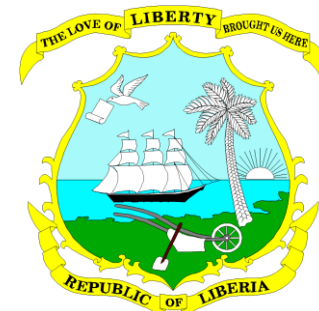


NCA IN LIBERIA: TECHNICAL DISCUSSION ON GAPS, BARRIERS AND OPPORTUNITIES

NCA Technical Advisory Committee Meeting

Monrovia, Liberia.

February 24, 2021



AGENDA

| TIME | ACTIVITY | RESPONSIBLE PERSON |
|-------------------|---|---|
| 1:00 PM – 1:15 PM | Opening remarks, expected outcomes & self-introduction | TAC / George Ilebo –Technical Director |
| 1:15 AM – 1:30 AM | NCA in Liberia: what it is, what it measures, why it is relevant, where we are/want to be | Rosimeiry Portela – Senior Director |
| | Analytical framework and outstanding issues for consultation: | Project Technical Team |
| 1:30 AM – 2:00 AM | <i>Ecosystem Extent Account</i> | <i>Miroslav Honzák – Senior Director</i> |
| 2:00 AM – 2:30 AM | <i>Ecosystem Condition Account</i> | <i>Timothy Wright – Director, Spatial Planning</i> |
| 2:30 AM – 3:00 AM | <i>Ecosystem services Accounts</i> | <i>Mahbubul Alam – Research Economist</i> |
| 3:00 AM – 3:30 AM | <i>Field work and data collection</i> | <i>Trond Larsen – Director, RAP</i> |
| 3:30 AM – 3:50 PM | Q & A and General Discussion | |
| 3:50 PM – 4:00 PM | Next steps / Closing Remarks | Mr. Peter G. Mulbah Country Director- Conservation International |
| | | |



SELF-INTRODUCTION OF PARTICIPANTS





NATURAL CAPITAL ACCOUNTING: DEFINITION, STANDARDS, POLICY AND DECISION-MAKING

Rosimeiry Portela

Senior Director

ACCOUNTING FOR NATURAL CAPITAL

A systematic process for tracking natural assets, the services provided by them and their relationship to the economy

- Measures the value of ecosystems (stocks) and the services they provide (flows)
- Integrates this information into accounting systems that governments already use in their decision-making
- Provides a more complete view of a country's assets, and of natural values, at appropriate spatial and temporal scales

Accounting embraces complexity but ultimately simplifies it into a clear message

Boyd, 2009



THE UN SYSTEM OF ENVIRONMENTAL ECONOMIC ACCOUNTING (SEEA)

- The SEEA is the statistical framework to measure the environment and its interactions with economy
- Part of the statistical system developed by the international statistical agencies (UNSD, IMF, World Bank, OECD, European Commission)
- Two complementary approaches aligned with SNA:
 - SEEA Central Framework
 - SEEA Ecosystem Accounts



