R Software Manual Developer Application Materials

Cole B. Brookson

2022-04-16

Dear Drs. Sztepanacz & Riskin,

I am writing to apply to the position of R software manual developer within the Department of Ecology and Evolutionary Biology at the University of Toronto. As a previous undergraduate in the EEB department, I am accutely aware of the need for this type of product in the undergraduate curriculum. Having spent the past 4 years working intensely in R, both in research and teaching capacities, I believe I have the skills and aptitude to build a dynamic, engaging, and adaptable product, usable in the department for years to come.

I have significant experience teaching R to students at beginner to advanced levels. Along with colleagues at the University of Alberta, I developed and delivered multiple free, open-source workshop series introducing over 150 Biological Sciences students to both R and Python https://colebrookson.github.io/r-for-biology/. I have developed and delivered workshops in reproducible research and coding practices for graduate students at the University of Alberta, and as the TA for Marine Population Ecology & Dynamics (an intensive field course held at Bamfield Marine Sciences Centre), I completely revamped the statistical and programming components of the courses, and built an open-source website to host the course online. I am a certified Data/Software Carpentries instructor, and completed graduate teaching and learning training through the University of Alberta's Faculty of Graduate Studies and Research. I have significant experience with a variety of other programming languages which lends context to my teaching approach to R (Julia, Python, MATLAB, Mathematica, C++, HTML, SQL, and JavaScript), and I am an expert in reproducible technologies such as version control with Git/GitHub, containerization with Docker & Singularity, and workflow implementation with bash, Make, Snakemake and others. In addition, I have experience building websites and working with RShiny to make teaching experiences more interactive and user-friendly.

When I was first learning R as an EEB undergrad, I struggled significantly, which I think is why I am so incredibly passionate about computational education. The opportunity to contribute to this type of product would be the ultimate full-circle experience for me, allowing me to give back to the EEB community that formed me as a student & researcher, and offered me my first exposure to the wonderful world of R.

As I am currently completing my MSc and will be on contract as an Ecological Data Analyst for the Kwikwasut'inuxw Haxwa'mis, 'Namgis, and Mamalilikulla First Nations until August 31, 2022, I would not be able to start the position until Aug 01, and would prefer a September 01 start date. However, I understand that might not fit with the timeline of this project, and would be very open to discussing possible solutions (i.e. part time earlier start dates).

My sincere thanks for your consideration,

Cole Brookson

Potential References
Dr. Marie-Josée Fortin - fortinmj@gmail.com
Dr. Alexandra CD Davis - acdavis@ualberta.ca (Instructor at Bamfield)

One-page foray into regression analysis.

Let's ask a biological question and answer it using regression. Regression, simply, is fitting a line through some points. We can think of this mathematically as $Y \sim \beta X$, where our goal is to ask how X explains Y, by estimating or "fitting" the value of the regression coefficient, β. For our example, let's test whether Bergmann's Rule holds for within-species size patterns of fiddler's crabs.

Implementation

So as usual, we will start by loading the required packages for this activity. To perform a simple linear regression, we can use the `stats` package which comes pre-loaded, but we'll also want the `tidyverse` package, to plot, and the `lterdatasampler` package, to load in some data for this task.

```
# install packages if needed
#install.packages("tidyverse")
#remotes::install_github("lter/lterdatasampler")

# load in libraries
library(tidyverse)
library(lterdatasampler)
```

We will first fit the model, then look at the output using the `summary()` function.

```
# we will use the lm() function from the stats package for this
crab_mod = stats::lm(formula = size ~ latitude, # first specify the formula of the model
                     data = pie_crab) # specify the data source

# look at the output
summary(crab_mod)
```

```
##
## Call:
## stats::lm(formula = size ~ latitude, data = pie_crab)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -7.8376 -1.8797  0.1144  1.9484  6.9280
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept) -3.62442    1.27405  -2.845  0.00468 **
## latitude     0.48512    0.03359  14.441  < 2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 2.832 on 390 degrees of freedom
## Multiple R-squared:  0.3484, Adjusted R-squared:  0.3467
## F-statistic: 208.5 on 1 and 390 DF,  p-value: < 2.2e-16
```

There's lots of useful information in this output, but the first thing that we're *really* interested in is the estimate value for `latitude`. Here, the estimate can be interpreted as the β value, and we can see that it is a positive value (so the slope of the regression line is positive), and we see that there is an associated p-value of <2e-16, which we can consider (for the purposes of this exercise) to be very significant, which then let's us reject our null hypothesis.

