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Collective behavior of mice passing through an exit under panic

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HIGHLIGHTS

·A series of experiments with mice escaping through exit with different width are conducted.
·The procedure that potentially reduce suffering or distress to the animals are adopted.
·The process of mice flow is divided into three stages based on the temporal evolution.
·The frequency of time intervals obeyed different distributions for different exit widths.
·The relationship between the group size and the group flow rate is analyzed.

ABSTRACT

Collective movement of animal under emergency situation has attracted growing attentions among researchers. Study of collective behavior of mice has received increasing attention in the field of evacuation. However, its rules still need to be confirmed with adequate explanation. In this paper, collective behavior of mice passing through an exit under panic was investigated. The results showed that the total evacuation time decreased with exit width increasing in a certain range. Based on the different tendency of the curve in temporal evolution, the process of mice flow was divided into three stages. The density of mice near the exit peaks at a certain horizontal offset and starts to decrease over time. With the increase of the exit width, the duration of the higher density state decreased. We found that the frequency of time intervals obeyed a lognormal distribution or an exponential decay for different exit widths. In addition, the relationship between the group size and the group flow rate was analyzed in different scenarios. The phenomena found in our experiments show the collective behavioral characteristics of mice. Our analysis in this paper will deepen our understanding of crowd dynamics under emergency situation.

1. Introduction

The existence of biological population is common in nature, such as ant colony, bird flock, wildebeest group, fish school, and pedestrian crowd. The characteristics of collective behavior of biological population are attracting growing attentions among researchers. Scientists in human public safety fields have devoted themselves into providing evidence for previous hypotheses or predictions about human behavior in