Prevalence of Tuberculosis and Brucellosis in Milking Dairy Cattle of the Buffer Zone of Bosawás Biosphere Reserve, Nicaragua

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Abstract

This study investigated the prevalence of tuberculosis and brucellosis by testing a representative sample of cattle in a portion of the buffer zone of Bosawas Biosphere Preserve, Nicaragua, using standard methods of evaluation. An average of 8.35% of the total cattle population was tested, which corresponds to an average of 29.7% of the total milking dairy cows. A prevalence of 6.9% brucellosis was found, and there was zero prevalence of tuberculosis.

Introduction

The Bosawás Biosphere reserve is restricted to the West by the río Bocay, to the South by the cerro Saslaya and to the East by the río Waspuk. These boundaries give the park its name (BOcay SAslaya WASpuk). The Honduran border is merely a political construct as the park continues North into the río Patuca National Park, the Tawhaka Anthropological reserve and the río Plátano Biosphere reserve, forming a unique complex of protected tropical rain forest.

The Bosawás reserve, declared by UNESCO to be part of the “Man and the Biosphere” program in 1991, is the heart of the Mesoamerican biocorridor that spans all of Central America from Chiapas, in Mexico, to Panama. Covering 19,928 km^2 (14% of Nicaragua’s surface), it represents the largest area of unaltered humid tropical rainforest North of the Amazonian basin. The Bosawás reserve is structured as two intricately connected areas: a pristine, totally protected nucleus of 8,068 km^2, and a surrounding buffer zone, where limited human activity is permitted (Smith 2003).

The Bosawás Biosphere reserve is managed from Managua by the Ministry of Environment and Natural Resources (Ministerio del Ambiente y Recursos Naturales, MARENA) in conjunction with the University of the Autonomous Caribbean Regions of the Nicaraguan Coast (Universidad de las Regiones Autónomas de la Costa Caribe Nicaragüense, URACCAN) based in Siuna. These dedicated managers of the Bosawás buffer zone face several serious problems. First, the population therein persistently lives in poverty. Second, inappropriate production systems are often implemented due to contempt for the knowledge possessed by indigenous populations regarding more appropriate production systems. For instance, rather than allowing cattle to graze in the jungle, slash and burn methods are utilized, causing mass despoiled areas. Similarly, general overuse and exploitation of water and land occurs, spreading disease and withering natural resources. Thirdly, the institutions in charge of controlling land use and implementing sustainable usage of natural resources are weak and incapable of actually accomplishing these goals.

The present biodiversity of the nucleus has yet to be described, but is thought to be vast (Gros, Camilo et al. 2004). Uncountable rivulets and streams drain the abundant rainfall to four main watersheds (including río Coco, the largest in Central America) that provide water for most of the Atlantic region of Nicaragua. Indigenous Mískitu and Mayangna peoples still inhabit the reserve as they have for centuries. However, increasing pressure from human activity in the buffer zone now threatens the integrity of the protected nucleus.

National parks and protected areas located in poor countries such as Nicaragua are subject to strong, unregulated economic demands on land and natural resources (Smith 2003). Extraction of timber, mining for gold and cattle ranching make up the lucrative dealings that attract businessmen to the Bosawás area. These businessmen then hire impoverished farmers from other areas of the country to work for them. As the value of commercial activities within the buffer zone has grown, so has the pressure on the protected nucleus.

How much human activity should be tolerated within a park's buffer zone before the protected area becomes altered? What limits should be imposed on commercial activities around pristine reserves? The goal of this study was to complete the first study of a data collection process leading to the construction of an agent-based model to assist decision-making processes for proper utilization of buffer zone resources. The general objective was to measure the disease impact of cattle on the Bosawás reserve. Specifically, prevalence of tuberculosis and brucellosis, both zoonotic diseases, was quantified in milking dairy cattle populations, and human and livestock populations were measured in a portion of the Bosawas reserve buffer zone near Siuna, Nicaragua.

Health professionals in Siuna had been dealing with a spate of farmers coming from the buffer zone of Bosawas to the clinic, sick with non malarial, non-dengue, febrile diseases. No disease has been attributed to these cases, but there is some speculation that either tuberculosis or brucellosis might be the insiting cause.