Expanded (but still brief) foray into regression analysis

Let's explore some common ecological problems, and investigate how we can use linear regression to solve them. As usual, we will separate the statistical concept of regression, the domain, from the computational implementation.

Regression as Concept

To refresh our memories, **regression** is a method of analysis we can use for hypothesis testing. At the simplest level, this idea of regression is simply *a measure of the relation between the mean value of one variable, and the corresponding values of other variables.* It is most common to relate these to the ideas of explanatory variables (denoted X) and the independent variable, Y. Since, as the name implies, linear regression means simply fitting a straight line through some points, what we are actually doing in practice most of the time, is finding the slope of that straight line, along with the y-intercept. Assuming for a moment the y-intercept isn't of interest, we can think of the simplest regression framework as being:

$$Y \sim \beta X,$$

where our goal is to ask how X explains Y, by estimating or "fitting" the value of the regression coefficient, β.

Implementation in R

So as usual, we will start by loading the required packages for this activity. To perform a simple linear regression, we can use the `stats` package which comes pre-loaded. We will want two additional packages: the `tidyverse` package, to plot our data, and the `lterdatasampler` package, to load in some data for this task.

```
# install packages if needed
#install.packages("tidyverse")
#remotes::install_github("lter/lterdatasampler")

# load in libraries
library(tidyverse)
library(lterdatasampler)
```

Our example dataset we are using today is the `pie_crab` dataset, which includes data on the size of fiddler crabs' carapace width, alongside environmental variables. Let's first take a quick look at our dataset.

```
head(pie_crab)
```

```
## # A tibble: 6 x 9
##   date       latitude site   size air_temp air_temp_sd water_temp water_temp_sd
##   <date>        <dbl> <chr> <dbl>    <dbl>       <dbl>      <dbl>         <dbl>
## 1 2016-07-24       30 GTM    12.4     21.8        6.39       24.5          6.12
## 2 2016-07-24       30 GTM    14.2     21.8        6.39       24.5          6.12
## 3 2016-07-24       30 GTM    14.5     21.8        6.39       24.5          6.12
## 4 2016-07-24       30 GTM    12.9     21.8        6.39       24.5          6.12
## 5 2016-07-24       30 GTM    12.4     21.8        6.39       24.5          6.12
## 6 2016-07-24       30 GTM    13.0     21.8        6.39       24.5          6.12
## # ... with 1 more variable: name <chr>
```

To avoid p-hacking ourselves (see Appendix 1 for a review of p-hacking), we need to first develop a hypothesis that we're going to use our linear regression to test. A classic theory in ecology is Bergmann's Rule. Given the premise of the rule, we might expect relationship between size and latitude to happen within species. Let's test this with our fiddler crabs!

Null Hypothesis

To ensure we are going about this properly, let's state our biological null hypothesis.

Our null hypothesis is that there is NO significant positive relationship between latitude and the size of fiddler crabs.

Note that this is a *directional* null/alternative hypothesis, which means we're not only stating that we believe there is a relationship, but the *direction* of that relationship. Now, let's think about what this means statistically. In our regression framework, remember we're thinking about **slope** of a line. A lack of a relationship is denoted by a slope of zero, but to reject our null hypothesis, we need a *positive* relationship since Bergmann's Rule states that body size *increases* as temperature (and therefore latitude) decreases! We can *reject our null hypothesis* (recall we can never accept a hypothesis, only reject the null!!) if the slope of our regression line is significantly different than zero in the positive direction.

If we relate these values to the expression for our simple linear model above ($Y \sim \beta X$), our data (X) will be the `latitude` variable in our dataset, our response variable (Y) will be `size`, and what we are estimating is β, the slope of the relationship. It turns our that in the implementation of this simple linear model, we can express it almost identically to how we have it written in math form.

