

# Workshop: Modeling distribution, abundance, demography and population dynamics using R, JAGS and NIMBLE

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**Venue:** Instituto de Investigación en Recursos Cinegéticos ([IREC](#)) c/ Ronda de Toledo s/n. Ciudad Real-Spain

**Computers:** Bring your own laptop with latest R, JAGS and NIMBLE

**Registration:** 375 €. To apply for the course, please send a brief description (max 0.5 page) of why the course would be important for your work. Some fee reductions for students may be available; if you want to apply for that, please also explain in another half-page max why you should get one.

The analysis of abundance and of the dynamic rates governing their change lies at the core of ecology and its applications such as conservation and wildlife management. Meta-population designs, where repeated measurements of some quantity such as counts or distance measurements are made at a collection of sites, underlie a vast number of studies in ecology and management. Inference about such data is conveniently based on hierarchical models, where one submodel describes the underlying true state of the process (e.g., abundance at a site) and another submodel describes the observation process that connects the true state to the observations.

In recent years, much progress has been made in the development of methods and computer algorithms to fit hierarchical models. In particular, Bayesian statistical analysis and the general-purpose Bayesian software packages like BUGS, JAGS, NIMBLE and others have revolutionized the ways in which ecologists can conduct complex population analyses.

This course provides a broad introduction for ecologists and wildlife managers to a wide variety of models fit using BUGS software. This course is based on:

- AHM books (Kéry & Royle, Applied hierarchical modeling for ecologists, Academic Press, vol. 1: 2016, vol.2: 2021).
- SCR book (Royle, Chandler, Sollmann & Gardner, Academic Press, 2014).
- IPM book (Schaub & Kéry, Integrated Population Models, Academic Press, 2022).

In this intermediate-level workshop about 80% of the time is spent on lecturing and 20% on solving exercises. No previous experience with BUGS software, or Bayesian statistics, is assumed. However, a good working knowledge of modern regression methods (linear models, GLMs) and of program R is required. Moreover, a basic understanding of capture-recapture and/or occupancy models is highly desirable.

To register for the workshop please email José Jiménez ([Jose.Jimenez@csic.es](mailto:Jose.Jimenez@csic.es)) with cc to Marc Kéry ([marc.kery@vogelwarte.ch](mailto:marc.kery@vogelwarte.ch)) until 31 March 2024. Invitations to accepted participants will be sent out approximately 1 week later.

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## **Part 1: Prelude**

1. Introduction to frequentist and Bayesian inference
2. Fitting GLMs and simple GLMMs with JAGS and NIMBLE
3. Introduction to data simulation

## **Part 2: Modeling the distribution and abundance in static systems**

1. Modeling distribution and occurrence using site-occupancy models
2. Modeling abundance using (binomial) N-mixture models
3. Spatial capture-recapture models (SCR)

## **Part 3: Modeling the distribution and abundance in dynamic systems**

1. Modeling species distribution and range dynamics using dynamic occupancy models
2. Modeling population dynamics with replicate counts within a season using Dail-Madsen models

## **Part 4: Modeling survival and population dynamics**

1. Modeling population size trajectories using state-space models
2. Modeling survival from capture-recapture data using the Cormack-Jolly-Seber model
3. Integrated population models (IPM)