



University of Kentucky  
UKnowledge

---

International Grassland Congress Proceedings

21st International Grassland Congress / 8th  
International Rangeland Congress

---

## Models for the Peak Value of Mixed Grasshopper Population Density in Ganjia of Gansu, China

Xiaoni Liu  
*Gansu Agricultural University, China*

D. G. Zhang  
*Gansu Agricultural University, China*

W. L. Jiang  
*Gansu Agricultural University, China*

Follow this and additional works at: <https://uknowledge.uky.edu/igc>



Part of the [Plant Sciences Commons](#), and the [Soil Science Commons](#)

This document is available at <https://uknowledge.uky.edu/igc/21/16-1/24>

The 21st International Grassland Congress / 8th International Rangeland Congress took place in Hohhot, China from June 29 through July 5, 2008.

Proceedings edited by Organizing Committee of 2008 IGC/IRC Conference

Published by Guangdong People's Publishing House

---

This Event is brought to you for free and open access by the Plant and Soil Sciences at UKnowledge. It has been accepted for inclusion in International Grassland Congress Proceedings by an authorized administrator of UKnowledge. For more information, please contact [UKnowledge@lsv.uky.edu](mailto:UKnowledge@lsv.uky.edu).

## Models for the peak value of mixed grasshopper population density in Ganjia of Gansu , China

Liu X N , Zhang D G , Jiang W L

Grassland Science College , Gansu Agricultural University , Lanzhou 730070 , China ; E-mail :liuxiaoni4035@sina.com

**Key words :** Xiahe ,Ganjia ,grasshopper ,population density ,peak value ,model

**Introduction** The Ganjia high mountain grasslands of Xiahe County are an important pastoral area of Gansu Province in the People's Republic of China . Grasshopper outbreaks of serious proportion occur here almost every year , and these grasslands are already fragile due to degradation caused mainly by overgrazing . This study used 1993-2003 survey data to re-evaluate the hypothesis for developing an accurate grasshopper predication model and analyzed the relationships between grasshopper occurrence and meteorological factors . Nonlinear models have been used for estimating peak values of mixed grasshopper population density .

**Methods** The grasshopper populations of different species were surveyed , at the same time , the environmental factors , including air temperature , rainfall and soil temperature , were recorded . After the grasshopper dominants were determined , the relationship between grasshopper occurrence and environmental factors was analyzed . And then the model was developed and tested with collected data .

**Results** By using  $y_n$  to express the population peak value of n generation (year as unit , head/m<sup>2</sup>) , and  $y_{n+1}$  to express that of n +1 generation , Hypothesis :  $y_{n+1} = y_n ( a_1 + a_2 x_1 + a_3 / \ln x_2 + a_4 e^{a_5 x_3} + a_6 x_4 e^{a_7 x_4} )$

In which ,  $x_1$  means annual average rainfall of Sep and Oct in previous year (mm) ;  $x_2$  means annual average temperature of Sep and Oct in previous year (C°) ;  $x_3$  means average temperature of April and May in current year (C°) ;  $x_4$  means average rainfall of April and May in current year (mm) .

The coefficients  $a_1$  ,  $a_2$  ,  $a_3$  , ... ,  $a_7$  were determined with least square method through Matlab software and then the population peak value models for 4 species of grasshopper were built (Figure 1) .

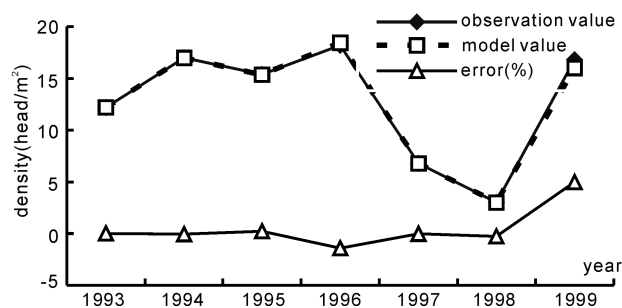


Figure 1 Stimulation models for mixed population .

**Discussion** Ma and Ding (1965) published an integrated mathematical model involving the use of an  $I$  value (index of the population trend) previously described by Morris and Watt for predicating the population dynamics of East Asian migratory locusts .

We are always facing the non-linear correlation and the difficulties of non-linear regression could be resolved by converting it into linear regression through variable conversion . Because the influence of environmental factors on grasshopper population change is comprehensive and complex , the exponential function and logarithmic function (Feng G H , 1994) could be used to convert the variables in multiple linear regression models and achieve non-linear stimulation .

### References

- Ma S J , Ding Y Q , Li D M , etc . (1965) Study on long-time prediction of locust population fluctuations . *Acta Entomologica Sinica* , 4 , 315-321 .
- Feng G H , Li Z Q , Du G Z , etc . (1994) A Study on the Mathematical Models of Population Dynamic on the Prairie Grasshoppers . *Journal of Lanzhou University (Natural Science Edition)* , 1 , 100-103 .