We will first fit the model, then look at the output using the `summary()` function.

```
# we will use the lm() function from the stats package for this
crab_mod = stats::lm(formula = size ~ latitude, # first specify the formula of the model
                     data = pie_crab) # specify the data source

# look at the output
summary(crab_mod)
```

```
##
## Call:
## stats::lm(formula = size ~ latitude, data = pie_crab)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -7.8376 -1.8797  0.1144  1.9484  6.9280
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept) -3.62442    1.27405  -2.845  0.00468 **
## latitude     0.48512    0.03359  14.441  < 2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 2.832 on 390 degrees of freedom
## Multiple R-squared:  0.3484, Adjusted R-squared:  0.3467
## F-statistic: 208.5 on 1 and 390 DF,  p-value: < 2.2e-16
```

There's a lot of useful information in this output that tells us about our test, so let's walk through it.

```
Call:
stats::lm(formula = size ~ latitude, data = pie_crab)

Residuals:
    Min      1Q  Median      3Q     Max
-7.8376 -1.8797  0.1144  1.9484  6.9280

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept) -3.62442    1.27405  -2.845  0.00468 **
latitude     0.48512    0.03359  14.441  < 2e-16 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 2.832 on 390 degrees of freedom
Multiple R-squared:  0.3484,    Adjusted R-squared:  0.3467
F-statistic: 208.5 on 1 and 390 DF,  p-value: < 2.2e-16
```

So here we can inspect the coefficients for our model fit. We can see the first value titled `(Intercept)`, but what we're *really* interested in here though is the value for `latitude`, as that is the X value in our regression, the explanatory variable. Here, the estimate can be interpreted as the β value we were discussing earlier! We can see that it is a positive value (so the slope of the regression line is positive), and we see that there is an associated p-value of <2e-16, which we can consider (for the purposes of this exercise) to be very significant, which then let's us reject our null hypothesis.

Do we reject our null? YES!!

We see here that our p-value is less than the standard requirement of 0.05, so we determine that there is a >95% chance that the pattern we are observing is **NOT** due to chance alone.

There is other information here that we should investigate though.

```
Call:
stats::lm(formula = size ~ latitude, data = pie_crab)

Residuals:
    Min      1Q  Median      3Q     Max
-7.8376 -1.8797  0.1144  1.9484  6.9280

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept) -3.62442    1.27405  -2.845  0.00468 **
latitude     0.48512    0.03359  14.441  < 2e-16 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 2.832 on 390 degrees of freedom
Multiple R-squared:  0.3484,    Adjusted R-squared:  0.3467
F-statistic: 208.5 on 1 and 390 DF,  p-value: < 2.2e-16
```

Here at the bottom of the output we are given three useful measures, the F-statistic, which we won't get into here, the degrees of freedom, and the overall p-value for our model.

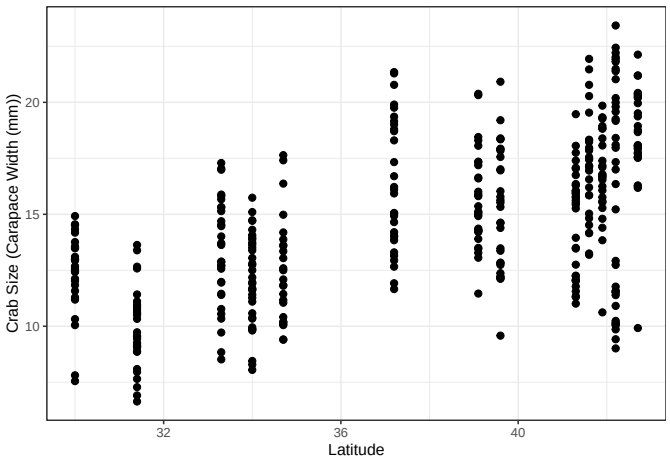
```
Call:
stats::lm(formula = size ~ latitude, data = pie_crab)

Residuals:
    Min      1Q  Median      3Q     Max
-7.8376 -1.8797  0.1144  1.9484  6.9280

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept) -3.62442    1.27405  -2.845  0.00468 **
latitude     0.48512    0.03359  14.441  < 2e-16 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 2.832 on 390 degrees of freedom
Multiple R-squared:  0.3484,    Adjusted R-squared:  0.3467
F-statistic: 208.5 on 1 and 390 DF,  p-value: < 2.2e-16
```

The last item here that is useful to discuss now is the R^2 value. This can most usefully be interpreted as how well the regression model fits the observed data. We should almost always use the `Adjusted R-squared` value as it *adjusts* the R^2 for the number of predictors (AKA explanatory variables) in our model. Ecological data are often very noisy, so a value of 0.35 is not too bad. However, interpreting this as the amount that our model explains the data, we can understand that there is still a fair bit of variation in our data that just latitude isn't explaining. Logically this makes sense.

