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| Mulford 124  For further details; orbidder@berkeley.edu | Fall 2019  Fridays  9:30 am to 12:00 pm |

Animal Movement Ecology Analysis in R

Instructors: Arthur Middleton, Owen Bidder, Justine Smith

Expected Class Size: 20

Course Description: Movement ecology is the study of how organisms move in response to their environment. This burgeoning field lies at the interface of behavioral ecology, physiology and geography (amongst others), and draws from a rich interdisciplinary toolkit. Typically, many of the techniques used to describe and understand movement require a high level of familiarity with the R programming language and a knowledge of the rich ecosystem of packages and software libraries available. R is open-source, but has a steep learning curve, which restricts researchers new to the software from progressing with their analyses.

This workshop series aims to familiarize graduate students with all of the tools necessary to conduct sophisticated movement analyses in R. We will complement available courses elsewhere on campus (e.g. The DLab’s R beginners course) with bespoke tuition on the movement ecology toolkit, so that participants feel confident and empowered to undertake research in this exciting discipline. Participants will be instructed using worked examples of R code in workshop sessions, be provided with theoretical background through lectures, and conduct analyses independently in a final assessment (using their own data or data provided by the instructors).

Prerequisites:

Objectives: As a result of this course, you will be able to:

* Download and install movement ecology packages from the CRAN repository
* Load data in to R, recognize common R data structures and build basic visualizations
* Recognize and use spatial data in R, e.g. points, vectors and rasters
* Perform common GIS functions in R, e.g. raster calculations, reprojections
* Understand and conduct home-range analyses through a variety of methods
* Model animal movement patterns and understand their consequences in ecology
* Construct and validate habitat selection models from animal GPS data
* Predict animal behavior from animal borne accelerometer data

Suggested Reading:

Hooten et al., (2017) Animal Movement: Statistical models for telemetry data. CRC Press

Manly et al., (2002) Resource Selection by Animals: Statistical Design and Analysis for Field Studies. Springer

Requirements: 100% attendance to all lectures and workshops (troubleshooting sessions are optional). Turn in project report at end of course.

Project Requirements:

Students are required to turn in a short report (4 pages maximum) that details an independent analysis, using either their own data, or if none is available, using data provided by the instructors. The report must contain the following sections;

Objectives – A paragraph detailing the motivation for the project and the biological question to be answered

Approach – A paragraph for each method used in the analysis, detailing what packages and parameters are used.

Results – 2 figures that detail the results of the analysis, along with any other outputs in text

Conclusions – A paragraph summarizing the biological conclusions drawn from the analysis.

Class Schedule:

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| Day | Date | Agenda/Topic | Venue |
| Friday | 11th October | Handling Spatial Data in R:   * *sp package* * points, vectors and polygons   GIS in R:   * *raster package* * raster calculations * extracting environmental variables | Mulford 124 Teaching Lab |
| Friday | 18th October | R Basics:   * loading and preparing data * basic visualization | Mulford 124 Teaching Lab |
| Friday | 25th October | Home-range estimation:   * *adehabitatHR package* * Minimum-Convex Polygons * Kernel Utilization Distributions * Brownian-Bridges * LoCoH | Mulford 124 Teaching Lab |
| Friday | 1st November | Habitat selection:   * Logistic Regression * Collinearity * Resource Selection Functions * Basic Model Selection | Mulford 124 Teaching Lab |
| Friday | 8th November | Habitat selection:   * Conditional Logistic Regression * Step-Selection Functions | Mulford 124 Teaching Lab |
| Friday | 15th November | Animal Behavior as ‘States’:   * *MoveHMM package* * State Space Modelling | Mulford 124 Teaching Lab |
| Friday | 22nd November | Migration Analysis:   * *migrateR* package * Net Squared Displacement movement models | Mulford 124 Teaching Lab |
| Friday | 29th November | Thanksgiving break |  |
| Friday | 6th December | GPS Clusters:   * hierarchical cluster analysis * finding kills, dens and nests * mapping predicted clusters | Mulford 124 Teaching Lab |
| Friday | 13th December | Movement Ecology Clinic:  Instructors available to answer questions related to the students’ analyses | Mulford 124 Teaching Lab |