Modeling tropical forest data in Nigeria - the challenges

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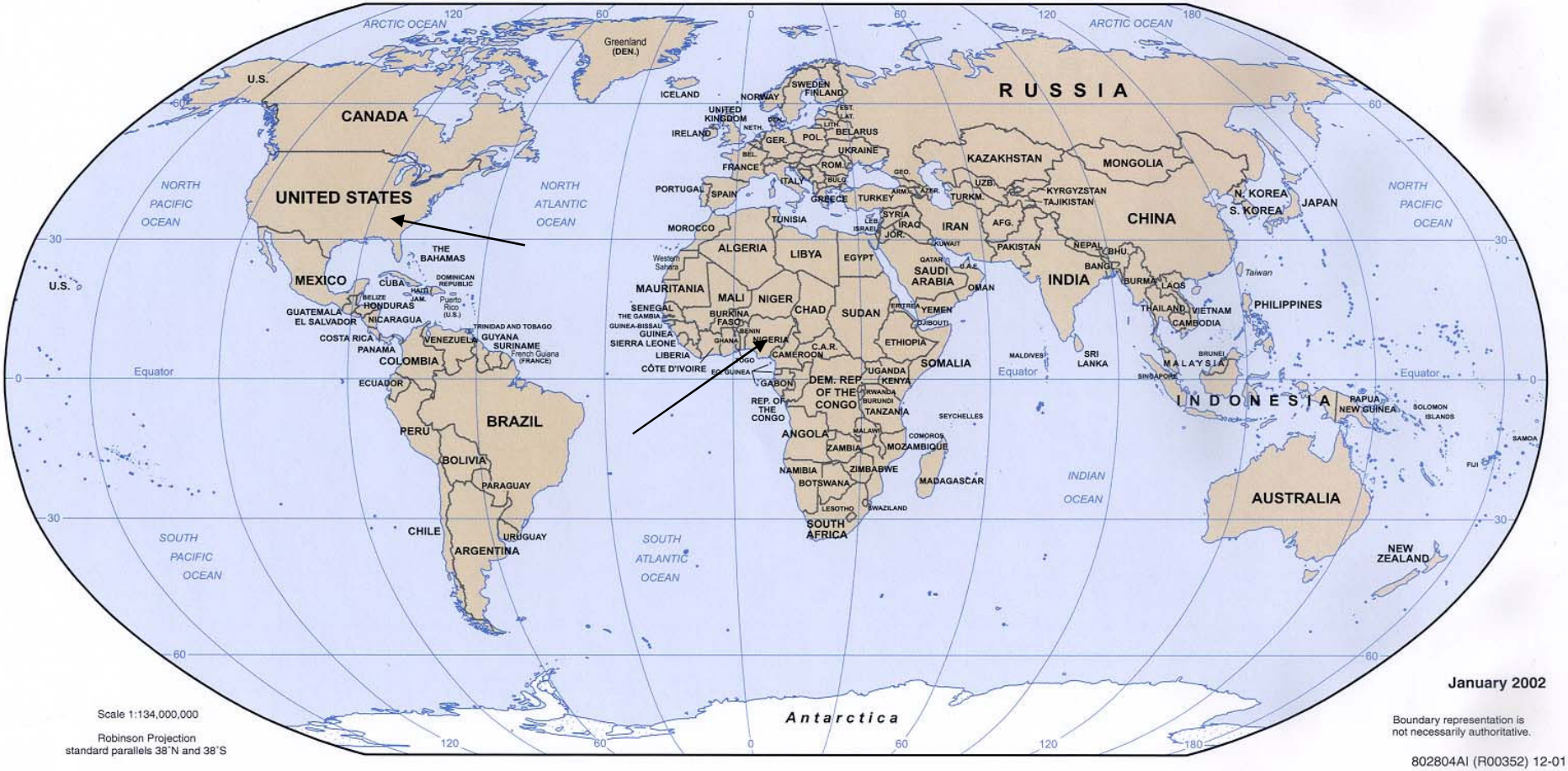
Seminar presented at the Warnell School of Forest Resources, University of Georgia, Athens, Georgia, USA on May 11, 2005.