Visualizing the Results

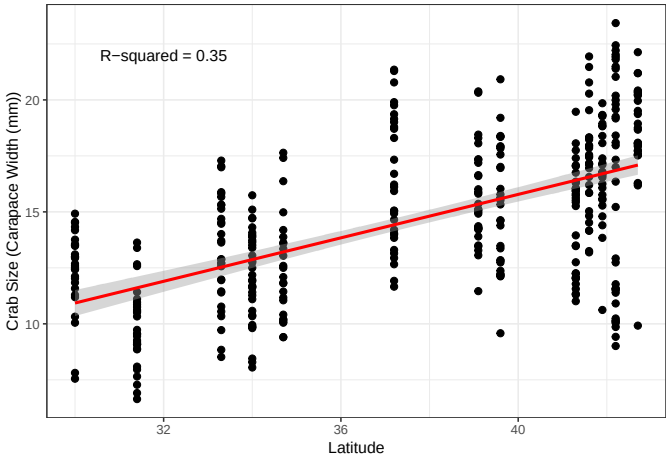
Now that we know what we wanted to know about our hypothesis (Bergmann's Rule appears to hold here!), we can go about visualizing this result clearly. To do that, we'll return to Ol' Faithful, the `ggplot2` package, which is a part of the tidyverse. We can start by making a simple plot of the points in the data that we used to fit our regression.

```
ggplot(data = pie_crab) + # in our first call, say which dataframe we're using
  geom_point(aes(x = latitude, # the aesthetics (aes()) will take the x and y arguments
                 y = size),
             size = 2 # make the points a bit bigger for easier viewing
             ) +
  labs(x = "Latitude", y = "Crab Size (Carapace Width (mm))") + # add in the axis labels
  theme_bw() # to make it a bit prettier let's add a black and white theme
```



Now let's plot our regression line through our points and for good measure, add on the R^2 value to the plot.

```
ggplot(data = pie_crab) +
  geom_point(aes(x = latitude,
                 y = size),
             size = 2
             ) +
  stat_smooth(aes(x = latitude, # again, we specify the aesthetics
                  y = size),
              method = "lm", # our method will be lm(), the same as the model we used
              colour = "red") + # make the colour red so as to be easy to see
  labs(x = "Latitude", y = "Crab Size (Carapace Width (mm))") +
  theme_bw() +
  annotate(geom = "text", # tell anotate we want a text label
           x = 32, # define x location
           y = 22, # y location
           label = "R-squared = 0.35")  # write out our r-squared value
```



And that's a wrap! We've now gone over how to fit a basic linear regression in R, interpreted the output, and made some very simple plots of our results.

Cole B. Brookson

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EDUCATION

MSc in Ecology (2019-2022) - 4.0 GPA

University of Alberta, Alberta, Canada
Supervisor: Dr. Stephanie J. Green *Committee:* Dr. Mark A. Lewis

Thesis: "Trait-based models to inform network food web rewiring under global change"

BSc (Hons) Ecology & Evolutionary Biology (2014-2019) University of Toronto, Ontario, Canada
Minor: Environmental Biology; *Minor:* Forest Conservation Science

- EEB499-Independent Research Project 2018-2019. *Supervisor*: Dr. Martin Krkošek. Investigating the differences in ectoparasite communities of juvenile Pacific Salmon species
- EEB397-Independent Research Project 2018-2019. *Supervisor*: Dr. Chelsea Rochman. Investigating the effects of plastic debris exposure on the population dynamics of a freshwater invertebrate, Daphnia magna
- EEB498-Independent Research Project 2017-2018. *Supervisor*: Dr. Marie-Josée Fortin. Determining the impact of climate and land cover change on beta diversity patterns on birds in Ontario

