Ph.D. in Information Technology: Thesis Defense

March 22nd, 2019

Room BIO1 – 11.30 am

Mattia PANCERASA - XXXI Cycle

"DATA ANALYSIS AND MODELS FOR LONG-DISTANCE BIRD MIGRATION. From correlations on ring recoveries to machine learning on geolocator measurements"

Advisor: Prof. **Renato Casagrandi**

Abstract:

Climate is one of the fundamental shapers of ecosystems, thus its ongoing changes deeply influence the behavior, distribution and dynamics of plant and animal populations. Migratory birds are among the species most affected by this phenomenon, as they need to fine-tune their phenology according to the climatic conditions of their breeding and wintering areas. To investigate how and to what extent alterations of climate regimes may determine key changes in the movement ecology of migratory birds, a detailed knowledge of their staging sites, a trustable reconstruction of their migration routes and of the time schedules of their journeys is very necessary. The classic methods for studying migration, such as bird ringing, can now be complemented by new technologies, such as GPS loggers of light level geolocators, that allow to record proxies of organisms' positions throughout their routes.

Focusing on a model species, the barn swallow (Hirundo rustica), in this work we first developed a method to investigate the occurrence of climatic connections between the African wintering and European breeding areas of this migratory passerine bird: surprisingly significant correlations between the average temperatures in the wintering and breeding locations of individuals emerged at the precise weeks of individuals' spring migration. Correlations have high significance only in the proximity of barn swallow wintering sites and if the temperature series refer to the precise weeks of migration. Second, we reconstructed migratory routes of 88 barn swallows using the measurements provided by light level geolocators, verifying the repeatability of the estimation method we used. The results obtained allowed us to identify four groups of individuals, as well as a possible effect of the year of migration on many indicators of the migration schedules obtained from the reconstructed routes. Third, using the routes data as reconstructed in the second research step, we have automated a long manual phase of data pre-processing by implementing filters based on Machine Learning algorithms. The migratory routes reconstructed using the automated pre-processing are completely comparable with those obtained from the manual selection of geolocator data. The work confirms that models based on data gathered with ICT devices may be helpful tools to let us gain insights on the influence of environmental and climate changes on species and ecosystems connectivity.

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