POLICY AND DECISION MAKING AND SEEA EEA

POLICY AND DECISIONMAKING

ECOSYSTEM ACCOUNTING

Measurement

Extent

Classification and measurement of ecosystem types

Condition

Measurement of ecosystem health

Valuation

Ecosystem Services

Services

Flow of Services to beneficiaries

Benefits

Value of the benefits people receive

Assets

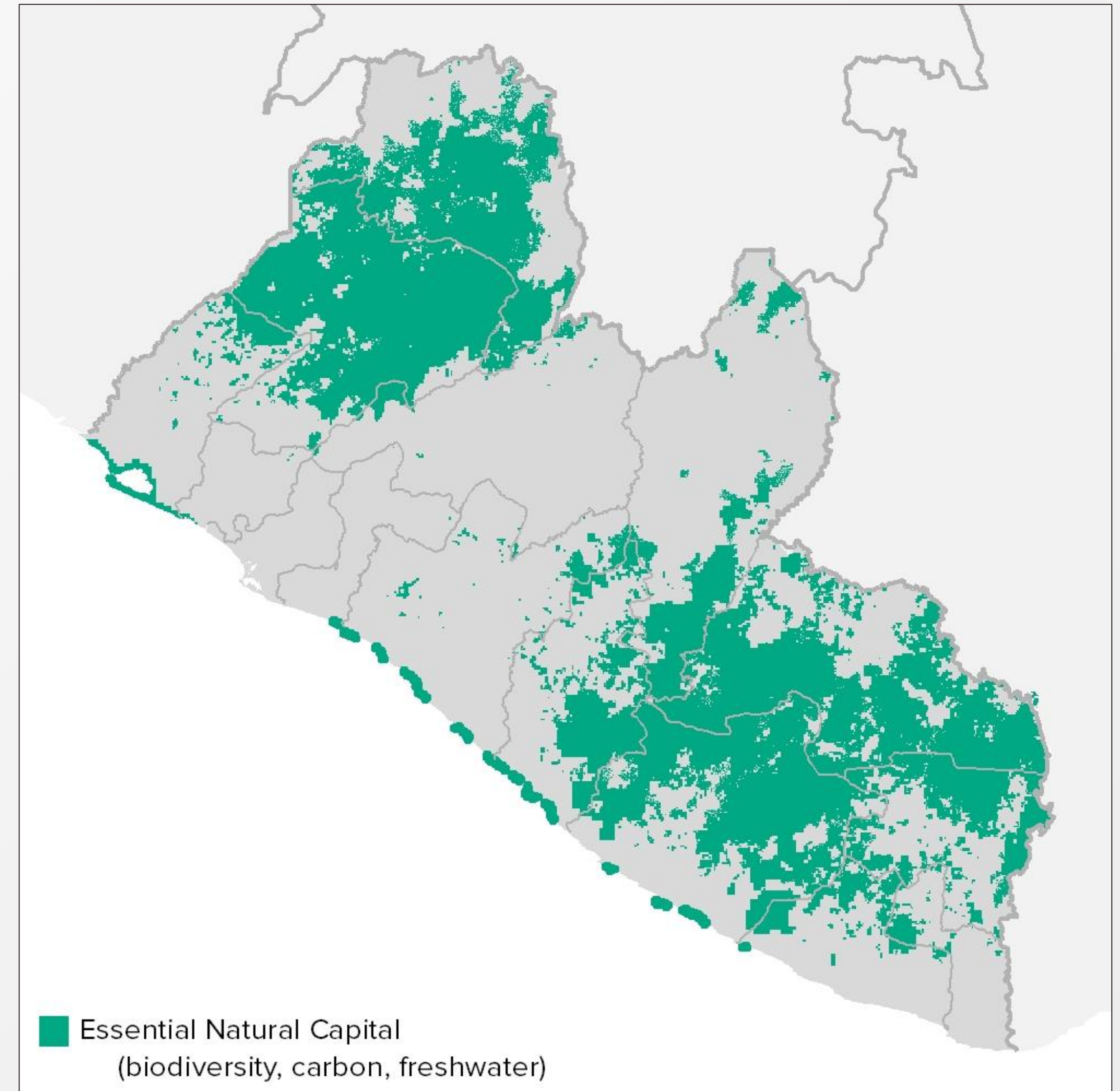
Monetary value of opening and closing stocks of all ecosystem assets



