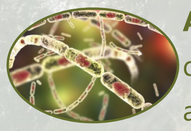
No Postage Necessary

Identifying Natural Anthrax Hotspots in Namibia

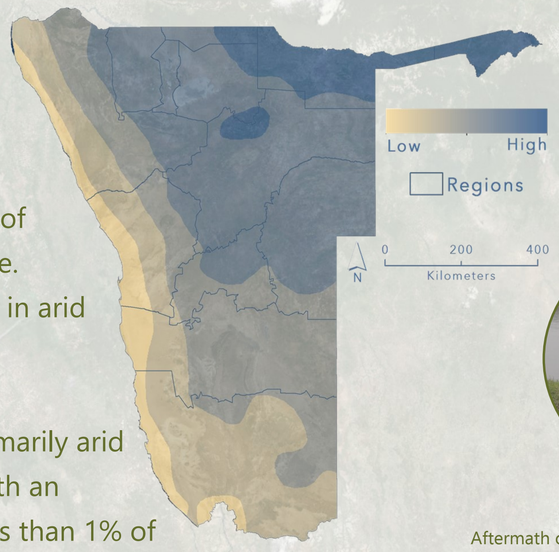
Not Just a White Powder



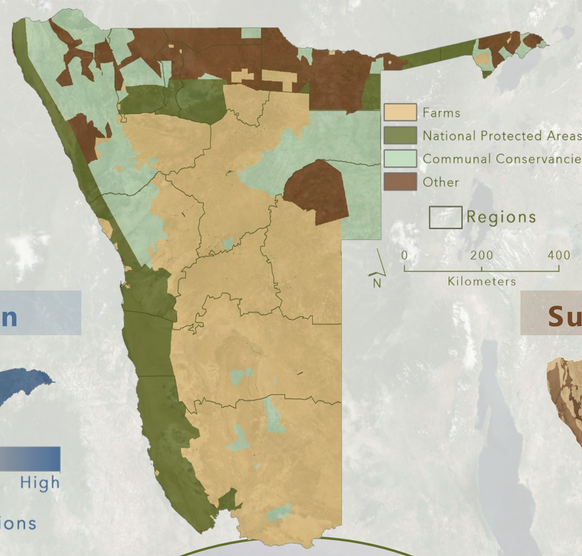
Anthrax is a bacterial disease that affects wildlife, domestic livestock, and humans. The causative agent, *Bacillus anthracis*, exists in soil around the world in a hardy spore form that may persist for decades. After extreme weather events, buried spores can become unearthed and available for ingestion by grazing herbivores. Once ingested, the spores become activated and release deadly toxins that are often fatal to most, if not all, mammals. Humans may encounter the pathogen through the consumption or handling of meat from diseased livestock or wildlife. Outbreaks of anthrax commonly occur in arid environments with seasonal rainfall.

Namibia consists of primarily arid and semi-arid terrain with an annual rainy season. Less than 1% of the land is suitable for crops, but over 70% of the population relies on the agriculture sector. Much of this reliance is on livestock farming. The number of livestock is greater than Namibia's human population. This high density of livestock, along with optimum environmental conditions and the presence of over 200 terrestrial mammal species, creates the perfect setting for the deadly disease. This analysis aims to identify particular areas in Namibia that are at an increased risk for outbreaks of anthrax in wildlife, domestic livestock, and humans.

Average Annual Precipitation

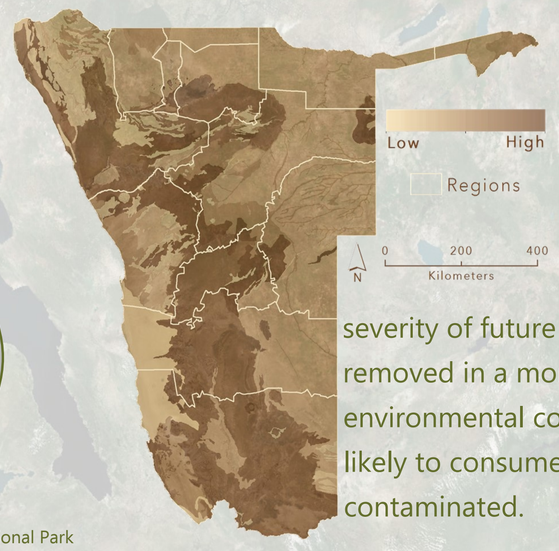


Land Use



Aftermath of a 2017 anthrax outbreak that occurred in Bwabwata National Park in northeastern Namibia. More than 100 hippos were found dead.

