# Universität Basel

Publication

# A mathematical model of the dynamics of mongolian livestock populations

Subsistence livestock herding is an important component of livestock production in Mongolia. However, pasture degradation, extreme weather, desertification, livestock overpopulation, infectious diseases and limited government support increasingly threaten this livelihood. To better assess these afflictions, understanding the population dynamics of livestock is critical. Towards this goal, we developed a model of Mongolian livestock populations. Using the Leslie-Gower difference equation competition model, a discrete analog of the continuous Lotka-Volterra 2-species model, Mongolian livestock population dynamics were simulated in MATLAB. The model encompasses four species and is stratified by age and sex. Calibration of parameters is accomplished using official population data from 1970 to 2010; a turbulent time period that includes the socialist to capitalist market transition and two growth periods both followed by two dzuds (severe winter storms). Herders were surveyed and herd structures were sampled for parameter and model initial value estimation. The current model simulates the Toy aimag (province) goat, sheep, cattle and horse populations. However, with more data collection, the intention would be to simulate all species populations in any aimag or soum (province subdivision). A ten-year simulation of future livestock populations predicts a more than two-fold increase in goat and sheep populations, a slight increase in cattle populations and a slight decline in horse populations. Preliminary validation with 2011 population data shows accurate estimation. Furthermore, a stable future livestock population was attained with the implementation of more than double the current culling rate. The model can be integrated in infectious disease transmission modeling, used as a tool for predicting the economic potential and support requirements of the livestock sector and used to illustrate the urgency of fostering sustainable management of livestock populations in Mongolia. This story of Mongolian pastoral life presents an excellent opportunity to study a social-ecological system as well as to contribute in creating a sustainable, healthy and efficient Mongolian livelihood. (C) 2013 Elsevier B.V. All rights reserved.