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PUBLICATIONS

In review, or revisions

1. Lewis, A., Rollinson, C., Allyn, A., Ashander, J., Brodei, S., **Brookson, C.B.,**, ..., Wardle, G. (*In Review*). The power of forecasts to advance ecological theory. *Methods in Ecology & Evolution.*
2. **Brookson, C.B.**, Kirk, D., Rochman, C.M. (*In Revisions*). Combining ecotoxicology and classic ecological models to predict the effects of microplastics on the growth and viability of aquatic populations. *Ecology and Evolution.*

Published or Accepted

3. Green, S.J., **Brookson, C.B.**, Hardy, N., Crowder, L.B. (*2022*). Trait-based approaches to global change ecology: from description to prediction, *Proceedings of the Royal Society B: Biological Sciences*
4. Bodner, K., Rauen Firkowski, C., Bennett, J., **Brookson, C.**, Dietze, M., Green, S. ... Fortin,M.-J. (*2021*). Bridging the divide between ecological forecasts and environmental decision-making. *Ecosphere.*
5. Linardich, C., **Brookson, C.B.**, Green, S.J., (*2021*). Trait-based vulnerability reveals hot spots of potential impact for a global marine invader. *Global Change Biology. 27(18).* 4322-4338.
6. **Brookson C.B.**, Krkošek, M., Hunt, B.P.V., Johnson, B.T., Rodgers, L.A., Godwin, S.C. (*2020*). Differential infestation of juvenile Pacific salmon by parasitic sea lice in British Columbia, Canada. *Canadian Journal of Fisheries and Aquatic Sciences. 77(12)*, 1960-1968.

7. **Brookson, C.B.**, de Solla, S.J., Fernie, K.J., Cepeda, M., Rochman, C.M. (*2019*). Microplastics in the diet of an obligate piscivore, double-crested cormorants (*Phalacrocorax auratus*), in a freshwater ecosystem. *Canadian Journal of Fisheries and Aquatic Sciences. 76(11)*, 2156-2163.

8. Rochman, C.M., **Brookson C.B.**, Bikker, J., Djuric, N., Earn, A., Bucci, K., Athey, S., ... , Borrelle, S. (*2019*). Rethinking Microplastics as a Diverse Contaminant Suite. *Environmental Toxicology & Chemistry. 38(4)*, 703-711.

TEACHING & SUPERVISION

Teaching Assistant, "Marine Population Ecology & Dynamics" - Fall 2021 - Bamfield Marine Sciences Centre

Developed course materials including lectures, computer labs, and field trips alongside the course instructor, for a three-week intensive population ecology course. I also built a course website with an automatic autograder and facilitated a plan to film and edit all lectures/field trips with the purpose of putting all course content online, freely available for anyone interested.

Undergraduate Thesis Supervision (BIOL499) - Fall 2020/Winter 2021

Conceptualized a topic and project for an undergraduate research thesis and then supervised the completion of that thesis, assisting with timeline planning, method development, writing and presentation, and skills development. This included advising the student in statistics, programming techniques, scientific philosophy, and writing.

Teaching Assistant, "Principles of Ecology" (BIOL208) - Winter 2021

Ran lab sections for 12 separate sections of students, instructing on general ecological principles as well as specific lab skills. Grading responsibilities included marking >80 final lab reports.

Instructor, Workshop Series: "Reproducible Methods for Biological Research" - Spring 2021

Developed content and individual lesson plans for a 7-week workshop series introducing graduate students and professionals to methods for making biological research reproducible. Instruction was given on the use of version control (i.e. Git/GitHub), script management, container software (i.e. Docker, Singularity), parallel computing, distributed computing, and cloud computing.

Instructor, Workshop Series: "Introduction to Programming in R/RStudio for Biology" - Winter 2019 & Fall 2020

Developed content and individual lesson plans for a 5-week workshop to teach undergraduate students tools for data management and manipulation, best practices in script management, foundational programming skills, and data visualization. Delivered and co-taught a mixed asynchronous/synchronous remote lecture mixture to accommodate students. Built and maintained a website for course website. Created stand-alone reference documents and live-coded videos for the series.