Suitability of Soil for *B. anthracis*



End Results

Areas with an increased risk for outbreaks of anthrax have been identified based on the weighted analysis of seven risk factors. Identified areas of concern generally align with, and extend beyond, regions that have experienced anthrax cases within the past 10 years. Some historical cases involved humans consuming relocated contaminated meat, which would not be predicted by this analysis.

Management plans and precautionary measures can be applied to the areas of concern. Increased awareness may reduce the severity of future outbreaks. Affected carcasses can be removed in a more timely manner to reduce further environmental contamination, and humans may be less likely to consume meat that has a high chance of being contaminated.

Thought Process

Weighted risk analysis was performed with seven factors. Each factor was reclassified as seen in the factor table.

Soil: *B. anthracis* thrives in warm, damp, slightly alkaline soils. Soil types throughout Namibia were reclassified according alkalinity, nutrient content, erosion levels, and the presence of certain cations.

Precipitation: Areas with high levels of annual rainfall are more likely to have increased soil disturbance that may bring bacterial spores to the surface. *B. anthracis* may also persist in the environment longer in wet or damp conditions.

Temperature: Optimum temperatures for *B. anthracis* are between 20-30°C. Extremely low temperatures may reduce the likelihood of spores surviving in the environment.

Land Use: Communal conservancies consist of humans, livestock, and wildlife often living in close proximity, increasing the risk of a widespread anthrax outbreak. National protected areas have high wildlife density, but an absence of livestock. Farms have high livestock density, but limited wildlife.

Livestock Density: Herbivores (cattle, sheep, etc.) are particularly susceptible to anthrax. Bacterial spores may be consumed accidentally as the animals graze. High livestock density increases the risk of spore consumption, and the risk of other species becoming affected.

Wildlife: Presence of wild mammals increases the likelihood of an anthrax outbreak, and a higher number of endangered species would increase the severity of the outbreak from a conservation perspective.

Sunshine: Prolonged exposure to sunlight can deteriorate *B. anthracis* and reduce the risk of future anthrax outbreaks.

Weighted Risk Analysis of an Anthrax Outbreak

Risk of an Anthrax Outbreak by Constituency

Kate Slyngstad

GIS for Conservation Medicine, 2017

Data Sources: EIS Namibia, IUCN, ESRI

Projection: Africa Albers Equal Area Conic

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Factors & Weights	1: Lowest Risk	2	3: Average Risk	4	5: Highest Risk
Soil Type (25%)	Coastal Salt Pans, Dune Sand, Rock Outcrops	Arenosols, Calcisols	Alluvium, Sand, Gravel, Calcrete plains, Cambisols, Fluvisols, Gypsisols	Leptosols, Luvisols, Solonetz	Regosols, Solonchaks
Precipitation (20%)	0-50 mm	50-150 mm	150-300 mm	300-500 mm	>500 mm
Temperature (15%)	<16°C	16-18°C	18-20°C	20-22°C	>22°C
Land Use (15%)	N/A	Other	Farm	Protected Area	Communal Conservancy
Livestock Density (10%)	0-19 kg/ha	20-59 kg/ha	60-99 kg/ha	100-139 kg/ha	140-186 kg/ha
Wildlife (10%)	2-5 species	6-8 species	9-10 species	11-12 species	13 species
Daily Sunshine (5%)	>10 hours	8-10 hours	6-8 hours	5-6 hours	<5 hours

Image Credits

Spores: https://goo.gl/images/kvpk2t, Namibia Landscape: https://goo.gl/images/Yjyczp, Hippos: https://goo.gl/images/HFxeQZ, Bwabwata Hippos: https://goo.gl/images/bCinfL, Soil: https://goo.gl/images/LSrAVf, Thermometer: https://goo.gl/images/cdPvoA, Etosha Pan: https://goo.gl/images/pPsohs, Sun: https://goo.gl/images/a8ShL8, Waterhole: https://goo.gl/images/ksCy7K , Livestock: https://goo.gl/images/7971UT, Rainfall: https://goo.gl/images/AfQydS, Border: https://goo.gl/images/iQfGcv