

Conservation & Global Change Biology

Course Objectives: The goal of this course is for students to develop a basic understanding in conservation biology with an emphasis on global change biology. In this course, we will cover topics such as biodiversity, ecosystem services, habitat fragmentation, human-wildlife interactions, anthropogenic climate change, and how to communicate climate change and conservation to the public. It is said that humans are currently experiencing an environmental crisis; that we have initiated a new geological era – the Holocene; that we are in the midst of a sixth extinction. The aim of this course is to train students on proper conservation techniques and understandings.

Resources:

- Kareiva, P., Marvier, M., & Silliman, B. *Effective Conservation Science: Data not Dogma*. 2018. Oxford University Press, Oxford, UK. (ECS)
- Van Dyke, F. *Conservation Biology: Foundations, Concepts, Application*. 2008. Springer Science+Business Media, New York, NY. (CB) (**There are many copies available at the library.**)

Additional Reading: Additional primary literature or online videos will be available for students to read or watch if they are interested. These optional reading and video assignments will be denoted by an asterisk (*).

SCHEDULE

WEEK 1: Introduction to Conservation

Meeting 1: The History of Conservation Biology

- CB: 1-26 (*The History and Distinctions of Conservation Biology*)
- (Myers *et al.*, 2000)

and Conservation: Lessons from History. *Science*, 260(5104), 17+36.

Meeting 2: Displaying and Describing Data

W&S: 26-52 (*Displaying data*)
W&S: 65-85 (*Describing data*)

WEEK 2: Uncertainty and Probability

Meeting 3: Uncertainty and Hypotheses

W&S: 95-107 (*Estimating with uncertainty*)
Standard deviation vs. standard error
[\(https://www.r-bloggers.com/standard-deviation-vs-standard-error/\)](https://www.r-bloggers.com/standard-deviation-vs-standard-error/)

Meeting 4: Probability

W&S: 117-138 (*Probability*)
*W&S: 115-116 (*Pseudoreplication*)

Lab 2: Building and Cleaning Data

Swirl: R Programming - ‘Sequences of Numbers’ and ‘Vectors’.

Install the ‘dplyr’ and ‘tidyr’ packages before class.

WEEK 3: Hypotheses and Proportions

Meeting 5: Hypothesis Testing

W&S: 150-168 (*Hypothesis testing*)

Hypothesis Testing (P-Value approach) (<https://onlinecourses.science.psu.edu/statprogram/node/138>)

Meeting 6: Proportions and Frequencies

W&S: 179-193 (*Analyzing proportions*)

*W&S: 201-202 (*Correlation does not require causation*)

Lab 3: Working with missing values and subsetting

Swirl: R Programming - ‘Missing Values’ and ‘Subsetting Vectors’

WEEK 4: Distributions and Inference

Meeting 7: Normal Distributions

W&S: 273-293 (*The normal distribution*)

*AH: 13-26 (*Concepts and methods from basic probability and statistics*)

Meeting 8: T-Tests and Inference

W&S: 303-318 (*Inference for a normal population*)

W&S: 301-302 (*Controls in medical studies*)

Lab 4: Matrices and Functions

Swirl: R Programming - ‘Matrices and Data Frames’ and ‘Functions’

WEEK 5: Choosing a Test and Handling Assumptions

Meeting 9: Mean Comparison

W&S: 327-353 (*Comparing two means*)

W&S: 366-367 (*Which test should I use?*)

Meeting 10: Handling Assumptions

W&S: 369-400 (*Handling violations of assumptions*)

Type I and II Errors and Significance Levels

(<https://www.ma.utexas.edu/users/mks/statmistakes/errortypes.html>)

Lab 5: Using t-tests in R

YouTube: ‘One-Sided Test or Two-Sided Test?’ (<https://www.youtube.com/watch?v=VP1bhonP74>)

Load the ‘Iris’ dataset in R before class (come early to class if you need help with this)

WEEK 6: Designing Experiments

Meeting 11: Sample Size and Effect Size

W&S: 423-450 (*Designing experiments*)

Lemoine, N.P., Hoffman, A., Felton, A.J., Baur, L., Chaves, F., Gray, J., Yu, Q., & Smith, M.D. (2016).

Underappreciated problems of low replication in ecological field studies. *Ecology*, 97(10,) 2554-2561.

