

Ecological Modelling

An ecosystem model, also called an ecological model, is usually a mathematical representation of an ecological system. It is a simplified form of a highly complex ecosystem in the real world. The ecological system can range in scale from an individual population to an ecological community, or even an entire biome.

There are two major types of ecological models:

- 1) Analytic models and
- 2) Simulation models

Principles: Based on data gathered from the field, ecological relationships—such as the relation of sunlight and water availability to photosynthetic rate, or frost resistance to cold temperature and the length of growth period—are derived, and these are combined to form ecosystem models.

Due to the complexity of ecosystems, it is impossible to capture every possible element of a system in a model. Thus, modelers need to take decisions about which of its features to include and which to disregard. These decisions are usually guided by the aims that the modeler is attempting to achieve. It is desirable to make an ecological model to be general (the model can be applied to a wide range of real-life systems), realistic (the model's conclusions have a close match to a real-life system) and precise (the model's predictions for a specific set of circumstances have little or no uncertainty). Trading-off one desideratum in order to achieve greater performance in the other two is often involved in model-building processes.

Significance: Ecological models enable researchers to simulate large-scale experiments that would be too costly or unethical to perform on a real ecosystem. They also enable the simulation of ecological processes over very long periods of time (i.e., simulating a process that takes centuries in reality, can be done in a matter of minutes in a computer model). More importantly, ecological models can be used to predict the state of ecosystems under future climates.

Ecosystem models have applications in a wide variety of disciplines, such as natural resource management, ecotoxicology, and environmental health, agriculture, and wildlife conservation. Applications of ecological models in forest resources management to mitigate the negative impact of climate change and help forest trees to adapt to a rapidly changing environment have become particularly important.

At present, our understanding of the relationships ecosystems and the changing environment is relatively weak. The vulnerability of ecological systems, and the services provided by them, to the impact arising from climate change remain largely unknown. Ecological models have been widely used to assess the impact of climate change in terms of productivity, carbon storage, and vulnerability to disturbances, and to provide information for developing forest adaptive strategies, such as assisted migration at the species level and assisted gene-flow at the population level.