Abstract

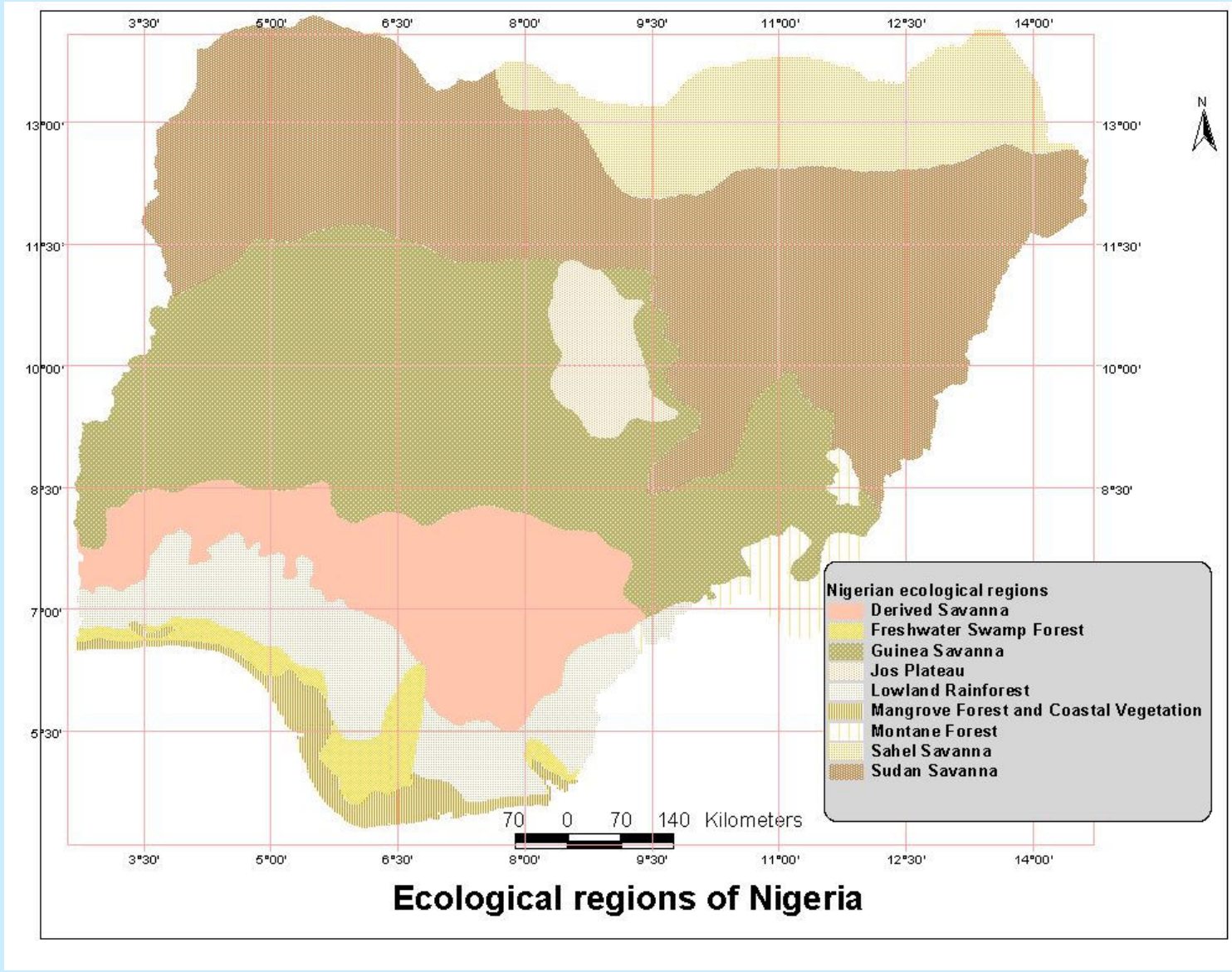
The tropical rain forest is the most diverse of all terrestrial ecosystems, containing more plant and animal species than any other biome. This pronounced heterogeneity in species composition and structure even within small areas makes growth and yield modeling very challenging for tropical species. In this presentation, some information is provided about the tropical rainforest in Nigeria, and the problems faced in collecting and analyzing data from this forest type. Brief review of existing methodologies for grouping species for analysis is presented; while suggestions are made on possible areas of assisting researchers in developing countries for greater efficiency in growth and yield modeling.

Outline

1. Some facts about Nigeria
   - ✓ The land
   - ✓ The people
   - ✓ The economy
   - ✓ The vegetation
   - ✓ The forestry sector
   - ✓ Forestry administration
2. Challenges to field data collection in Nigeria's tropical rainforest ecosystem
3. Analyzing forest data in Nigeria – the challenges
4. Nature of tropical forest data
5. Analysis of tropical forest data – three options
6. How should the species be grouped?



World Map with arrows pointing to the location of USA and Nigeria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Nigerian ecological regions
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Guinea Savanna
Jos Plateau
Lowland Rainforest
Mangrove Forest and Coastal Vegetation
Montane Forest
Sahel Savanna
Sudan Savanna
70 0 70 140 Kilometers
Ecological regions of Nigeria

Some facts about Nigeria – the land

- Lat. 4°16'N & 13°52'N; Long. 2°49'E & 14°37'E;
- Total Land Area = 288.3 million acres (about 6 times the size of Georgia);
- Fragmented into 36 States and a Federal Capital Territory;
- Generally lowland with some inselbergs; highest elevation = 7,936 ft;
- Endowed with many natural resources such as petroleum, tin, columbite, iron ore, coal, limestone, lead, zinc, etc.

