P5

PLAGUE IN TANZANIA: FROM A HOST AND VECTOR PERSPECTIVE

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Today, in Tanzania *Yersinia pestis* apparently persists in sylvatic enzootic cycles, sometimes lasting for decades. Plague circulation remains undetected until an epizootic or an epidemic is observed. In 1982, Akiev wrote "The evidence available concerning plague in Africa indicates that the infection is enzootic throughout the continent and that under certain conditions cases of human plague might occur in any African country". This single sentence summarizes what we don't know about plague. In fact, we still know very little about the "certain conditions" that favour long-term maintenance of plague in African foci. In Mbulu district for example, in northern Tanzania, a sudden plague outbreak in February 2007 reminded the Tanzanians that plague was still present, despite the fact that no plague cases had been reported since 1977. In the Lushoto district, the first recorded plague outbreak occurred in 1980. The outbreak began in a single village and rapidly spread to more than 50 villages. By 2004, 7,603 cases had been reported from this region. There was great variation in the number of cases of plague among the villages. Although evidence of infection with *Y. pestis* has been observed in several wild rodent and flea species during epidemics, the actual reservoir in which the infection survives has not yet been identified. The ecology of plague and the source from which humans acquire infection are poorly understood. We compared the domestic and sylvatic ecology in villages having frequent plague outbreaks with those in villages where plague is relatively rare. In particular, we studied the prevalence of the infection in small mammals including their species composition and distribution, and the seasonal and spatial pattern of host-flea association. During this 4 years study we found no seropositive animals and no difference in sylvatic rodent and flea diversity between the two sets of villages. The reason for the differences in plague incidence between villages may not be the difference in species composition of either rodents or fleas, but rather difference in relative abundances of those rodent and flea species that possess ecological characteristics that facilitate transmission of the plague pathogen. Within affected villages, socio-cultural factors might be responsible for the observed differential plague incidence in females and different age groups recorded in the Lushoto hospital dataset. Interviews suggest that the risk of exposure to domestic fleas during daily activities is higher in children and women. Moreover, we found that *Pulex irritans*, the human flea, was the predominant flea species in houses and that *P. irritans* index was strongly positively correlated with plague frequency and with the logarithmically transformed plague incidence. These observations suggest that in Lushoto District, at the domestic level, human fleas may play a role in plague epidemiology in the domestic environment. However, this doesn't explain how plague reaches the village, nor does it answer where and how do plague persists between outbreaks, especially on the long term.

P6

RESPONSE BY SWIFT FOXES TO PLAGUE EPIZOOTICS IN BLACK-TAILED PRAIRIE DOGS

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An analysis of the relationships between swift fox (*Vulpes velox*) home range distribution and prairie dog colonies (*Cynomys ludovicianus*) on the Central Plains Experimental Range (CPER) in northeastern Colorado is presented. Data from the years 2003–2007 is used in conjunction with home range kernel density estimates illustrating swift fox home range distribution and overlap onto prairie dog colonies. The intent of the study is to determine swift fox dependence on prairie dogs for their burrows and food resources. Plague epizootics caused by *Yersinia pestis* occurred in 2005 and again in 2007, and dramatically altered the distribution of prairie dog colonies on the CPER. This event offers a unique opportunity to compare swift fox distribution from the pre- and post- plague time periods. Future work will entail scat analysis to determine the presence of prairie dogs found in swift fox diet, ectoparasite collection and analyses using PCR to determine if foxes are carrying plague positive fleas.

P7

FLEA COMMUNITY AND PREVALENCE OF *YERSINIA PESTIS* IN BLACK-TAILED PRAIRIE DOGS (*CYNOMYS LUDOVICIANUS*) FROM NORTH-WESTERN MEXICO

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One of the largest areas of native grasslands in northwestern Mexico is in Janos-Nuevo Casas Grandes, Chihuahua. The black-tailed prairie dog (*Cynomys ludovicianus*) is the keystone species and engineer of these native grasslands (Ceballos et al., 1993). Plague, caused by the bacterium *Yersinia pestis*, has decimated entire prairie dog populations in southern USA (Cully and Williams, 2003). However, we don't know if plague is present in Mexico. Similar environmental conditions exist in Janos and southern USA and fragmented prairie dog populations are factors that may enhance local transmission and perpetuation of disease outbreaks in prairie dogs in this area. The main objective of this study is to evaluate occurrence, distribution, and spatial dynamics of *Y. pestis* in black-tailed prairie dogs in the region of Janos-Nuevo Casas Grandes, Chihuahua, Mexico. In 2007, we sampled 13 prairie dog colonies and we captured 272 individuals with Tomahawk traps. Captured animals were handled in canvas bags to collect blood samples and fleas. Blood samples were taken with Nobuto filter strips. Fleas were collected in microtubes with physiological solution and were later identified at the "Universidad Nacional Autónoma de México" (UNAM) in Mexico City. We obtained 182 blood samples and 1838 fleas. A total of three flea species were identified including *Pulex simulans, Echidnophaga gallinacea*, and *Oropsylla* [*Opisocrostis*] *hirsuta*. Fleas in the genus *Pulex* and *Oropsylla* were the dominant fleas in prairie dogs from Janos, Chihuahua. To further evaluate the flea community structure and plague dynamics we will collect more fleas in future trapping sessions in 2008 and 2009. Plague identification in both blood samples and fleas is in progress at the Medicine School, UNAM in Mexico. We will then analyze the effect of flea community structure and prairie dog population structure on plague dynamics. Final products of this research will help to develop conservation strategies that sustain wildlife populations and ecosystem integrity in one of the top priority areas for conservation of Mexican vertebrate diversity in the region of Janos, Chihuahua.

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P8

PLAGUE IN TANZANIA – A LANDSCAPE ECOLOGICAL APPROACH

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Plague remains a public health threat in many parts of the world, but particularly in sub-Saharan Africa. In general, it occurs seasonally and shows a clear geographically disjunct distribution in circumscribed foci. In spite of plague's highly focal nature, the underlying ecology remains often unknown and Ecological Niche Modeling suggests that plague can occur in highly diverse landscapes under wide ranges of environmental conditions (Neerinckx et al. in press). In 1980 a persistent focus of human plague was discovered in Lushoto, northeastern Tanzania. By 2004 >7000 cases had been reported from this region and a strong variation in plague frequency and incidence is seen among neighboring villages in the plague endemic area (Davis et al. 2006). Earlier studies, which focused mainly on the host-vector-parasite system, demonstrated that this striking variation could not be explained by differences in fauna composition or human domestic behavior. Therefore, landscape ecological factors are suspected to determine plague's local persistence and/or to act as disease-provoking factors. In the present study, we report on the link between human plague incidence in Lushoto and data on climate, landforms, land cover, soils and vegetation. We performed a comparative field survey in a number of plague-positive and -negative villages in Lushoto and gathered the collected information in a GIS database, including an elevation model, weather data time series (rainfall and temperature), landform and land cover descriptions, soil physical and chemical properties, and concentrations of chemical elements in the common plant *Rumex usambarensis*. We found a positive correlation between plague incidence and altitude, and the endemic plague area appeared to coincide with an area that had been totally deforested in the early 1960s. Moreover,