Instructor, Workshop Series: "Introduction to Programming in Python for Biology" - Fall 2020

Developed content and individual lesson plans for a 5-week workshop to teach undergraduate students tools for data management and manipulation, best practices in script management, foundational programming skills, and data visualization in Python. Delivered and co-taught a mixed asynchronous/synchronous remote lecture mixture to accommodate students. Built and maintained a website for course website. Created stand-alone reference documents and live-coded videos for the series.

AWARDS (A), RECOGNITION (R), & RESEARCH FUNDING (F)

A - D Alan Birdsall Memorial Scholarship (**7,000 CAD**), University of Alberta - 2022

A - Alberta Graduate Excellence Scholarship (**12,000 CAD**), University of Alberta - 2021

A - Donald M. Ross Excellence Scholarship (**3,000 CAD**) - 2021

A - Martin J. Paetz Memorial Graduate Award in Fisheries Management (**6,100 CAD**) - 2021

A - Peter A. Larkin Award for Excellence in Fisheries (**400 CAD**) - 2020

A - NSERC Alexander Graham Bell Canada Graduate Scholarship-Masters (**17,500 CAD**) - 2020

A - Walter H Johns Graduate Fellowship (**5,800 CAD**), University of Alberta - 2020

A - Alberta Graduate Excellence Scholarship (**12,000 CAD**), University of Alberta - 2019

A - Thesis-Based Master's Recruitment Scholarship (**22,990 CAD**), University of Alberta - 2019

A - Dept. of Biological Sciences Recruitment Scholarship (**5,000 CAD**), University of Alberta - 2019

R - Best Conservation & Ecology Poster (non-monetary) University of Toronto EEB Research Fair - 2019

F - Undergraduate Research Fund (**2,000 CAD**), University of Toronto - 2019

A - Conservation Essay Scholarship (**1,000 CAD**), Orca Spirit EcoTourism Co. - 2018

A - Edwin J. Crossman Undergraduate Scholarship (**500 CAD**), University of Toronto - 2018

A - Best Conservation & Ecology Poster, Runner Up (non-monetary) UofT EEB Research Fair - 2018

A - Jack O'Hara Memorial Forestry Scholarship (**500 CAD**), University of Toronto - 2018

A - Entrance Scholarship (**1,000 CAD**), University of Toronto - 2014

A - Entrance Scholarship (**2,000 CAD**), University of Guelph (Declined) - 2014

A - Entrance Scholarship (**6,000 CAD**), Trent University (Declined) - 2014

COMMUNITY AND LEADERSHIP

Ecological Society of America Council - Student Representative (Jan 2022 - Dec 2024)

The ESA Council is a representative body that includes leadership from the disciplinary and geographic units and reflects the diversity of ESA's members. I represent the student section to the council, and promote student participation in advancing ESA's mission.

Diversity, Equity, & Inclusion Committee Member - Society for Open and Reproducible Ecology & Evolution (Dec 2021 - Present)

The DEI committee focuses on advancing SORTEE's mission to make science a more equitable place. My role is as the consultant to the Membership Committee, helping to identify groups that are not equitably represented in the membership, and make recommendations to the membership committee.

Advocacy Committee Member - Society for Open and Reproducible Ecology & Evolution (Dec 2021 - Present)

I work as a project drafter for the committee, identifying projects to promote and advocate for open science initiatives within the Society and more broadly.

Education & Outreach Committee Member - Society for Open and Reproducible Ecology & Evolution (Sept 2020 - Present)

This committee focuses on directing outreach and education initiatives towards members of the scientific community to promote open and accessible research in ecology and evolution. I contribute to program development, annual meeting programming, and developing online resources.

Courses & Curriculums Committee Member - Dept. of Biological Sciences, UAlberta (Sept 2020 - May 2021)

Served on committee that oversees and directs the course offerings in the department of Biological Sciences at the University of Alberta. I reviewed proposed course and curricula changes, and provided feedback and development of program development overall.

Graduate Student Peer Tutor - First Peoples House, UAlberta (Nov 2019 - May 2020)

Tutored fellow graduate students in the Department of Biological Sciences, in computing science, statistics, and ecological modeling.

Graduate Student Organizer - Quantitative Ecology Group, UAlberta (Sept 2019 - May 2020)

Initiated and organized a bi-weekly meeting of quantitative ecologists for discussions surrounding methods, best practices, and general ideas in mathematical and statistical ecology.