Some facts about Nigeria – the people

- Population = 137 million (Georgia = 7.8 million);
- Average Population Density = 384 persons per sq. mile (135 persons per sq. mile);
- Over 250 ethnic groups with distinct languages (the most prominent are Hausa/Fulani, Igbo and Yoruba);
- Amalgamated into a country by the colonialists in 1914; (Georgia's Statehood, 1788);
- Official language is English.

Some facts about Nigeria – the economy

- Oil sector provides 20% of GDP, 95% of foreign exchange earnings, and about 65% of budgetary revenues;
- About 70% of the population live below the poverty line;
- Nigeria's external debts = US$34 billion *(Nigeria paid US$42 billion over the past 38 years to service a US$13.5 billion debt, and yet US$34 billion is still outstanding due to interest);*
- Oil production = 2.7 million barrels per day;
- 2005 national budget ≈ N1.8 trillion;
- Currency: Naira (N), Exchange Rate: US$1.00 = N132.86.

Some facts about Nigeria – the vegetation

- Forest cover thins out as one moves from the south to the north;
- Two broad types (Forests and Savanna);
- Forest Cover $\approx$ 10% of land area (Georgia = 66%);
- Plant diversity: Over 4,600 plant species identified (Ranked 11th in Africa);
- The forests have over 560 tree species (with a range of 30 to 70 species per hectare for trees $\geq$ 5 cm dbh);
- Natural Forest MAI = 3 – 5 m^3/ha/yr, Plantation MAI = 20 - 25 m^3/ha/yr;
- Gmelina and Teak occupy about 60% and 25% of total plantation area, respectively.

Some facts about Nigeria – the forestry sector

- Forest Ownership: Government = 75%, Communities = 25% (In Georgia, Government = 7%, Industry = 21%, Private = 72%);
- Nigeria is a member of African Timber Organisation (ATO) and the International Tropical Timber Organisation (ITTO);
- Nigeria has several NGOs involved in forestry, e.g. the Forestry Association of Nigeria (FAN), Nigeria Conservation Foundation (NCF), Savanna Conservation, Nigeria Environmental Study Team (NEST), etc.;
- Forestry Education: 2 Technical Colleges, 12 Universities;
- Nigeria has not endorsed any certification scheme yet, but work is in progress in this regard. Less than 10% of forest reserves is managed sustainably;
- Federal Forestry Legislation almost ready.

Some facts about Nigeria – forestry administration

Federal

- Plays advisory role to the State Forestry Departments;
- Coordinates and monitors projects funded by the Federal Government;
- Relates with International development Agencies.

State

- Implementation of forest policy at the State level;
- Revenue generation from the forestry sector.

Local Government

- In the south, no specific role;
- In the north, dual control with the State Government.

Challenges to field data collection in Nigeria's tropical rainforest ecosystem

1. Nature of the forest ecosystem
   - High biodiversity, requiring taxonomists for species identification;
   - Difficult terrain and dense undergrowth, resulting in much time spent in plot location than in actual enumeration;
   - Presence of dangerous animals; enumerators face high risk;
   - Some variables (e.g. tree height and crown attributes) are difficult to measure reliably due to interlocking crowns;
   - Trees have no reliably distinct annual growth rings that can facilitate age determination from ring counts.