Tuberculosis is the most common infectious disease in the developing world, affecting more than a third of the world's population. Brucellosis is another bacterial, zoonotic, fever-inducing disease. Both diseases are contracted via consumption of unpasteurized milk and/or cheese, the main source of dairy in Nicaragua. Thus, testing cattle in the buffer zone for these diseases makes logical sense. The urgency and importance of testing dairy cattle for these diseases increases when one realizes that not only are the local farming populations potentially being affected by the diseases, but also that they have the potential to be spread into the nucleus of the Bosawas reserve by way of deer,

tapirs, monkeys, wild boars, or indigenous peoples. Such transfer of disease could have devastating consequences.

While this study is only a small snapshot of the area in Summer 2005, the intent was to catalyze continued study of human/environment interactions in the region. Hopefully, the economic and environmental framework developed from this initial project and further studies in the area will be adaptable to other national parks in the world.

Materials and Methods

Siuna, Nicaragua, a mining town accessible by plane from Managua, became home base where I was able to buy food and travel to my central location, a village called Hormiguero. In Siuna, I hired a 3rd year veterinary student (studying in Managua) and an agricultural student (studying in Siuna at URACCAN) to help with the project. Radio announcements were made, introducing the project and asking local health leaders of various communities to come collect us from Hormiguero with horses from their communities on certain days. Each week we traveled from Siuna to Hormiguero by bus, where we slept at the local health ministry for the majority of the week. Thanks to radio communication, each day a health leader would come to act as our guide for the day, with horses to carry us through mud and rivers. There are no roads into any of the communities in which we worked. We paid the guides for their time and the use of horses. Some communities were too distant or difficult to get to, to be able to complete our work and return safely to Hormiguero in a single day. In these cases, arrangements were made to stay with a local family or in an empty building in the community. We brought our own hammocks and food rations to avoid further burdening the impoverished communities.

Communities within Hormiguero's health outpost district and simultaneously in the Bosawas buffer zone were chosen to work with. This includes: Danli arriba, El Carao, Agua Sucia, El Consuelo, El Limon, Coco, Coco Central, Comenegro, Waspuko Central, Waspuko Abajo, Torno, Consuelo, and Hormiguero. As this was the rainy season, several of these communities were inaccessible due to high rivers. Therefore, the communities successfully included in this project were: Hormiguero, Agua Sucia, El Carao, Waspuko Central, Waspuko Abajo, Consuelo, and Torno.

The community health leader guided us to each *finca,* or farm, that had milking cows. There, the *jefe/jefa*, or head of the farm would share with us how many total cattle they had, how many were milking, how many people lived at this location, and what happened with the milk whether it was consumed on site,

or made into *cuajada*, a local cheese, and sold. Not knowing how many cows would be encountered and having only limited testing resources, I decided to test 20% of the milking population of cattle. The cows would be called in, and the 1st and every 5th milking cow from then on was lassoed for inclusion in the testing. Blood was sampled from the caudal tail vein for brucella testing later on the same evening. Monovet 9 cc Red Syringes with 20g 1inch needles were used for collection. Brewer diagnosic Brucellosis Card Tests (a serum agglutination procedure using disposable materials) available through the USDA were used for the testing. A caudal-fold tuberculin test was also administered to the cow. Each cow used was marked clearly in large lettering with wax livestock marking chalks, with her own identifier, for easy recognition when we returned 72 hours later to read the tuberculin test. At each *finca*, global positioning (GPS) coordinates were noted. The project took place between the dates of June 28th and August 8th, 2005.

Results

Fifty three *fincas* from seven communities—Agua Sucia, Consuelo, El Carao, Hormiguero, Torno, Waspuko Abajo, and Waspuko Central—were included in this project. There were a total of 1162 dairy cattle on these fincas (averaging 166 per community), 308 currently-milking dairy cows (averaging 44 per community), and 368 people that directly benefit from this production by consuming the milk (averaging 52 per community).

Censuses done earlier in the year reveal that the guides took us to approximately half of the houses that had cows in each community. The households that we were taken to were the households that had at least one milking cow present. The censuses do not reveal how many cows each household had, but one likely assumption based on observation is that the remaining households had only one or two cows. Of all the total cows, 28.12% were currently-milking, and of these, 29.7% were tested. Thus, an average of 8.35% of the total cattle population from *fincas* that we visited were tested.

