THE UNKNOWN ECOLOGY OF AN ENVIRONMENTAL PATHOGEN:
BURULI ULCER DISEASE IN WEST AFRICA

LINDSAY CAMPBELL
ECOLOGY AND EVOLUTIONARY BIOLOGY
UNIVERSITY OF KANSAS

GIS DAY 2013

Buruli Ulcer Disease (BU)

- *Mycobacterium ulcerans* (MU)
  - Environmental pathogen
  - Related to leprosy and tuberculosis

- Mode of transmission and ecological niche unknown
  - Flooding events, disturbance, land cover
 - Most studies at local scales
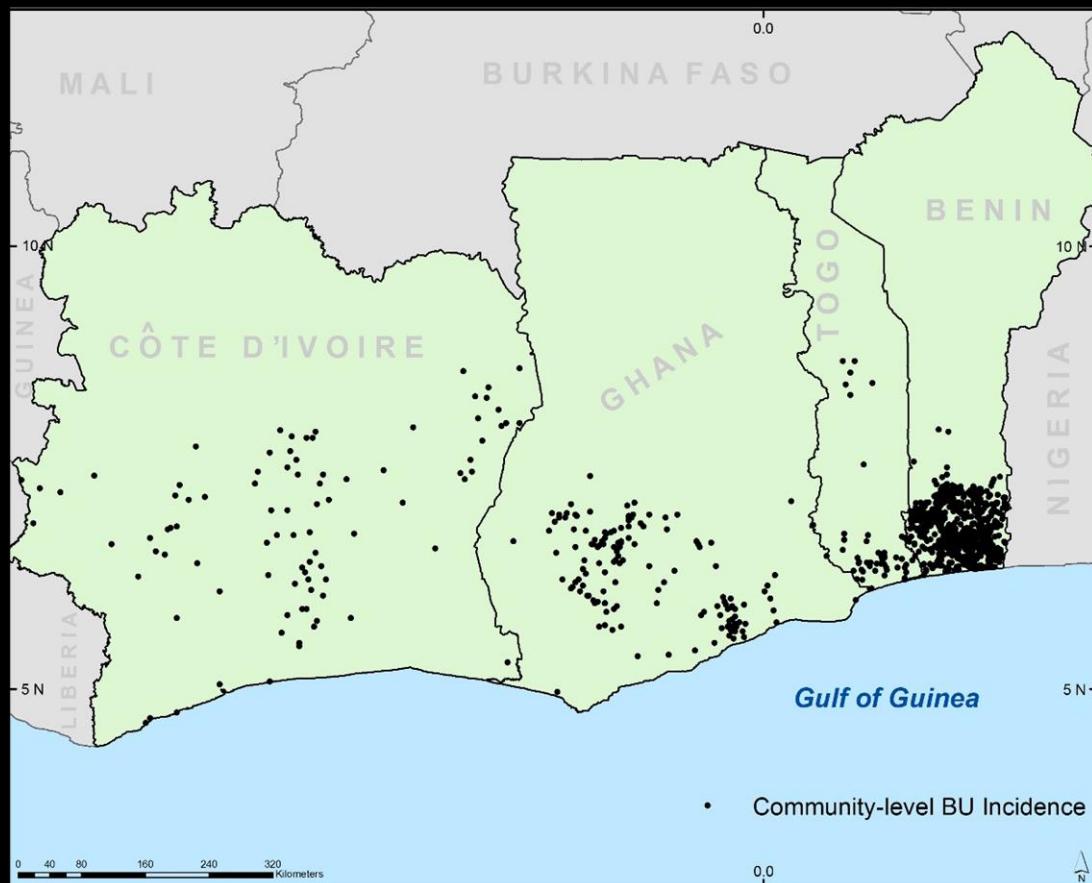
- Objective: to predict potentially suitable environments for BU across West Africa using a correlative modeling approach