Outreach Scientist - Skype a Scientist Foundation (Oct 2019 - Present)

Volunteered as an outreach ambassador, using Skype to connect with classrooms worldwide to speak to children about aquatic/marine ecology and my work as a researcher.

RE Peter Biological Science Conference Organizing Committee Member - UAlberta (Sept 2019 - March 2020)

Acted as a committee member in charge of planning, logistics, speaker liaising, and execution of the RE Peter Conference, an annual conference in the department.

Student Mentor & Tutor - Golden Mentors (Sept 2019 - April 2020)

Volunteered tutoring high school students in mathematics, biology, calculus, and computer programming.

Atwood Colloquium Organizer - UToronto (April 2018 & 2019)

Various logistics for the departmental in-house conference (prepare refreshments, set up and tear down conference venue).

Student Experience Mentor - UToronto Student Experience Mentorship Program (Feb 2019 - April 2019)

Acted as a mentor to a member of the University of Toronto's Student Life staff, helping to bridge the gap between students and staff/faculty and providing insight on the student experience at U of T and how it could be improved.

Undergraduate Peer Mentor - UToronto Ecology & Evolutionary Biology Peer Mentorship Program (Sept 2018 - April 2019)

Mentored two 2 nd year undergraduate students, advising them on course selection, gaining research experience, and getting the most out of their undergraduate experience. Additionally, acted as an ambassador for potential members of the program, and promoted it within the university.

Student Facilitator - UToronto Ecology & Evolutionary Biology Conservation Sub-group (Sept 2018 - April 2018)

Participated in discussions and facilitated community partnerships with local outreach initiatives to promote public awareness of conservation issues and support citizen science.

Undergraduate Evaluation Faculty Search Committee Group Member - UToronto Ecology & Evolutionary Biology Dept. (Nov 2018)

Assisted with the review process of tenure-track applications for a teaching stream faculty member in the department of Ecology & Evolutionary Biology.

Outreach Team Member - UofT Trash Team (Sept 2018 - April 2020)

Develop and present education outreach material about plastic pollution problems and solutions to groups of interested community groups.

Outreach Program Leader - Ontario BioBlitz (May 2018)

Developed and presented educational outreach material about plastic pollution to members of the public and members of the BioBlitz team.

Treasurer - UToronto Forestry Undergraduate Student Union (Sept 2017 - 2018)

Maintained a balanced budget for a student-run, not-for-profit group.

ADDITIONAL RESEARCH EXPERIENCE

Research Assistant (May 2019 - Aug 2019)
Supervisor: Dr. Stephanie Green
Dept. of Biological Sciences, University of Alberta

- Performed data management and constructed ecological models to determine vulnerability of various prey species to an invasive predator
- Assisted with a review of all relevant literature surrounding traits-based foraging ecology

Data Analyst Research Assistant (Feb 2019 - April 2019)
Supervisor: Dr. Marie-Josée Fortin
Dept. of Ecology & Evolutionary Biology, University of Toronto

- Assisted with spatial analysis and data management for a long-term ecological monitoring project
- Performed data wrangling and cleaning tasks for large ecological datasets

Work-Study Student (Sept 2018 - Feb 2019) Supervisor: Dr. Marie-Josée Fortin Dept. of Ecology & Evolutionary Biology, University of Toronto

- Assisted with spatial analysis of ecological and oceanographic data to inform Marine Protected Area design

Research Assistant (Oct 2017 - Sept 2018) Supervisor: Dr. Chelsea Rochman Dept. of Ecology & Evolutionary Biology, University of Toronto

- Conducted multiple lab studies on incidence of microplastics in aquatic ecosystems

Volunteer Research Assistant (March 2018 – July 2018) Supervisor: Dr. Benjamin Gilbert (Kaitlyn Brown) Department of Ecology & Evolutionary Biology, University of Toronto * Assisted with data collection and analysis for a community ecology experiment examining the effects of species assemblage on plant fitness * Managed other undergraduate assistants and coordinated data collection

