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Sommario	Despite the debate about the definition and subject of ecology, it is actually undeniable that the scientific study of the distribution and abundance of organisms, together with their underlying processes, is among the main subjects of ecology . Therefore, counting animals, and understanding the mechanisms that drive occurrence and abundance over space and time, have been the focus of many studies in animal science. Since population size is one of the fundamental state variables in ecology, obtaining accurate information on population abundance is of primary importance for conservation, monitoring and management of animal populations. Moreover, accurate population estimates allow the analysis of the temporal variation of abundance (i.e. trends detection), which is a major objective in species conservation and monitoring programs. Population abundance, however, is not the only candidate variable for ecological and conservation studies: other variables may be used to infer the status of a community or a population. For example, the proportion of area occupied by a species, i.e. Occupancy, is another important state variable of ecology. Although the use of Occupancy, instead of abundance, may appear limiting for drawing inferences about the status of a population or a species, Occupancy is actually related to temporal stability of populations. Occupancy also reflects

habitat choice (or resource selection) and a higher Occupancy is usually linked to higher abundances . No matter what state variable we decide to adopt, the inference about abundance and Occupancy must face a critical aspect: these two variables, indeed, cannot be directly measured, because species occurrence and population abundance are always subject to imperfect detection. Usually, only a fraction of the population of interest is encountered and available for sampling, while an unknown fraction is unavailable and undetected. This issue led ecologists to the development of several techniques, for taking into account imperfect detection, and obtaining unbiased estimates of population abundance. Several methods rely on individual identification, such as capture-mark-recapture (CMR) and removal sampling, other methods take into account auxiliary data, such as distance sampling. These methods are widely capable of overcoming the issue of imperfect detection: however, they may be expensive in terms of costs and efforts, they can be applied to few populations at a time and they are not practical for large scale monitoring. In the last two decades, the development and application of Hierarchical Models (HMs) in ecology contributed to overcome this issue. HMs, from a mathematical point of view, are a sequence of probability models, ordered by their conditional probability structure, that describe conditionally dependent random variables. In other terms, and for what concerns the ecological applications in the present thesis, HM describe both the state variable , and the measurement error in the observation process. HMs are indeed composed by a sub-model for the true state of interest, that may be Occupancy or abundance, and a sub-model for the observation process, which allows to estimate detection probability. From the application of HMs in ecology, two main tools emerged: Occupancy models, and N-mixture models. From these foundational works, many other models have been developed, but at a bottom level HMs in ecology share some common principles and characteristics: i) they usually require a spatially structured design (several sampling locations), ii) they rely on repeated surveys over sampling locations (sampling sites should be visited several times), iii) they do not require individual identification, since they use presence/pseudo-absence or count data, and iv) the ecoogical and the detection process can be modelled as a function of environmental or sampling covariates. These characteristics make HMs a useful framework for scientific studies in ecology and also for conservation and management applications. The metapopulation design of HMs indeed allows to obtain estimates of the state variable for several populations, or wide study areas, at once. Abundance (but also other demographic parameters such as recruitment or survival), Occupancy and detection probability can be inferred on the basis of environmental variables or management options, trough the inclusion of appropriate covariates in the modelling process. Last but not least, the cost-effectiveness of HMs: the use of cheap methods to collect data, such as simple counts and presence/psesudoabsence data, make these methods highly recommended when time and economic resources are limited. Indeed, the application of HMs seems to be increasing over time, since their first formulation, and they received great interest by both scientists and managers in several fields of environmental science. The aim of the present thesis is to evaluate the application of HMs in the ecology and conservation of Amphibians and Reptiles.