each pair, but this also poses more of a risk if it's compromised.

7.1.2 Upload the public key

For GRIT, upload your pub key through [this form](#).

Normally, you would be responsible for uploading the **public** key to the server yourself with this command:

```
ssh-copy-id -i ~/.ssh/id_ed25519_vscode.pub username@remote.server.edu
```

This command does not generate a new file on the destination server, it just adds a line to the `~/.ssh/authorized_keys` file. Then on your local machine, you would add this host to your IDE config so it looks like this:

```
Host server_name.cnsi.ucsb.edu
  HostName server_name.cnsi.ucsb.edu
  User your_username
  IdentityFile ~/.ssh/id_ed25519_name_of_file
```

Now you will be able to SSH in the command line with just `ssh server_name.cnsi.ucsb.edu` and just select the remote hostname in your IDE without typing in a password.

7.1.3 Ensure correct permissions

Ensure you have the right directory and file permissions set. The `~/.ssh` directory should be private, and the private key file itself should be readable and writable only by you. The public key should be readable by everyone.

```
chmod 700 ~/.ssh          # only owner can access (rw-----)
chmod 600 ~/.ssh/id_ed25519 # only readable, writable, and executable by me (rw-----)
chmod 644 ~/.ssh/id_ed25519.pub # readable by everyone (rw-r--r--)
```

SSH will refuse insecure keys. If you get a permission denied error, it is likely that the directory or file permissions are too open. SSH is looking out for you! Here's an example of this error message:

```
Warning: Permanently added 'ssh.grit.ucsb.edu' (ED25519) to the list of known hosts.
@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@
@                WARNING: UNPROTECTED PRIVATE KEY FILE!                @
@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@
Permissions 0644 for '/Users/julietcohen/.ssh/id_ed25519' are too open.
It is required that your private key files are NOT accessible by others.
This private key will be ignored.
Load key "/Users/julietcohen/.ssh/id_ed25519": bad permissions
```

7.1.4 Understanding user permissions

User, group, and other have permissions outlined when you run `ls -al`.

```
drwx-----@  6 julietcohen  staff    192 Sep 21 19:59 .ssh
-rw-----@  1 julietcohen  staff    444 Sep 21 19:41 id_ed25519
```

The first character designates it as a file (-) or directory (d). After the first character, the following 3 are the user permissions, the next 3 are the group permissions, and the last 3 are the permissions for other.

r = “read”, w = “write”, x = “execute” (run script)

7.1.5 Accessing Nextcloud Storage via SSH

Specify the local key file within the command.

```
ssh -i ~/.ssh/id_ed25519 username@ssh.grit.ucsb.edu
```

- Access destination directories `username@ssh.grit.ucsb.edu:/home/oliver-lab` or `username@ssh.grit.ucsb.edu:/home/username`
- If you set up a passkey when you generated the key pair, you will be prompted to enter it
- The first time, seeing a warning “The authenticity of host can’t be established” is not reason for concern. Continue logging in.
- There are several other SSH endpoints within GRIT, but this is the only one that works for me. I expect more to work over time.

```

PROBLEMS  OUTPUT  DEBUG CONSOLE  TERMINAL  PORTS
○ (base) [julietcohen@braid2 ~]$ ssh -i ~/.ssh/id_ed25519 jscohen@ssh.grit.ucsb.edu
Enter passphrase for key '/home/julietcohen/.ssh/id_ed25519':
Welcome to Ubuntu 24.04.2 LTS (GNU/Linux 6.8.0-64-generic x86_64)

System information as of Wed Sep 17 11:39:45 PDT 2025

System load:  7.66           Processes:            262
Usage of /:   50.6% of 9.51GB Users logged in:     2
Memory usage: 19%           IPv4 address for eth0: 128.111.104.76
Swap usage:   0%

GRIT MOTD:
is a server down or is it just you? check out https://zabbix.grit.ucsb.edu/zabbix.php?action=dashboard.view

Last login: Tue Sep 16 15:35:21 2025 from 128.111.247.243
jscohen@ssh-bastion:~$ █

```

In order to break the connection, kill the terminal or use the `exit` command.

```

[jscohen@ssh-bastion:~$ exit
logout
Connection to ssh.grit.ucsb.edu closed.
Juliets-MacBook-Pro-2:~ julietcohen$ █

```

7.1.6 tmux

It’s always wise to use a persistent shell when making transfers a large amount of data or files.

