

Prediction of Goitered Gazelle (*Gazella subgutturosa*) Population in Mond Protected Area with Contest Model by RAMAS ECOLAB Software (Booshehr Province, Iran)

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Abstract: RAMAS ECOLAB is ecological software that uses for population simulation and population changes predictions in future years. Data's of *Gazella subgutturosa* populations in Mond protected area have been collected between 2002-2006 years. Survival rates, finite rate of increase and their standard error surveyed between mentioned years. Carrying capacity determined and simulation was carried out in the basis of 50 durations and 1000 replications with Contest model. This model is assumed that resources are finite for gazelle. These resources are intensive in special areas. Therefore, each of species has more potential for making territory and conservation of their resources with contest can increase their populations. On the basis of population trajectory summary, predicate if population is 251 head in this year, in 2016 year would be 284 head and in last years would be decreased to 91 head. In the basis of extinction probability, 100% probability is that for one time in 50 future years, population decrease to fewer than 419 head. Extinction probability is 33%. In the basis of explosion probability, 100% probability is that for one time in 50 future years, population increase to more than 80 head or 10% probability is that for one time in 50 future years, population increase to more than 58407 head.

Key words: *Gazella subgutturosa* • Mond protected area • Contest model • RAMAS ECOLAB software • Booshehr Province • IRAN

INTRODUCTION

Human manipulative in earth planet without attention to environmental carrying capacity are caused that plant and animal species impose endangered. In its result, biodiversity as an index in natural environment has decreased [1].

Parks and protected areas development are as an effective tool for conservation of genetic diversity and species conservation of extinction [2].

Robert Lee, expert of IUCN, presented a computer model as called Vortex. In mentioned model, we can predict population extinction probability in time durations. This model is the most important program for simulating and Population Viability Analysis (PVA). One of the applicable models for PVA calculation is RAMAS ECOLAB. This software is as management software in wildlife sciences. It can predict population frequency,

increase or decrease trend for future years in the basis of current population data. Maximum time for prediction is 50 years and indicates the extinction probability or population increase [3].

Goitered Gazelle (*Gazella subgutturosa*) is the most important mammal in studied region [4]. This species has suitable population in Mond protected area. Different factors as: Mond river fluctuations, flood, road making, livestock entry, habitat degradation, uncontrolled catching and other agents are effective in their population changes. These agents imposed Goitered Gazelle population upward threat in studied region. Comprehensive studies have not performed about mentioned subject. Therefore, this paper selected that Goitered Gazelle population trend predict for determination of conservative condition in future years and presentation a management or conservation technique.

MATERIALS AND METHODS

Studied Area: Mond protected area has 53.705 ha area. It located in Bordekhoon part of marginal Dayyer city in Booshehr province. Ecological and habitat values are caused that Mond introduced as a protected area under the environmental organization [4].

Methods: Collection of frequency information about Goitered Gazelle population was carried out in environmental conservation office in Booshehr province. By cooperation with environmental experts, data about Goitered Gazelle population collected for five years (2002-2006). With attention to current information, formulas, essential parameters for software as a current population, finite rate of increase, survival finite rate and standard deviation calculated.

Survival Rate Determination: For survival rate, below formula is used per year. Then, their means calculated for determination of survival finite rate.

$$\text{Survival finite rate} = \frac{N_{t+1}}{N_t}$$

In above formula, N_t : alive number in the first of time duration and N_{t+1} : alive number in the end of time duration.

Finite Rate of Growth Determination: For this purpose, ecological methodology software was used. In mentioned software, growth rate alternative would select of Extras menu. Then, population frequency in different years would record. Finally, results of rates mean would determine finite rate of growth (Fig. 1). Standard deviation for finite rate of growth would determine per year.

Modeling by RAMAS ECOLAB Software: RAMAS ECOLAB is the ecological software for simulating, small population analysis and production of population models. Its purpose is population simulation and population prediction for future years. Then, conservative and management methods for populations and their habitats would use upward recovery of endangered species [5].

Contest Model: In Contest model, assumed that there is limitations for environmental agents. But, resources have not distributed as evenness in studied region. There for, each species would try for more resources by competition with individuals. Carrying capacity definite in the basis of limited factors.

Fig. 1: Finite rate of growth determination by ecological methodology software

Fig 2: Essential factors for prediction of population by Contest model

In mentioned model, different factors as a primitive population frequency, finite rate of growth, survival finite rate, standard deviation and carrying capacity would record.

RESULTS

Population Frequency: Data about population frequency is indicated in table 1.

Survival Rate Determination: Survival rate would determine in the basis of mean of yearly survival rate. These results indicated in Table 2.

Finite Rate of Growth: Results of finite rate of growth and its standard deviation observed in table 3.