Meeting 12: Experimental Design and Power Calculations

AH: 437-454 (*Sample size and power calculations*)

Noordzij, M., Tripepi, G., Dekker, F.W., Zoccali, C., Tanck, M.W., & Jager, K.J. (2010).

Sample size calculations: basic principles and common pitfalls. *Nephrology Dialysis Transplant*,

25,
1388-1393.

Lab 6: Module in Effect vs. Sample Size and Power Calculations
Download the script from the course website ‘EffectvsSample.R’

WEEK 7: Understanding ANOVAs

Meeting 13: One-way ANOVAs

W&S: 459-471 (*The analysis of variance*) & (*Assumptions and alternatives*)
AH: 487-490 (*Analysis of variance: Classical analysis of variance*)

Meeting 14: Two-way ANOVAs

W&S: 471-486 (*Comparing means of more than two groups*) Part II
W&S: 500-501 (*Experimental and statistical mistakes*)

Lab 7: Intro to ANOVAs in R

YouTube: ‘How to Calculate Anova Using R’
(<https://www.youtube.com/watch?v=fT2No3Io72g>)
Install the ‘car’ package - we will use the ‘Anova’ function rather than ‘aov’)

WEEK 8: Linear Regression Part I

Meeting 15: Intro to Linear Regression

W&S: 539-557 (*Regression*)
*JWHT: 59-70 (*Simple Linear Regression*)

Meeting 16: Interactions and Collinearity

AH: 34-36 (*3.3 Interactions*)
JWHT: 99-102 (*Collinearity*)

Lab 8: Intro to Linear Regression in R

Download the ‘dogs’ dataset on the course website.)

WEEK 9: Linear Regression Part II

Meeting 17: Transformations and Assumptions

W&S: 557-562 (*Assumptions of regression & Transformations*)
AH: 37-47 (*Statistical Inference & Graphical displays of data and fitted model*)

Meeting 18: Interpreting Results

AH: 53-74 (*Linear regression: before and after fitting the model*)
Understanding regression models and regression coefficients

(<http://andrewgelman.com/2013/01/05/understanding-regression-models-and-regression-coefficients/>)

Lab 9: Linear Regression in R: Interpreting results

Install the ‘arm’ package for ‘display’ function to interpret results)

WEEK 10: Logistic Regression Part I

Meeting 19: Intro to Logistic Regression

W&S: 563-575 (*Nonlinear regression*) & (*Logistic regression*)
AH: 79-85 (*Logistic Regression*)

Meeting 20: Building a Model

W&S: 605-625 (*Multiple explanatory variables*)
*AH: 85-104 (*Logistic Regression*)

Lab 10: Apply functions in R

Swirl: R Programming - ‘lapply and sapply’ and ‘vapply and tapply’

WEEK 11: Logistic Regression Part II**Meeting 21:** Generalized linear models

AH: 109-124 (*Generalized linear models*)

W&S: 593-596 (*Using species as data points*)

Meeting 22: Model Selection

AH: 524-526 (*Model comparison and deviance*)

JWHT: 175-181 (*Resampling methods*)

*W&S: 635-46 (*Computer-intensive methods*)

Lab 11 GLM Model building and interpretation of results

We will again use the ‘dogs’ dataset, which can be downloaded from the course website.)

WEEK 12: Brief Intro to Meta-analysis and Multilevel Models**Meeting 23:** Power of Meta-analysis

W&S: 681-697 (*Meta-analysis combining information from multiple studies*)

MacLean, S.A & Beissinger, S.R. (2017). Species’ traits as predictors of range shifts under contemporary

climate change: A review and meta-analysis. *Global Change Biology*, 23, 4094-4105.

Korner, C. (2017). When meta-analysis fails: A case about stomata.

Global Change Biology, 23(7), 2533-2534.

Meeting 24: Intro to Multilevel Models

AH: 237-248 (*Multilevel structures*)

AH: 251-262 (*Multilevel linear models: the basics*)

Lab 12 Cleaning large dataframes and multilevel model notation

Download the ‘osprey’ dataframe from the course website and make sure you read through

AH: 259-262 again before lab.)

Grading Rubric:

Type	Percent of Grade
Participation	10
Lab Problem Sets	20
Midterm	30
Final Exam and Project	40

References

Myers, N., Mittermeier, R., Mittemeier, C., da Fonseca, G. & Kent, J. (2000) Biodiversity hotspots for conservation priorities. *Nature* **403**, 853–858.