

Modeling Control Methods to Manage the Sylvatic Plague in Black-Tailed Prairie Dog Towns

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Black-tailed prairie dogs (*Cynomys ludovicianus*) are a keystone species of shortgrass and midgrass prairies, making them essential for successful reintroduction efforts of endangered black-footed ferrets (*Mustela nigripes*). Sylvatic plague extirpates black-tailed prairie dog towns. We present a model to determine optimal control methods to sustain a black-tailed prairie dog town against the plague, including a recently developed vaccine. Our host submodel is a Susceptible, Exposed, Infectious, Vaccinated model, and our vector submodel is a Susceptible, Exposed, Early-Stage and Late-Stage Infectious model with questing and on-host vectors. Both submodels are hybrid ordinary differential and difference equation models to reflect the phenology of black-tailed prairie dogs. Our model suggests vaccination efforts can substantially outperform previous control methods (e.g., reactive insecticidal dusting). Our model suggests that a vaccine that provides eighteen months of immunity, administered annually, starting one year before an outbreak, can efficiently sustain a black-tailed prairie dog town against the plague.