Of the 87 cows tested, none tested positive for tuberculosis, and six tested positive for brucellosis (6.9% prevalence). There was one positive test each in Consuelo and Waspuko Abajo, and four positive tests in the community of Waspuko Central. Two of the positive tests in Waspuko Central were on the same *finca*. None of the fincas that had positive-testing cows sold their milk or *cuajada* cheese elsewhere—it was all consumed on site.

Discussion

The flight into Siuna, in a small twelve-seater biplane, flew only a few thousand feet above ground, allowing for a good overview of the country. There are roads only between large towns. Except for the towns, the whole of Nicaragua is sparsely populated, though regularly so. Single houses dot the countryside, surrounded by slash-and-burn fields of agriculture. Irregular swaths of untouched jungle could be found on steep, uncultivatable land and other diffuse patches. Houses are generally not visible from one to the next, and "communities" are somewhat random collections of households within an hour's walk of one another. Rivers cut through the countryside causing many communities to be even more remote or difficult to access than a simple lack of roads might suggest, especially in the rainy season when they are not fordable. Considering the view of the country from the plane, I conclude that the seven communities included in this project are typical of most communities in the buffer zone of the Bosawas Biosphere Reserve regarding layout, size, and number of cattle present, and is therefore more or less representative of the buffer zone as a whole.

The fact that no cows tested positive for the tuberculin test was a welcome surprise. These results are well within the 5% false-positive margin error that is expected in the caudal-fold tuberculin test. The near 7% positive brucellosis tests are not conclusive, but do allow us to conclude that exposure to virulent brucellae is present in the area to some degree. The fact that of the 53 *fincas* visited, none of the *fincas* whose cows tested positive tended to disseminate their products for trade is good, indicating that there is less likelihood of spreading the disease through the human population. However, the possibility for wildlife to contract and spread Brucellosis, either through proximity and shared grazing space, or through ingestion or physical contact with aborted fetuses of infected animals, is still potentially an issue. Presence of Brucellosis seems to be fairly localized. Containment or eradication of the disease depends on culling affected animals and their herdmates. Due to poverty in the area and the wealth that cattle represent, this is an extremely unlikely event. Therefore, further testing is needed in the area to see if wildlife populations are being affected. In order to maintain the Bosawás reserve's biodiverse integrity, better management of the area is needed. In the meantime, evidence of brucellosis is key for beginning discussion of and looking for funding for solar-powered milk pasteurization systems in the area.

This information would be well used in a Geographic Information System (GIS) map to describe the present situation around the boundary of the Bosawás

nucleus. Such a map could act as an agent-based model for the exploration of biological and economic scenarios for optimal resource utilization in the future. This includes, inherently, the wellbeing of wildlife who are affected by encroaching human activity and cattle rearing.

Conclusion

The first of several projects in and around the Bosawás Biosphere reserve has been completed. Eighty-seven milking dairy cows from 53 fincas (seven communities) were tested for brucellosis and tuberculosis using serum agglutination card tests and intradermal skin tests, respectively. This corresponded to 28.12% of all milking cows, and 8.35% of total cattle population in the seven communities visited. Tests for tuberculosis were negative, while brucellosis prevalence was approximately 7%. Continuation of this sort of work is important to further investigate whether Brucellosis is being spread within the wild population of animals in nearby jungles, and to investigate the need for installing solar-powered pasteurization techniques in the area.

Thanks and Personal Notes

I am grateful to my mentor, Louise Maranda DVM PhD, for her support and encouragement as I prepared for this study. Thank you, also to Bridges to Community in Siuna, where I was welcomed and given great logistical support in-country.

My personal interest in this project stems from a passionate sense of responsibility for the conservation of our world's natural resources and biodiversity. I feel that by undertaking this project, I have contributed to the body of knowledge that will aid in future decision making regarding the usage of precious resources around the world. I hope to continue working for the benefit of our environment, for sustainability and conservation.

I have had the good fortune to have traveled and worked in many remote areas of the world, and of all the places I have ever been, Nicaragua's jungle biodiversity easily outshone the rest. To think that such ecological richness is so close to this country and yet so threatened is tragic. Losing this sort of natural wealth in whole or in part would be unconscionable and I endeavor to do my part to prevent it.

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