[tmux cheat sheet](#)

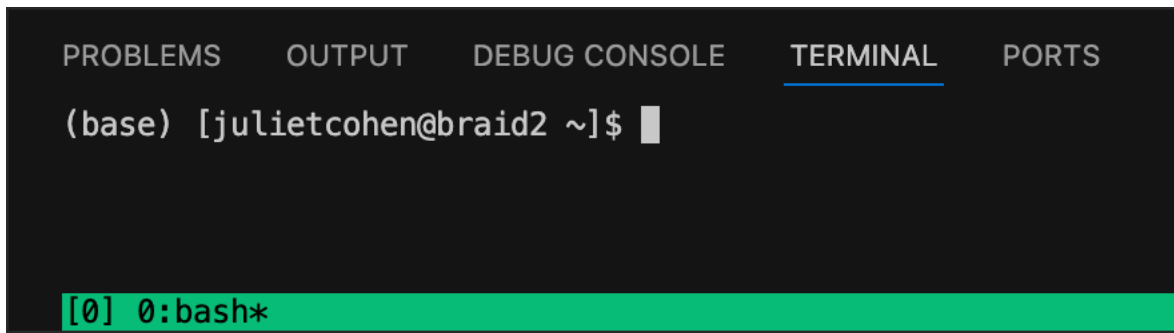
You can name your tmux sessions, but the default name for a session is “0”

```

tmux
tmux ls
tmux attach -t 0
tmux kill-session -t 0

```


A tmux terminal is designated by a green bar at the bottom:



```
PROBLEMS  OUTPUT  DEBUG CONSOLE  TERMINAL  PORTS

(base) [julietcohen@braid2 ~]$ █

[0] 0: bash*
```

Note: If you do not use a tmux session and your terminal is killed midway through an rsync, the process will abort. But you can just run the same rsync command again and it will pick up where it left off, checking that some files were already transferred.

7.1.7 rsync

See the Options Summary section of the [man page](#)

- When making transfers within the same machine, common to use **-a** archive mode, which is a combination of multiple options: **-rlptgoD**
 - **-r** recursive, use when transferring a directory hierarchy
 - **-l** copy symlinks as symlinks
 - **-p** preserve permissions
 - **-t** preserve timestamps (good practice)
 - **-g** preserve group
 - **-o** preserve owner
 - **-D** copies device files as such (like those in **/dev** directories) and preserve special files, not necessary for our purposes
- Include **-z** for compression
- Include **--dry-run** when want to see what will be transferred before executing.
- Include **-v** for verbose if you want to see what is being copied in real time.
- When specifying the source directory, including a trailing slash will transfer everything *within* the directory but not the top level dir. Usually we want to transfer the top level dir, so omit the trailing slash.
- Ensure the quotes are not fancy. Re-type the quotes before running the rsync command if copied the command from another text editor.
- When using an SSH key pair, include the filename for the file in the command so rsync knows where to pull from.

```
rsync -tvr -e "ssh -i ~/.ssh/id_ed25519" safegraph jscohen@ssh.grit.ucsb.edu:/home/oliver-lab
```

7.1.8 Check directory and file contents

Check number of files in a directory, recursively

```
find directory_name -type f | wc -l
```

Check number of bytes in a directory, summing up all files recursively, auto-scaling the bytes to human readable format (MB, GB, etc.). Note that this number can vary slightly across machines with the same data due to metadata overhead.

```
du -sh directory_name
```

```
jscohen@ssh-bastion:/home/oliver-lab/covid/covid-raw-data$ du -sh safegraph
5.7G    safegraph
```

Check if files are identical using SHA256 checksums (string that uniquely represents file contents).

```
sha256 file1.txt file2.txt
```

```
[Juliets-MacBook-Pro-2:~ julietcohen$ sha256 Documents/covid/human_mobility_wildlife/out/dbbmm_size.csv Documents/covid/human_mobility_wildlife/out/dbbmm_size_w_test_skunks.csv
SHA256 (Documents/covid/human_mobility_wildlife/out/dbbmm_size.csv) = 27f678f418a57e3757c7e0ef15a8533860c4720a6d648b15e49e7fa3ab032a09
SHA256 (Documents/covid/human_mobility_wildlife/out/dbbmm_size_w_test_skunks.csv) = bd535e66a04a0d4d2581c14c483fe2d230fa32498990af8e24ffbd6c61284fe4f
```

Check if files are identical by comparing bytes. No output means they are the same.

```
cmp file1.txt file2.txt
```

```
[Juliets-MacBook-Pro-2:~ julietcohen$ cmp Documents/covid/human_mobility_wildlife/out/dbbmm_size.csv Documents/covid/human_mobility_wildlife/out/dbbmm_size_w_test_skunks.csv
Documents/covid/human_mobility_wildlife/out/dbbmm_size.csv Documents/covid/human_mobility_wildlife/out/dbbmm_size_w_test_skunks.csv differ: char 9, line 1
```

