

# To live in crowd to call higher? Testing the “active space” hypothesis for the speckled ground squirrel *Spermophilus suslicus*

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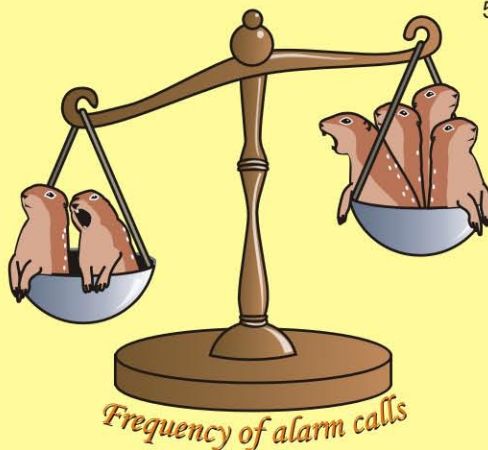
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## INTRODUCTION

The “active space” hypothesis predicts the higher-frequency alarms at higher population densities. Propagating less distantly compared to the low-frequency calls, the high-frequency alarms are less audible for predators but effectively warn conspecifics at close distances, occurring at high population densities.

### Purpose

To reveal the relations between the alarm call fundamental frequency and population density in the *Spermophilus suslicus*.



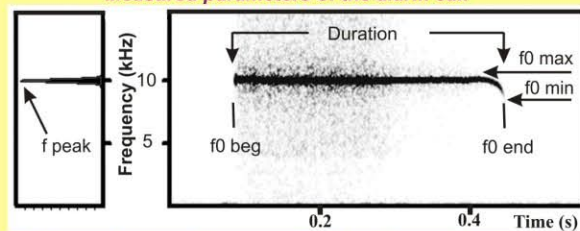
## ANIMALS AND METHODS

The alarm calls were recorded in **natural colony** on the 0.5 ha study plot in spring-summer 2003-2005 in Moscow region, Russia, from **28 marked individuals (16 males, 12 females)**, captured singly in live-traps and calling toward a human. We selected **10 calls** of good quality **per animal**, but 6 animals provided only 4 to 7 calls. In total, we analysed **534 calls** from 56 recordings.

We estimated **population density** for total sample of adult individuals, captured per year at the study plot, and **calculated** minimum distances between centers of individual territories for 52 animals in 2003, 44 animals in 2004 and 23 animals in 2005.

The spectrographic analysis of calls was made with Avisoft SASLab Pro v.4.3. The analysis of individual territories was made with ArcView 3.3.

### Measured parameters of the alarm call



*f peak* - frequency of maximum amplitude;  
*f0 max* - maximum fundamental frequency;  
*f0 min* - minimum fundamental frequency;

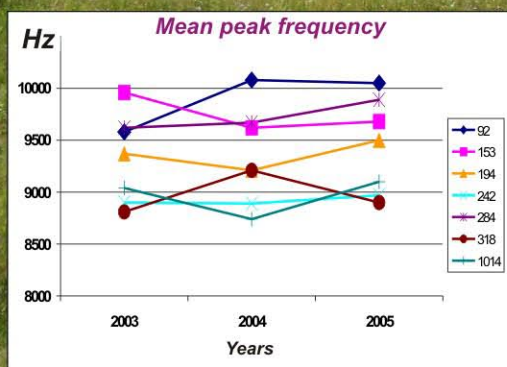
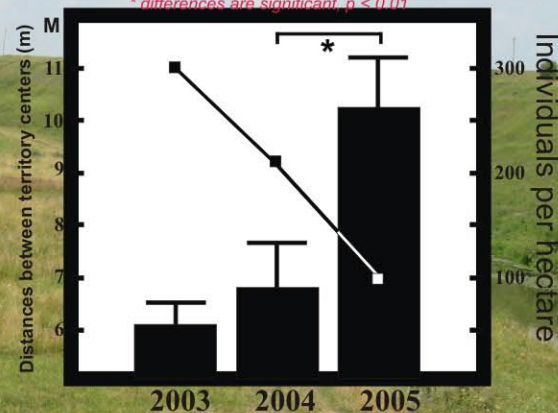
*f0 beg* - fundamental frequency at the beginning of a call;  
*f0 end* - fundamental frequency at the end of a call;  
*Duration* - duration of a call

## RESULTS

During the three successive study years, population density decreased from 300 individuals per hectare in 2003 to 216 individuals per hectare in 2004 and to 100 individuals per hectare in 2005. At the same time, the distance between the nearest individual territory centers increased correspondingly from 6.1 to 10.2 m (differences between 2004 and 2005 were non-significant, Mann-Whitney U-test,  $U = 259$ ,  $n_1 = 44$ ,  $n_2 = 23$ ,  $p < 0.01$ ). However, the alarm call frequency and duration did not show the expected decrease with increase of the distance between animals (see Table). In 7 individuals, from which calls were recorded from 2003 to 2005, the alarm call frequency varied inconsistently between years.

Distances between nearest individual territory centers (bars, mean  $\pm$  SE) and population density of the *Spermophilus suslicus* (line) on the study plot for 3 study years.

\* differences are significant,  $p < 0.01$



Frequency shifts were inconsistent between individuals

### Call parameter values (bars, mean $\pm$ SE) and results of their comparison between neighboring years with Wilcoxon matched pairs test

Calls parameters	Comparison between years			Comparison between years		
	2003	2004	<i>p</i>	2004	2005	<i>p</i>
Duration (ms)	226 $\pm$ 58	224 $\pm$ 57	0.42	261 $\pm$ 63	247 $\pm$ 65	0.16
<i>f peak</i> (kHz)	9.61 $\pm$ 0.70	9.76 $\pm$ 0.51	0.53	9.50 $\pm$ 0.71	9.29 $\pm$ 0.62	0.16
<i>f0 max</i> (kHz)	9.78 $\pm$ 0.70	9.93 $\pm$ 0.56	0.53	9.66 $\pm$ 0.74	9.44 $\pm$ 0.67	0.24
<i>f0 min</i> (kHz)	9.42 $\pm$ 0.67	9.53 $\pm$ 0.53	0.66	9.18 $\pm$ 0.71	9.02 $\pm$ 0.69	0.69
<i>f0 st</i> (kHz)	9.68 $\pm$ 0.72	9.83 $\pm$ 0.56	0.59	9.51 $\pm$ 0.80	9.30 $\pm$ 0.69	0.27
<i>f0 end</i> (kHz)	9.51 $\pm$ 0.71	9.62 $\pm$ 0.64	0.59	9.28 $\pm$ 0.76	9.11 $\pm$ 0.76	0.69

No relation between the alarm call frequency and population density

## CONCLUSION

No support to the “active space” hypothesis. So, the *Spermophilus suslicus* does not use the mechanism for lowering the predation risk, based on manipulation the call pitch depending on the distance to the conspecific neighbors.