R Programming for Ecological Modelling Training Course

Professional Development Training Course Outline

Category	Environmental Management and Conservation	**Duration**	10 Days
Base Fee	$3,000 USD	**Delivery Mode**	Online / On-site Hybrid

Course Introduction

R Programming for Ecological Modelling Training Course is designed to equip ecologists, environmental scientists, and conservation professionals with the cutting-edge computational skills needed to analyze complex environmental data. In today's data-driven world, the ability to effectively process, model, and visualize ecological datasets is a critical requirement for impactful research and conservation. This course bridges the gap between traditional ecological theory and modern data science, focusing on the versatile and powerful **open-source** language, R. Through hands-on exercises and real-world case studies, you'll learn to move beyond static spreadsheets and unlock the full potential of your data, fostering **reproducible research** and **data-driven decision-making**.

This training provides a structured pathway to mastering **ecological data analysis**, from foundational **data wrangling** and manipulation to advanced statistical modeling and **spatial analysis**. We emphasize a practical, problem-solving approach, ensuring that participants can immediately apply their new skills to their own projects. The curriculum is built around the **tidyverse** philosophy, promoting clean, intuitive, and efficient code. By the end of this course, you will not only be proficient in R but will also possess a robust **computational toolbox** for tackling the most challenging questions in **ecological modeling**, from predicting species distributions to assessing climate change impacts.

Programme Curriculum

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Course Objectives

Upon completion of this course, you will be able to:

- Master **data wrangling** and manipulation using the **Tidyverse** ecosystem.
- Conduct **reproducible research** and create dynamic reports with R Markdown.
- Perform **exploratory data analysis** (EDA) and visualize complex ecological datasets.
- Build and interpret a variety of **statistical models** for ecological data.
- Apply **mixed-effects models** to analyze hierarchical and repeated measures data.
- Execute **species distribution modeling** (SDM) and **niche modeling** with R.
- Analyze and visualize **spatial data** using **GIS** packages in R.
- Perform community ecology analyses, including **ordination** and diversity metrics.
- Conduct **population dynamics** modeling and time-series analysis.
- Implement **Bayesian data analysis** for robust ecological inference.
- Automate repetitive tasks and streamline your ecological workflows.
- Leverage **machine learning** for ecological prediction and classification.
- Contribute to **open science** by sharing your code and data effectively.

Organizational Benefits

- Automating routine tasks and streamlining data pipelines saves time and reduces manual errors.
- Standardized, script-based workflows ensure that research and analysis are transparent, auditable, and easily replicated by others.
- Equipping teams with advanced statistical and modeling techniques leads to more robust, defensible, and impactful scientific conclusions.
- A common programming language and a culture of code sharing facilitate better teamwork and knowledge transfer across projects and departments.
- Utilizing R, a free and open-source platform, eliminates the need for expensive proprietary software licenses for statistical analysis.

- Organizations with skilled R users are better positioned to tackle complex ecological challenges, from **climate change adaptation** to **biodiversity conservation**, and to publish in high-impact journals.

Target Audience

- Ecologists and Environmental Scientists
- Early Career Researchers (MSc/PhD students and Postdocs)
- Conservation Biologists and Wildlife Managers
- Government Agency Staff (e.g., environmental protection, natural resources)
- GIS Analysts and Spatial Ecologists
- Consultants in environmental and ecological fields
- Academics and Educators in life sciences
- Data Analysts transitioning into environmental applications

Course Modules

Module 1: R & RStudio Fundamentals

- Getting Started: R and RStudio installation, interface navigation, and project setup.
- Basic Data Structures: Understanding vectors, matrices, data frames, and lists.
- Importing Data: Reading various data formats like .csv, .xlsx, and shapefiles.
- Reproducibility with R Markdown: Creating dynamic reports and presentations.
- **Case Study**: Importing and summarizing a biodiversity checklist from a local park.

Module 2: Data Wrangling with Tidyverse

- Data Manipulation: Using dplyr for filtering, selecting, and transforming data.
- Data Aggregation: Summarizing data using group_by() and summarize().
- Handling Missing Data: Techniques for identifying and dealing with NA values.
- Data Joins: Combining multiple datasets using various join functions.
- **Case Study**: Cleaning and merging fragmented wildlife survey data from different sources.

Module 3: Data Visualization with ggplot2

- Grammar of Graphics: Understanding the layered approach of ggplot2.
- Creating Plots: Generating scatter plots, bar charts, histograms, and boxplots.
- Aesthetics and Faceting: Customizing plots and creating subplots.
- Advanced Graphics: Creating maps, heatmaps, and publication-quality figures.
- **Case Study**: Visualizing the relationship between forest cover and species richness.

Module 4: Exploratory Data Analysis

- Visual EDA: Using plots to discover patterns and outliers in your data.
- Descriptive Statistics: Calculating central tendency and variability.
- Correlation Analysis: Examining relationships between variables.
- Data Distribution: Exploring data normality and transformations.
- **Case Study**: Analyzing historical fisheries data to identify trends and anomalies.

Module 5: Introduction to Ecological Statistics

- Hypothesis Testing: Understanding t-tests, ANOVA, and chi-squared tests.
- Linear Models: Building and interpreting simple and multiple linear regression models.

- Generalized Linear Models (GLMs): Modeling non-normal data
- Model Diagnostics: Checking assumptions and assessing model fit.
- **Case Study**: Modeling the effect of a specific pesticide on amphibian population size.