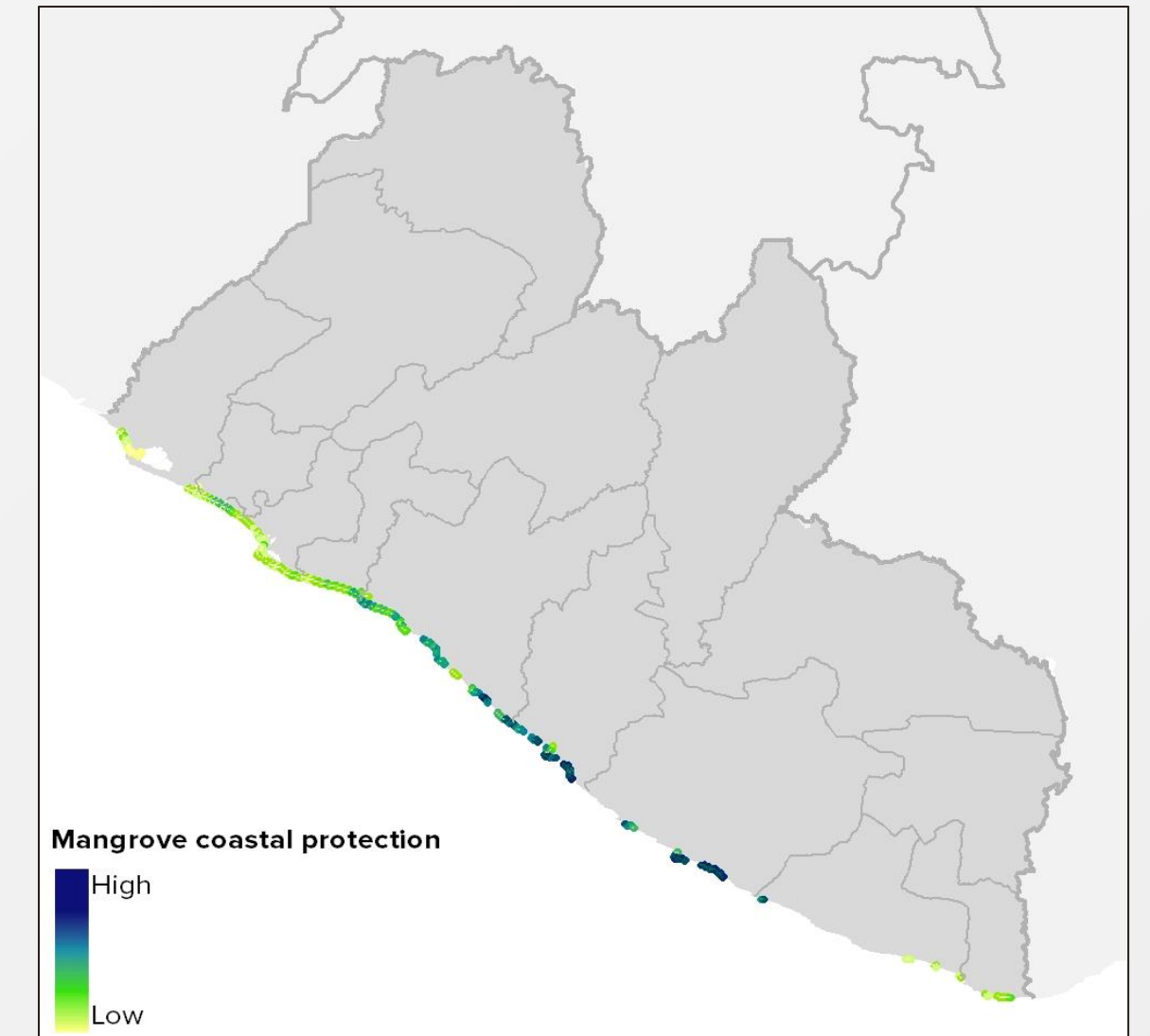
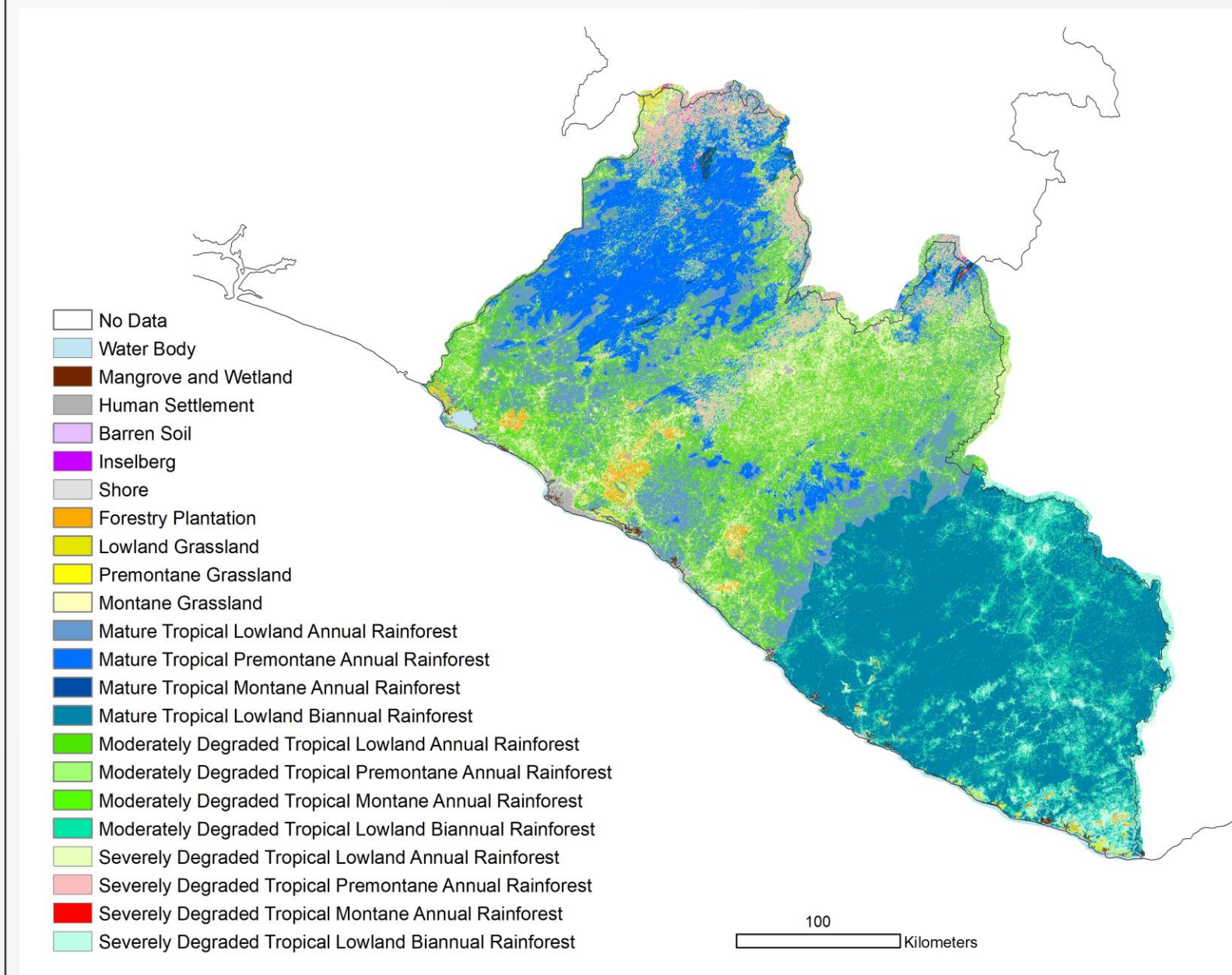