Images courtesy of Lindsay Campbell and http://www.who.int/buruli/photos
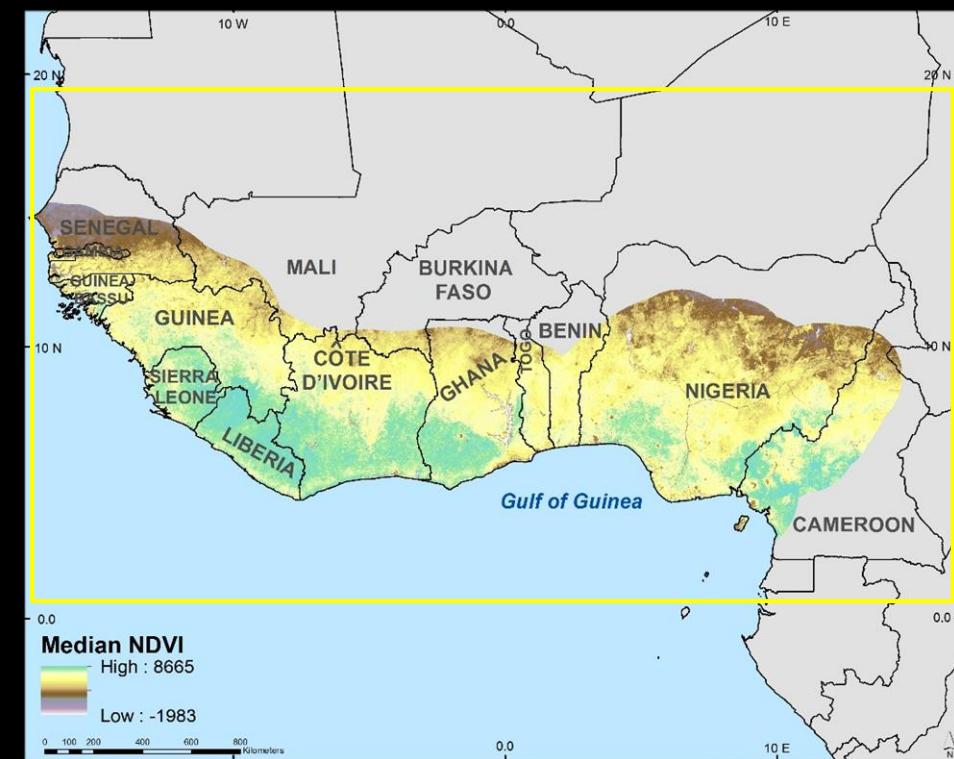
Occurrence Data

- Laboratory confirmed cases
  - (1997 – 2006)
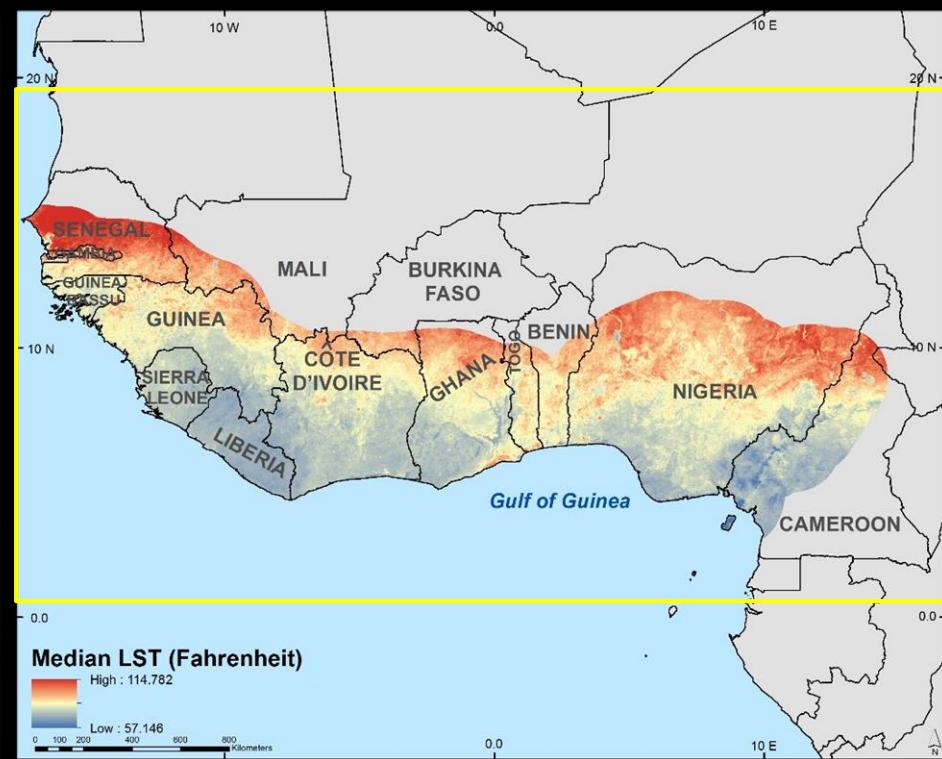
- Sampling bias
  - Random points
  - 3 data sets
  - ~275 locations