Table 1: Goitered Gazelle number in Mond protected area between 2002-2006 years

years	Number
2002	384
2003	191
2004	119
2005	187
2006	251

Table 2: Survival rates between 2002-2006 years

year	Survival rate
2002-2003	0.55
2003-2004	0.62
2004-2005	1.57
2005-2006	1.34
Mean=	1

Table 3: Rate of growth between 2002-2006 years

year	Finite rate of growth
2002-2003	0.548
2003-2004	0.623
2004-2005	1.571
2005-2006	1.342
Mean=	1.02

s.d. = 0.44

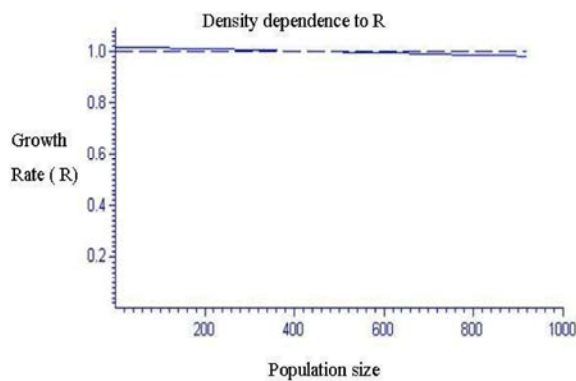


Fig. 3: Density dependence for growth rate about Goitered Gazelle population in Mond protected area.

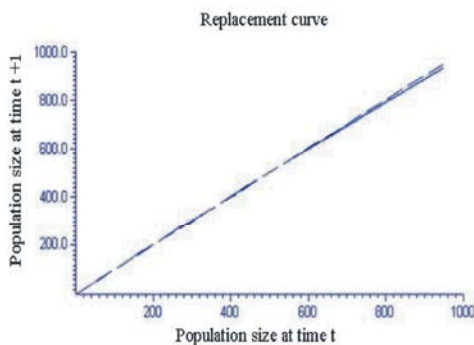


Fig. 4: Prediction of population for 50 future years in the basis of replacement curve

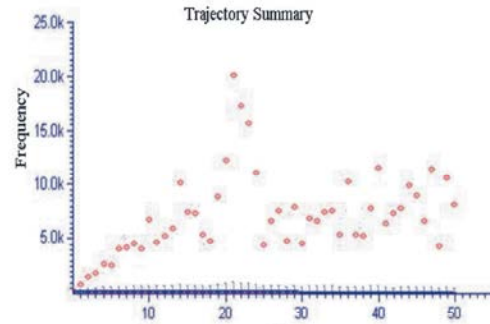


Fig. 5: Trajectory summary trend for 50 future years

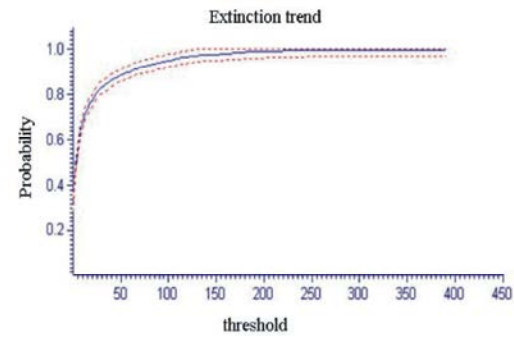


Fig. 6: Extinction probability for Goitered Gazelle population for 50 future years in Mond protected area

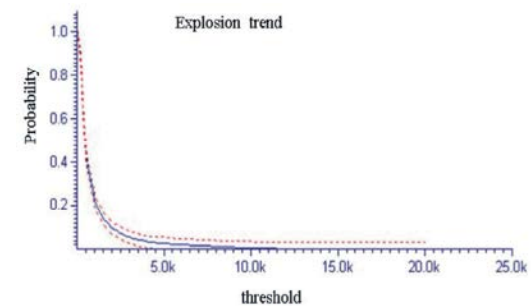


Fig. 7: Explosion probability for Goitered Gazelle population for 50 future years in Mond protected area

Prediction of Population Trend for Gazelle by Contest Model: 5 graphs (Fig. 3-7) are present in below for prediction of population trend.

DISCUSSION

In Contest model which assumed that there are limitations for environmental resources. These resources have not distributed as evenness in region. Therefore, territories would make. Species with territory making would protect of their resources by competition with intra

and inter species, finally can be increasing their population [5]. Results of density dependence to growth rate indicate that in the basis of 500 head carrying capacity, growth rate for 50 future years would decrease of 1.02 to 0.98. Population of 0.10 head for first year would increase to 921.05 head in 50th years.

In the basis of population trend by replacement curve, Goitered Gazelle population would decrease. For example, if population frequency be in 32th simulated year (2034) almost 601.4 head, therefore, in next year would decrease to 599.0181 heads.

Results for population trajectory trend would indicate that population would decrease for 50 future years. For instance, if population be 251 head in current time, in 15th simulated year (2017) would increase 284 head and in 50th simulated year (2052) would decrease to 91 head.

Extinction probability trend indicate that there is 100% probability for 50 future years, population would decrease at least one time under the 419 head. With 90% probability, population would decrease under the 57.93 head at least one time. Extinction probability would predict about 33%.

Explosion probability trend indicate that there is 100% probability, population would increase more than 80 head in 50 future years. With 10% probability, population would increase more than 58407 head for one time.

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