

# One predator and two prey: Coexistence of pumas, guanacos and sheep in Patagonia

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The ecosystem considered in this study is the outcome of a lengthy sequence of historical and ecological events. Patagonia's indigenous fauna comprises survivors of five significant extinction events, with the notable presence of the puma and the guanaco, two of the largest native mammals. In addition to these, European immigrants introduced sheep into the ecosystem. Together, these three species form a straightforward trophic network, featuring one predator and two prey species, all competing within the Patagonian steppe. For ranchers, guanacos and pumas are frequently perceived as threats to their economic interests, making them targets for ongoing removal through hunting. In recent decades, the field of biology, particularly ecology, has witnessed a substantial increase in the development of equation-based models. Scientists are interested in the ability to systematize hypotheses and gain insights into the behavior of complex biological systems, such as the one presented in this study. However, the nonlinear nature and the large number of parameters of models, represent a challenge when one wants to explore the parameter space. To overcome this and, at the same time, improve the understanding of the Patagonia ecosystem, we start by building an equation-based model based on previous contributions, and we reduce it to the essential minimum set of parameters. Then, we introduce two tools, a generalization of ternary graphs and a perceptron based ML, to help understand the response of the system equation to the key parameters. The perceptron tool allows us to visualize/interpret the influence of each parameter on the survival or extinction of each species. Through the generalization of the ternary graph, it was possible to conveniently visualize how the system responds to different combinations/variations of the five parameters of the reduced system equation in a single graphical representation.

**Type**

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