Community-level BU Incidence

Environmental Data
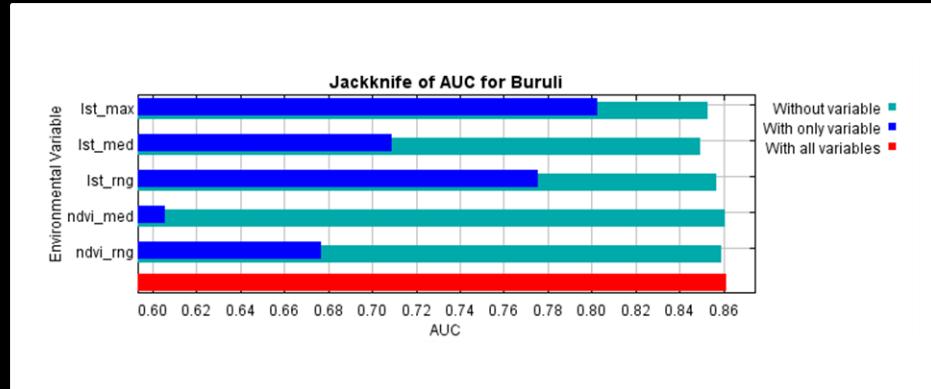
1 km Monthly MODIS Aqua NDVI data
(July 2002 – December 2006)
Minimum, maximum, median, range
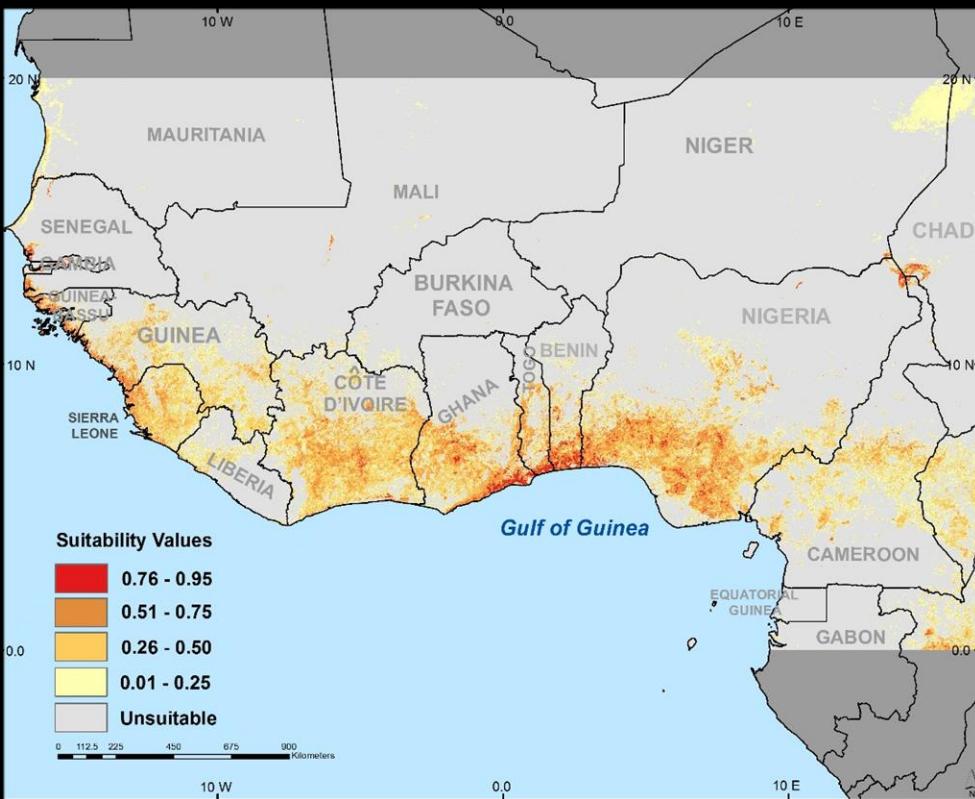
1 km 8 Day MODIS Aqua LST Daytime data
(July 2002 – December 2006)
Minimum, maximum, median, range

http://reverb.echo.nasa.gov/reverb/#utf8=%E2%9C%93&spatial_map=satellite&spatial_type=rectangle

