Université de Bretagne Occidentale

MASTER BIOLOGIE

PARCOURS SCIENCES BIOLOGIQUES MARINES (SBM)

semestre 9 Biologie SBM

SPÉCIALITÉ "POPULATIONS"

Modeling for the conservation of marine megafauna

4 crédits ECTS

Volume horaire

Cours Magistral : 10h
Travaux Pratiques : 20h

Présentation

The marine megafauna is not a taxonomically defined group, as it includes sea mammals, birds, reptiles, large fish and elasmobranchs. Marine megafauna species are large vertebrates that depend on marine food resources. These mobile species are generally at the top of their trophic food webs and have none or few predators. Our perception of marine megafauna as a coherent group is based on ecological similarities and shared conservation issues. These species are exposed to a myriad of threats and generally show limited resilience due to their intrinsic life history traits such low fecundity rates and high longevity, which often limit the capacity of collapsed populations to quickly recover. Consequently, they share common conservation challenges, and their current conservation status often results from pressures of the last century cumulated with current pressures.

Marine megafauna are a key element of many marine conservation strategies. Large marine vertebrates are generally used as flagships to mobilize society at large on conservation issues. They can function as umbrella species due to their large home ranges and high trophic level. Conservation measures focusing on marine megafauna often benefit lower trophic level species, positively impacting marine habitat protection. They also have the potential to act as sentinel species and inform the ecological status of other less visible compartments of marine ecosystems. Focusing on marine megafauna as a target of conservation strategies is thus rational and ecologically motivated.

However, despite their large body size, marine megafauna can be very elusive, undermining our ability to document crucial parameters for effective conservation such as population size (abundance), distribution, or vital rates (fecundity, survival or mortality). The presence or absence of a species across a set of spatial units is a fundamental concept in ecology, conservation biology and wildlife management (e.g., species range or distribution changes, habitat use, resource selection functions). An important sampling issue, however, is that a species may not always be detected when present at a spatial unit. Unaccounted for, 'false absences' can lead to misleading inferences about patterns and dynamics of species occurrence, and the factors that influence them. Similarly, abundance and population vital rates (mortality, breeding frequency, dispersal among habitat 'patches' or suitable areas) are fundamental quantities required to address questions about population dynamics and assess population 'health' state. Imperfect detectability of individuals during sampling sessions can also plague inferences about patterns and processes underlying population dynamics.

Objectifs

This course will cover the design of sampling protocols and the modeling of species occurrence and population processes in marine megafauna in classical situations where the detectability of species or individuals is imperfect, with a particular emphasis on marine mammals and seabirds. The course will address the estimation of quantities needed in the modeling effort, and the application of these estimates and models to monitoring and conservation problems. Students will be introduced to the models through worked examples, with a particular emphasis on state-of-the-art inference techniques in the Bayesian framework. The main pieces of software that will be used are R, JAGS or NIMBLE (to fit models to real-life datasets and estimate parameters of interest). All models that will be detailed fall under the umbrella of 'hierarchical models' with latent parameters separating population and observation processes. The conceptual and philosophical foundations of such models will be briefly detailed to enable users to build a subsequent in-depth understanding with regular practice.

Pré-requis nécessaires

- Knowledge of the R language
- Bases in statistical theory and Generalized linear models
- Bases in population dynamics

Compétences visées

> Formalize demographic processes governing population fluctuations in situations of anthropogenic pressures and environmental variation
> Develop models for population size to address population trajectory under different scenarios of global change
> Use quantitative methods to model processes operating at the population level.
> Use statistical theory to design monitoring programs, population and occupancy models, and to draw inferences about model parameters; quantitative ecology skills
> Use and develop analytical tools in programming languages that are relevant to the question
> Use statistical theory to design monitoring programs, population and occupancy models, for decision making in conservation biology, and to draw inferences about model parameters; quantitative ecology skills
> Critically address interactions between human beings and marine ecosystems (global change, species interactions, ecosystem services)
> Use reproducible research methods
> Contextualize and write scientific results in formats relevant to knowledge transfer or to teaching

Descriptif

This course will cover the design of sampling protocols and the modeling of species occurrence and population processes in marine megafauna in classical situations where the detectability of species or individuals is less than one, with a particular emphasis on marine mammals and seabirds. The course will address the estimation of quantities needed in the modeling effort, and the application of these estimates and models to monitoring and conservation problems. Students will be introduced to the models through worked examples, with a particular emphasis on state-of-the-art inference techniques in the Bayesian framework. The main software that will be used is R (to handle data) and JAGS (to fit models to real-life datasets and estimate parameters of interests). All models that will be detailed fall under the umbrella of 'hierarchical models' with latent parameters. The conceptual and philosophical foundations of such models will be briefly detailed to enable users to build a subsequent in-depth understanding with regular practice.

Modalités de contrôle des connaissances

Session 1 ou session unique - Contrôle de connaissances

Nature de l'enseignement	Modalité	Nature	Durée (min.)	Coefficient	Remarques
	CC	Ecrit - rapport		100%	

Session 2 : Contrôle de connaissances

Nature de l'enseignement	Modalité	Nature	Durée (min.)	Coefficient	Remarques
	CT	Ecrit et/ou Oral	60	100%	