ABSTRACTS

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Development of an individually based simulation model to compare predicted results of different interventional methods on feral and free-roaming cat populations

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OBJECTIVE: We created an individually based, stochastic simulation model that allows for evaluation of different interventions (capture rates, sterilization methods) on feral and free-roaming cat populations. As an individual-based model, each cat is tracked on a day-by-day basis, updating its status (age, reproductive state, etc.) as required. As new cats are born they are added to the population, and dead cats are removed. Each run simulates the cat population over a fixed number of days. In this paper we simulated 6000 days, a number substantially greater than the average lifetime of a feral cat. In order to allow the cat population to reach a steady state both in terms of population size and age distribution the simulated trapping program was not initiated until well into the simulation (on day 2000).

Individual cat parameters that can be set in the model include number and sex of cats in the targeted population, predicted daily survival rate of individual cats based on age, hormonal status, and gender, minimum and maximum litter sizes, maximum number of copulations per day for males and females, copulations required for ovulation, and pregnancy probabilities per mating. In addition, a dominance structure is specified for males and a social structure for females. Population parameters that can be specified include initial number and gender of cats in the targeted population, carrying capacity, effect of density dependence of survival, number of months of sexual activity annually, and level of immigration and emigration. In the model we can also specify the trapping program, including how many consecutive days trapping will be carried out, with what success, and how frequently across the year. Possible interventions include removal of all trapped cats, castration or vasectomy of males, ovariohysterectomy or hysterectomy of females, or any combination thereof.

The program output includes the population histories from individual simulations; the population size over time averaged over a number of simulations, and the "cat-days" for individual or averaged population histories. We defined "cat-days" as the area under the population history curve after day 2000 (when the trapping program begins), i.e., the total number of cats alive each day summed over day 2000 to day 6000. Cat-days is a proxy for the cumulative exposure of the cat population to the environment. Also available for an individual simulation is a life history record for each individual cat. This includes date of birth, date of death, date they were trapped (if they were) and treated, and for females, total number of kittens produced over their lifetime. Because our focus is on cat population control, we limit our reported results to population size over time and cat-days, depending on which is more informative.

For the purpose of this study we specifically evaluated the effect of three different interventions on an isolated population of feral or free-roaming cats: permanent removal from the population of all trapped cats (trap-elimination, TE), castration of males and ovariohysterectomy of females followed by releasing them back into the population (standard TNR), and vasectomy of males with hysterectomy of females followed by releasing them back into the population (TVHR).

RESULTS: Evaluation of output plots indicated good concordance with expected behavior of wild cat populations. In general, TVHR performed better than TNR over a wide range of trapping effort, and better than TE at some levels of intervention if population decline is the goal. At some levels of intervention, TNR actually caused an increase in extant population size because of increased survival of member cats, particularly kittens.

CONCLUSION: Our model results suggest that for a wide range of trapping rates, TVHR outperforms TNR and TE for controlling feral cat populations. In addition, for some range of trapping rates TNR actually increases the standing feral cat size. This model should be useful for individuals, organizations and government agencies for determining the required financial and manpower commitment required to have a desired effect on feral cat populations.