Model: Correlative Modeling Approach
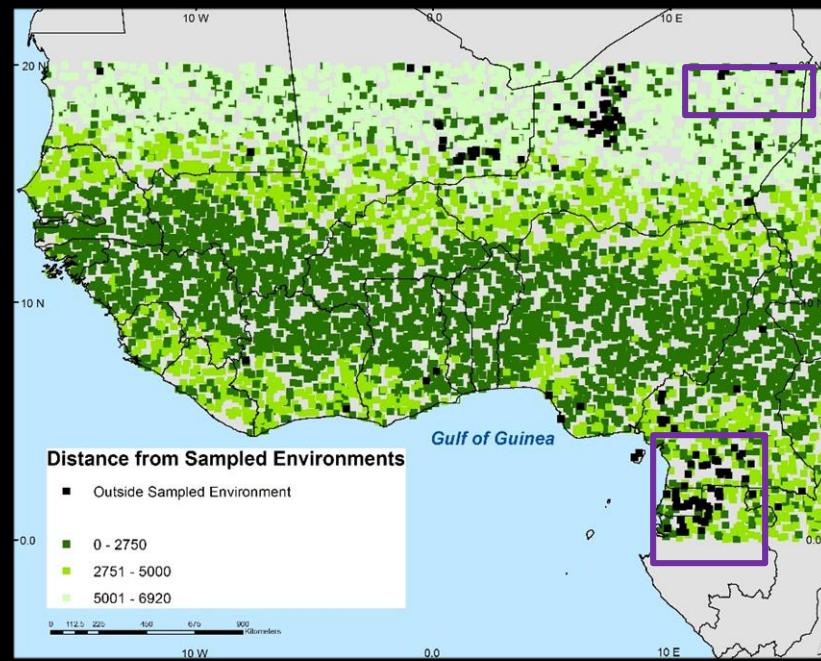
- Maxent
  - 3 models
  - 50% training/50% testing
- Jackknife
  - Removed NDVI max, NDVI min, LST min
- Threshold
  - E = 10%
- Validation
  - Withheld points
  - Cumulative binomial test (p-value < 0.01)
- MOP
  - Model extrapolation

Jackknife of AUC for Buruli

Projection and Results

MOP Results
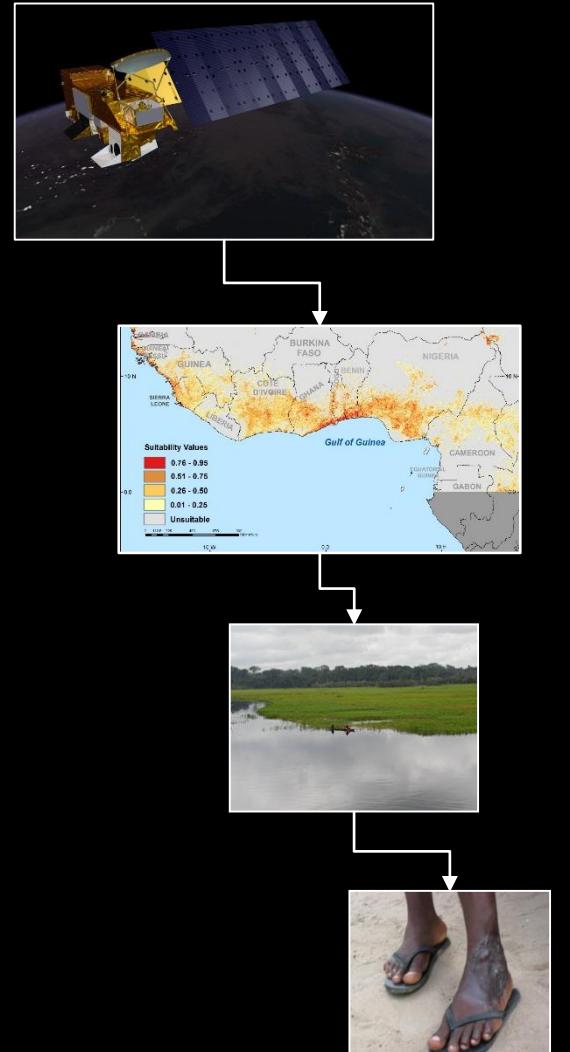
% Suitable Area		Suitable Hectares	
Sierra Leone	81.2 %	Nigeria	29,466,700 ha
Côte d'Ivoire	60.4%	Côte d'Ivoire	22,198,400 ha
Togo	43.0 %	Cameroon	12,789,600 ha

Conclusions and Future Directions

□ Geospatial technologies are excellent tools

□ Additional data

□ Additional variables

□ Continued interdisciplinary research

Questions?

Acknowledgements

Patrick Suykerbuyk

Andrés Lira-Noriega

A. Townsend Peterson

Yoshinori Nakazawa

KU Ecological Niche Modeling Group