

Investigating the Impacts of Disease on Conservation at the Ecosystem Level: A multi dimensional challenge in Chitwan Nepal and Nazenga, Burkina Faso

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Problem to be studied and its significance

Stochastic events involving disease appear to be occurring more frequently, as populations become more stressed, more fragmented, and less genetically fit. Whereas, pathogens and disease have traditionally been studied in isolation, conservation medicine gives scientists a new look at the linkages between human, animal, and environmental health. This proposed project will explore a multidimensional and dynamic analysis of disease processes enabling a better understanding of their role in the current and future health of ecosystems.

The evaluation of potential disease risks in the context of conservation has been repeatedly called for and proved important in a variety of settings around the globe: a valuable population of hunting dogs was nearly extirpated by rabies in Africa; development and bush meat trade are considered intensifying factors in human-great ape disease exchange (HIV/SIV and Ebola virus) causing significant mortality within very fragile populations; and deadly parasites such as *Cryptosporidium* are contaminating water supplies shared by wildlife, livestock, and humans in multiple communities. These examples point out the fact that there is an increasing opportunity for disease to significantly affect a species' health and survival. Ironically, conservation strategies like translocation or restoration also have the potential to affect normal disease dynamics within a group and/or introduce novel diseases through manipulation of the environment. We are now obligated to pursue a greater understanding of disease risks, to take this knowledge into account when developing conservation strategies, and to devise mechanisms for minimizing disease risks where possible and practical.

This project will study the relationship between disease and conservation. It will investigate disease surveillance as a tool for assessing the health of an ecosystem. It will also investigate mechanisms for producing preemptive strategies to minimize adverse disease events and maximize conservation. By creating a data management system that integrates disease prevalence across many species, includes environmental trends, and incorporates ethnographic factors, we will be better positioned to influence policy that safeguards critical habitats and economic sustainability in surrounding communities – producing healthier wildlife, people and their domestic animals. This investigation will take place in two different sites, both already working with Tufts faculty on conservation medicine related projects, and involving regions of high biodiversity alongside significantly developed human landscapes. These sites are in Chitwan District, Nepal and Nazenga, Burkina Faso. In both communities, concerns for many important agricultural and zoonotic diseases already exist alongside a desire to preserve their rich bioheritage. This project strives to address the needs of economic sustainability and improved health of the agricultural community as well as supporting conservation efforts already in place. Currently, there are two projects underway to collect data on elephants from Nepal and Burkina. Disease and ethnographic data will be collected from captive and wild elephants, entered into Epi Info and analyzed using GIS. It is our intention with the proposed planning grant to examine the feasibility of moving this preliminary disease surveillance to the next level: expanding the databases created in both sites to include wildlife, domestic animal, human, and

environmental parameters. We will then examine the feasibility of developing proactive conservation strategies and disease modeling from the database. These two sites will form the focus of this planning grant, however, it is intended that the concept will be generic and may be applicable in many other settings around the globe.

Previous research

As stated above, disease surveillance and ethnographic studies are already underway in Burkina and Nepal.

Nepal site: The Central Terai Arc encompasses vital wildlife habitat for many endangered species in Northern India and Nepal. The incredible biodiversity in this region has resulted in the creation of several important protected areas, including Royal Chitwan National Park and Parsa Wildlife Reserve. These parks shelter a small population of critically endangered Asian elephants (41-60) as the only stable non-migratory population left in Nepal, raising its level of importance and making it particularly vulnerable to stress and disease. The Terai has also become the most fertile and economically important agricultural zone in Nepal. This juxtaposition has led to increased human contact with wildlife and thus increased conflict. The Institute of Agriculture and Animal Science (IAAS), including Nepal's only national veterinary school, is situated in Rampur, in the heart of the buffer zone surrounding the national park. Tufts has partnered with IAAS to develop collaborative research initiatives that help to improve agricultural and conservation efforts in the region. Veterinary students and faculty from both institutions are working on these initiatives, including the year round elephant health and ethnographic research mentioned above. This preliminary data will be integrated into this proposals' database development. A proposal has also been submitted to USFWS to strengthen the elephant data collection initiative.

Burkina Faso site: Burkina Faso contains 2,000-4,000 African elephants, which is of the highest populations in all 14 West African countries. They have dedicated a significant portion of their land to conservation and protection of endangered species such as the African elephant. Although Burkina is one of the foremost activists in elephant conservation, they are also one of the continent's poorest countries with very restricted resources. Conservation attempts are impaired by the growth of human populations and the subsequent fragmentation of their ecosystem. Current efforts by Tufts faculty and students parallel those in Nepal and involve gathering data on elephant habitat, demographics, and available health parameters. This information will be synthesized with ethnographic data collected from various communities in Burkina Faso to better understand the potentials of elephant/human/livestock interaction.

Zimbabwe: Last year Tufts students and faculty developed a model for health monitoring in Zimbabwe. This project assessed the conservation priorities of a specific area in Zimbabwe, and developed an ecosystem health monitoring system to be used by local veterinarians and community workers. This year another Tufts student will be evaluating the progress and success of that system and will make necessary recommendations for its long-term feasibility and utility. This work will provide insight into the development of the multidimensional disease data management system proposed here.

External funding

This planning grant will enable the Tufts team to pursue major grant funding for implementing the conservation medicine database system developed. It will also open the possibility of pursuing the conservation medicine database model in other sites. Possible funding agencies would include: NSF Biocomplexity Grant, NSF Ecology of Infectious Disease and NSF Direct Application to Ecology Program.

Contribution to student development

As a student at Tufts Veterinary School concentrating on international medicine, this project will support my veterinary development through exposure to the ecology, economic development, political atmosphere, and conservation dilemmas of various communities. This project involves innovative techniques for disease management and conservation medicine, and will develop my skills in ecosystem database design and GIS analysis. Exposure to the conservation needs of Nepal and Burkina, will foster ongoing relationships between Tufts and our international collaborating partners. It is an important benchmark for future research, and it can help catapult conservation medicine into a proactive mode, rather than its' traditional reactive mode.

The AT student intern, preferably with a graduate level biology background, will gain experience in multidimensional database design and in GIS analysis. This student will also become familiar with disease modeling and be able to participate in developing conservation policy from multidimensional disease data.

This project will also benefit the African and Nepali students working in parallel with Tufts veterinary students on this conservation medicine project. They will truly benefit from learning advanced research techniques to enhance

the conservation and agricultural policies in their own communities and gain an appreciation for integrative, community based initiatives.