7.1.9 Aliases

Commands you run often can be made into a shortcut. This is simply a line added to your `~/.bashrc` script:

```
alias myalias="command_to_execute"
```

Then open a new terminal so the `.bashrc` script is loaded.

```
$ .bashrc
$ .bashrc
41 alias sshgrit="ssh -i ~/.ssh/id_ed25519 jscohen@s
```

I created an alias for my SSH login to grit:

```
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS

(base) [julietcohen@braid2 ~]$ sshgrit
Enter passphrase for key '/home/julietcohen/.ssh/id_ed25519':
Welcome to Ubuntu 24.04.2 LTS (GNU/Linux 6.8.0-79-generic x86_64)

System information as of Sun Sep 21 19:32:37 PDT 2025

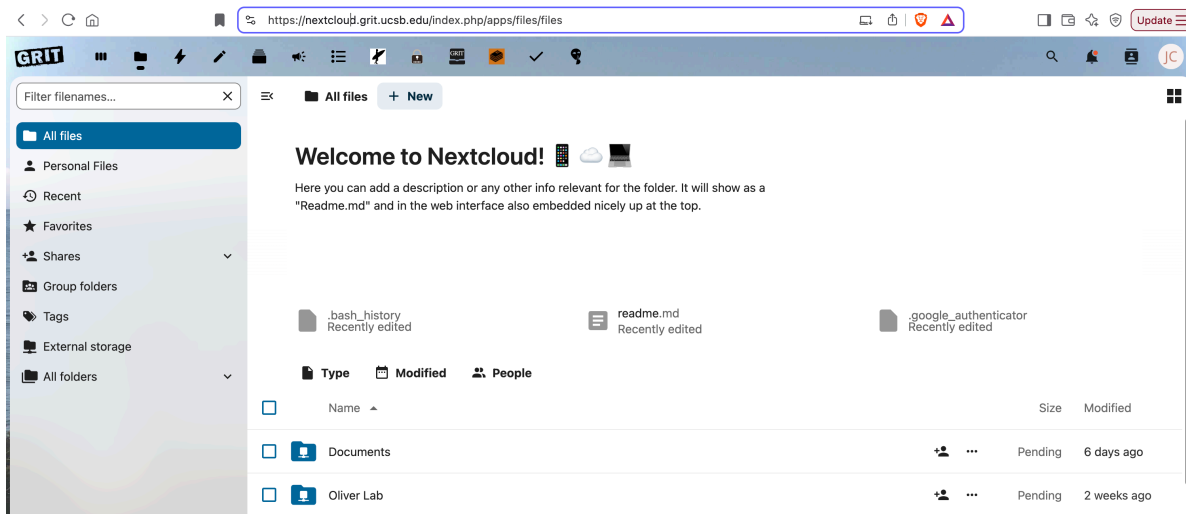
System load: 0.24          Processes:              302
Usage of /:  52.7% of 9.51GB Users logged in:         1
Memory usage: 7%          IPv4 address for eth0: 128.111.104.76
Swap usage:  0%

GRIT MOTD:
need to reset your password or update your ssh key? visit selfservice.grit.ucsb.edu

Last login: Wed Sep 17 11:39:46 2025 from 128.111.247.243
jscohen@ssh-bastion:~$
```

7.1.10 Accessing Nextcloud Storage via a browser

<https://nextcloud.grit.ucsb.edu/index.php/apps/files/files>



7.2 Commands on Pod

Command	Use
<code>ssh {username}@pod-login1.cnsi.ucsb.edu</code>	login to pod
<code>srun --pty bash -i</code>	run in a tmux session, launch an interactive job on a normal memory node (add to the queue) that doesn't respect SBATCH commands in the sh files run
<code>sbatch script.sh</code>	launch a non-interactive job on a normal memory node (add to the queue)
<code>sbatch -p largemem script.sh</code>	launch a non-interactive job on a high memory node (add to the queue)
<code>squeue -u {username}</code>	print information regarding requested jobs such as JOBID, NAME, NODES, etc.
<code>ssh node48</code>	open terminal in the appropriate node number such as node 48
<code>scontrol show job {jobID}</code>	show detailed info about your job, such as endtime
<code>top -u {username}</code>	show node memory usage and only your processes, with %MEM column showing each process's memory usage (htop is not available on Pod)
<code>module load R/4.1.3 gdal/2.2.3 proj/5.2</code>	load modules in one of the terminals on the job node
<code>R</code>	open R module in terminal
<code>q()</code>	exit out of R module, switch wd to ~
<code>sinfo -o "%n %m"</code>	shows the total amount of memory per node for all nodes on the server
<code>sinfo -o "%n %m %C" awk '\$2 >= 512000'</code>	shows the core availability of each node that has at least 500GB