Challenges to field data collection… *contd.*

2. Lack of suitable field equipment.

Challenges to field data collection… *contd.*

3. Shortage of competent personnel to train and lead field teams.

Challenges to field data collection… *contd.*

4. Lack of funds

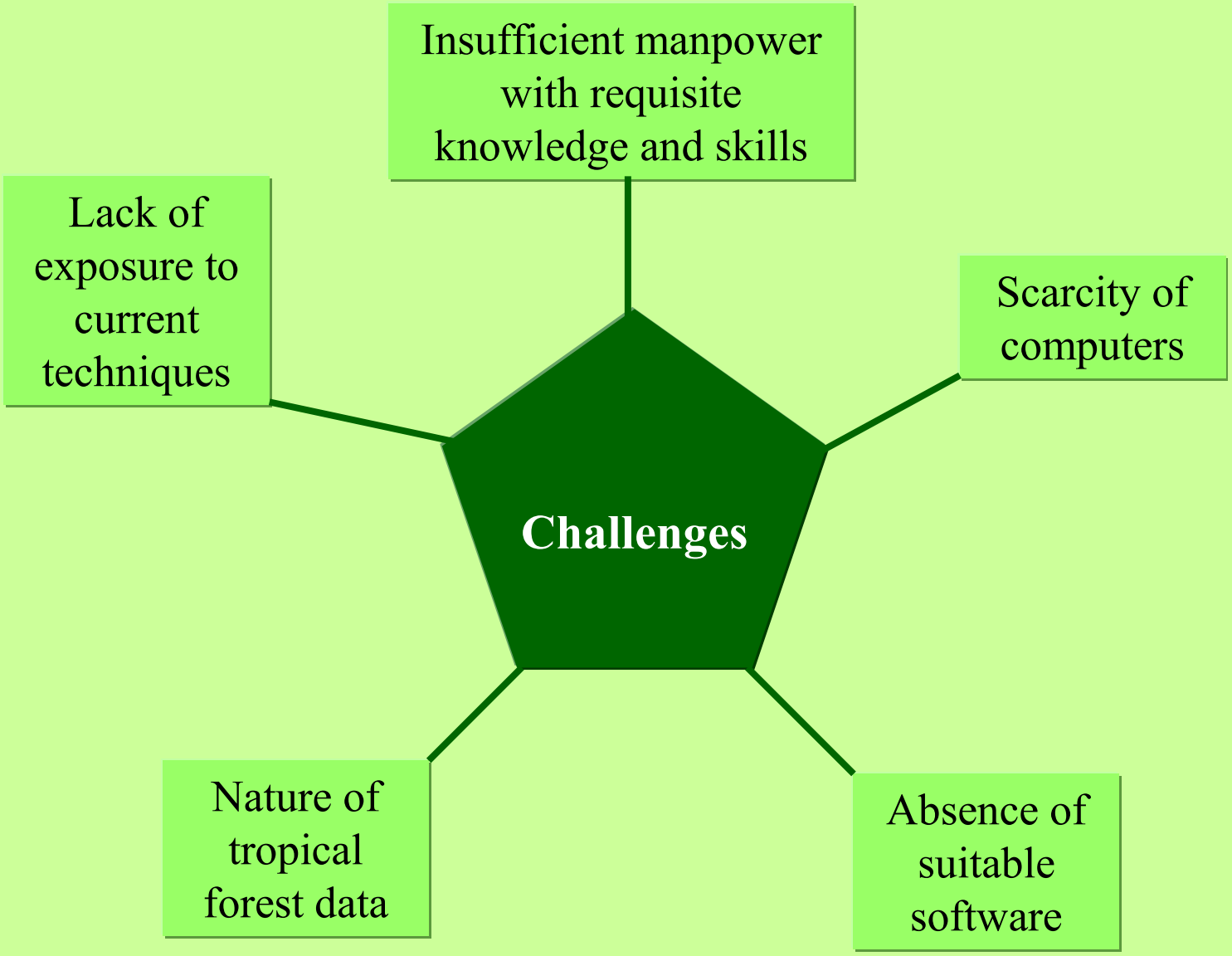
(Field measurement is very expensive).

Challenges to field data collection… *contd.*

5. Lack of coordination of data collection efforts.

Challenges to field data collection… *contd.*

6. Forest ownership status (Conflicts with local forest dwellers).



Challenges confronting forest data analysis in Nigeria

Coping with the challenges

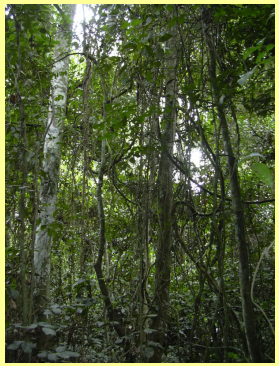
1. Use of experienced tree identifiers from forest communities;
2. Use of appropriate sampling design;
3. Giving lessons on field practice and animal behavior to crew members;
4. Inclusion of only attributes that can be correctly assessed during the inventory;
5. Use of PSP data (where available);
6. Avoiding areas of conflict;
7. Involvement local people in the field work as paid labor;
8. Participation in the Global Forest Information System (GFIS);
9. Exploring possibility of collaboration and networking with other scientists.

Analysis of tropical forest data – three options

1. Species by species;

High species diversity leads to too many equations, weird and difficult to manage.

Some species have very low frequency (insufficient data).



2. All species together;

Leads to very inaccurate estimates due to large variation among species.

3. Groups of species.

Most efficient, compromise between 1 and 2; requires satisfactory grouping method.

How should the species be grouped?

- Taxonomic (according to Genus);
- Commercial (according to economic value);
- Ecological (according to light demand);
- Morphological (e.g. according to wood density, potential tree height, etc.);
- Statistical classification
  - Pairwise comparison
  - Cluster Analysis, *etc*.

Assisting tropical scientists

To promote modeling of tropical forest data, institutions in developed countries (e.g. University of Georgia) can assist in the following ways:

- Capacity building – providing training for graduate students;
- Collaborative research with local scientists;
- Institutional Strengthening through provision of books, software, equipment, etc.

For more information, contact:

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Website:

http://www.forestry.ubc.ca/biometrics/

Thank You