Volunteer Research Assistant (Sept. 2017 – July 2018) Supervisor: Dr. Luke Mahler (Christopher Boccia) Department of Ecology & Evolutionary Biology, University of Toronto * Performed morphometric landmark analysis and data management and manipulation to investigate how adaptive traits can be used to build an Anolis lizard phylogeny

Work-Study Student (Sept. 2017 – Feb. 2018) Supervisor: Dr. Benjamin Gilbert (Denon Start) Department of Ecology & Evolutionary Biology, University of Toronto, ON * Assisted with data collection and analysis for a community ecology experiment looking at the effects of species assemblage on plant fitness

Field Research Assistant (May 2017 – Sept. 2017) Supervisor: Dr. Spencer Barrett (David Timerman) University of Toronto – Koffler Scientific Reserve at Jokers Hill, Newmarket, ON * Assisted with experimental

design, set-up and management of a study looking at the reproductive responses to sex ratio treatments * Conducted data entry and management tasks including organizing and analyzing large datasets

Volunteer Lab Assistant (Sept. 2016 – April 2017) Supervisor: Dr. Spencer Barrett (David Timerman/Chris Balogh) Department of Ecology & Evolutionary Biology, University of Toronto, ON * Assisted with greenhouse and lab duties related to maintaining plant stocks and data collection * Performed data analysis and management tasks for a variety of experimental datasets

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ACADEMIC SERVICE

Manuscript reviewer for: Ecology Letters, Conservation Biology, Journal of Fish Biology, Proceedings of the Royal Society, Biology

Professional societies:

Canadian Society for Ecology & Evolution (CSEE)

Ecological Society of America (ESA)

American Fisheries Society (AFS)

Society for Open and Reproducible Ecology & Evolution (SORTEE)

PRESENTATIONS

NOTE: *Italic* font indicates invited speaker.

American Fisheries Associated Annual Meeting - Online (Sept 2020) "A trait-based approach to predicting predator-prey dynamics under climate change"

Canadian Society for Ecology & Evolution Annual Meeting – Edmonton, Canada *(May 2020) "Prey-switching as a method of persistence for predatory species under climate change"* Cancelled due to SARS-CoV-2

North Pacific Maine Science Organization Annual Meeting (PICES) – Victoria, Canada (Oct 2019) "A trait-based approach to predicting predator-prey uncoupling under climate change"

Ocean Awareness Symposium - David Thomas King School, Edmonton, Canada (Oct 2019) "Living in the Bath Tub – Climate Change and the Effects on our Ocean Ecosystems"

Canadian Society for Ecology & Evolution Annual Meeting – Fredericton, Canada (Aug 2019) "A combined ecotoxicological and classical ecological modeling approach predicts microplastics may be affecting the growth and viability of Daphnia Magna populations in aquatic ecosystems"

University of Toronto EEB Undergraduate Research Fair - Toronto, Canada (April 2019) "Differential Infection of Juvenile Pacific Salmon by Parasitic Sea Lice"

University of Toronto Undergraduate Research Conference - Toronto, Canada (Jan 2019) "Microplastics in the diet of an obligate piscivore, double-crested cormorants (*Phalacrocorax auratus*), in a freshwater ecosystem"

International Science Day - John Fraser SS, Toronto, Canada (Nov 2018) "What's in the Water? Aquatic Ecology & Ecosystem Conservation in the Age of Plastic"

University of Toronto EEB Undergraduate Research Fair - Toronto, Canada (April 2018) "The Effects of Climate and Land Use Change on Beta Diversity of Breeding Birds in Southern Ontario."

Earth Day Symposium – Humberside CI, Toronto, Canada (March 2018) "Plastic Pollution in Aquatic Ecosystems"

SKILLS & CERTIFICATIONS

Proficient use of Fourier Transform Infrared Spectroscopy (FTIR, Bruker 2018) technologies

Fluent use of R, Python, Julia, MATLAB, and ArcGIS software, experience with C/C++, Mathematica, HTML, SQL, Java, JavaScript, and RShiny

Ontario 'G' Licence (Ontario Ministry of Transportation, 2017), Pleasure Craft Operator Card (Transport Canada, 2018), Standard First Aid & CPR / AED Level C (Red Cross, 2015)

Diversity Practitioner (National Diversity Council 2018), SmartServe Certification (Liquor Control Board of Ontario, 2015)