Module 6: Mixed-Effects Models

- Hierarchical Data: Understanding nested and grouped data structures.
- Random Effects: Incorporating random intercepts and slopes to account for variability.
- Model Building: Using the lme4 package for linear and generalized mixed models.
- Model Interpretation: Understanding fixed vs. random effects and their implications.
- **Case Study**: Analyzing bird count data collected from multiple sites over several years.

Module 7: Spatial Data Analysis & GIS

- Spatial Data in R: Working with sf (simple features) and terra packages.
- Data Import/Export: Reading and writing spatial data formats like shapefiles.
- Spatial Operations: Cropping, re-projecting, and joining spatial layers.
- Spatial Visualization: Creating choropleth maps and mapping species occurrences.
- **Case Study**: Mapping and analyzing land-use change impacts on local ecosystems.

Module 8: Species Distribution Modeling (SDM)

- Theory of SDMs: Understanding the principles and assumptions behind niche modeling.
- Environmental Data: Preparing and extracting climate and landscape data.
- Modeling Algorithms: Using popular packages like maxnet and dismo.
- Model Evaluation: Assessing model performance and interpreting outputs.
- **Case Study**: Predicting the potential range expansion of an invasive species under a future climate scenario.

Module 9: Population Dynamics

- Population Growth Models: Simulating exponential and logistic growth.
- Matrix Population Models: Building and analyzing life tables.
- Survival Analysis: Using survival package to model survival rates.
- Harvesting and Conservation: Modeling the effects of human interventions.
- **Case Study**: Projecting the future population viability of a threatened species.

Module 10: Community Ecology

- Community Data: Working with species-by-site matrices.
- Diversity Indices: Calculating and comparing alpha and beta diversity.
- Ordination Techniques: Using PCA, NMDS, and RDA to visualize community structure.
- Permutation Tests: Statistical testing of community patterns.
- **Case Study**: Analyzing how different habitat types affect the composition of insect communities.

Module 11: Time-Series Analysis

- Time-Series Objects: Creating and manipulating time-series data.
- Trend and Seasonality: Identifying and decomposing patterns in data.
- Autoregressive Models: Using ARMA and ARIMA models for forecasting.
- Intervention Analysis: Detecting the impact of specific events on trends.
- **Case Study**: Modeling the long-term changes in a lake's water quality.

Module 12: Introduction to Bayesian Methods

- Bayesian vs. Frequentist: Understanding the conceptual differences.
- Bayesian Thinking: Prior distributions, likelihood, and posterior inference.
- Bayesian Models in R: Using packages like rstanarm and brms.
- Model Evaluation: Assessing convergence and interpreting posterior distributions.
- **Case Study**: Re-analyzing a population study using a Bayesian approach to incorporate prior ecological knowledge.

Module 13: Machine Learning in Ecology

- Supervised Learning: Regression and classification algorithms.
- Random Forests: Using randomForest for complex ecological prediction.
- Boosted Regression Trees: Advanced modeling for non-linear relationships.
- Model Tuning and Validation: Cross-validation and performance metrics.
- **Case Study**: Classifying land cover types from satellite imagery.

Module 14: Ecological Niche Modeling (ENM)

- Advanced Concepts: Niche theory, transferability, and model uncertainty.
- Niche Overlap: Quantifying similarity between species niches.
- Bioclimatic Data: Downloading and preparing data from sources like WorldClim.
- Spatial Forecasting: Projecting species ranges under future climate scenarios.
- **Case Study**: Assessing the potential impact of climate change on a butterfly species.

Module 15: Automation and Best Practices

- Creating Functions: Writing your own functions to automate tasks.
- Version Control: Introduction to Git and GitHub for collaborative coding.
- Workflow Management: Structuring projects for efficiency and clarity.
- Debugging: Techniques for identifying and fixing errors in your code.
- **Case Study**: Building an automated script to download, clean, and analyze daily weather data for a field site.

Training Methodology

Our training methodology combines theoretical lectures with extensive hands-on practice, fostering a deep understanding of concepts and their practical application. Key components include:

- Hands-On Workshops.
- Instructor-Led Demonstrations.
- Problem-Based Learning.
- Case Studies.
- Peer-to-Peer Learning.
- Continuous Support.

Register as a group from 3 participants for a Discount

Send us an email: info@fineskilltrainingcenter.org or call *+254769199797*

Certification

Upon successful completion of this training, participants will be issued with a globally- recognized certificate.

Tailor-Made Course

We also offer tailor-made courses based on your needs.

Key Notes

a. The participant must be conversant with English.

b. Upon completion of training the participant will be issued with an Authorized Training Certificate

c. Course duration is flexible and the contents can be modified to fit any number of days.

d. The course fee includes facilitation training materials, 2 coffee breaks, buffet lunch and A Certificate upon successful completion of Training.

e. One-year post-training support Consultation and Coaching provided after the course.

f. Payment should be done at least a week before commence of the training, to Fineskill Training Center account, as indicated in the invoice so as to enable us prepare better for you.

Upcoming Scheduled Sessions

Start Date	End Date	Location	Price
23 Nov 2026	04 Dec 2026	Online	$2,000
23 Nov 2026	04 Dec 2026	Physical	$3,000
23 Nov 2026	04 Dec 2026	Physical	$6,000
23 Nov 2026	04 Dec 2026	Physical	$6,000
23 Nov 2026	04 Dec 2026	Physical	$12,000
23 Nov 2026	04 Dec 2026	Physical	$9,000
23 Nov 2026	04 Dec 2026	Physical	$12,000
23 Nov 2026	04 Dec 2026	Physical	$12,000

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