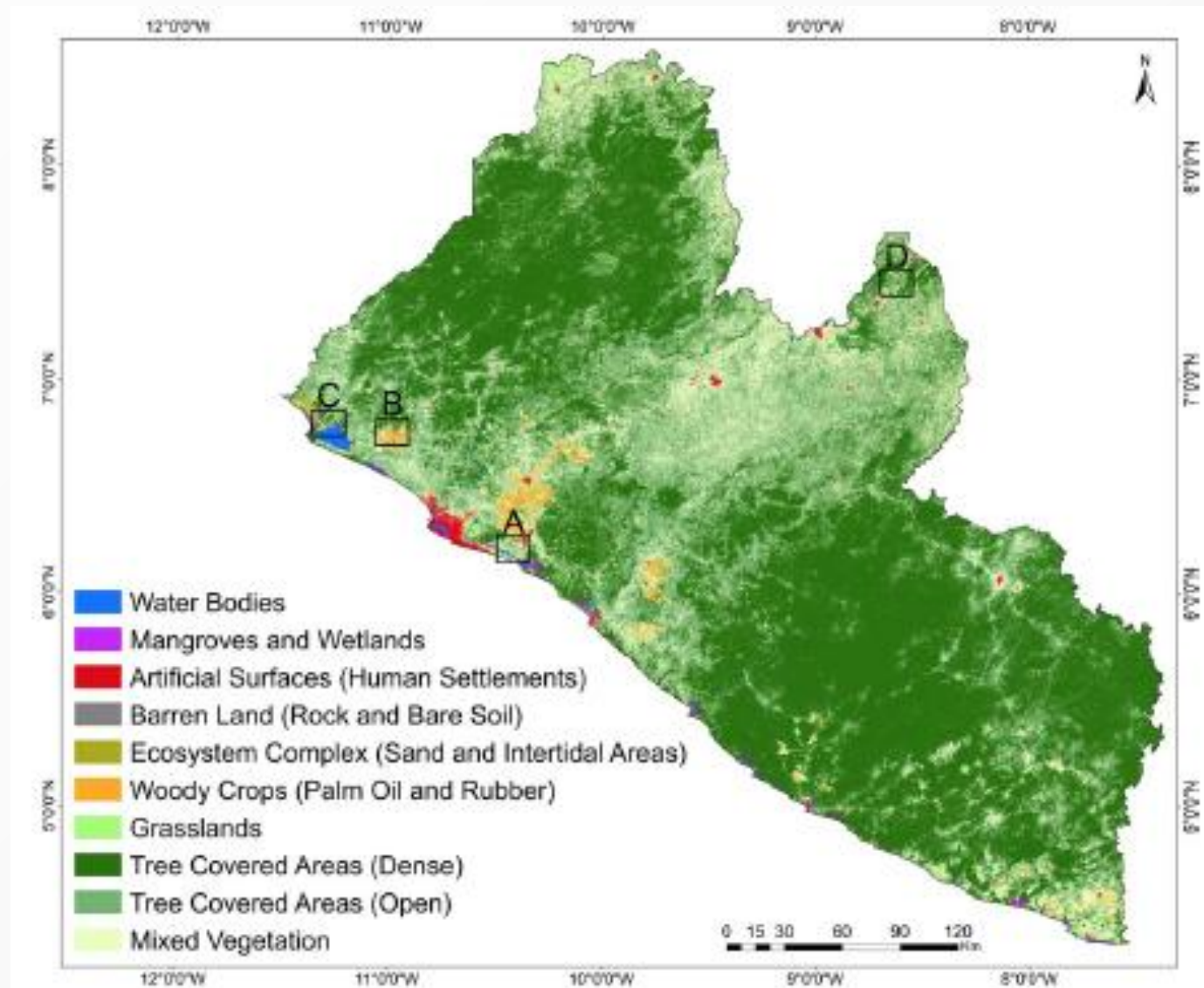
FROM ASSESSMENT: MEASURING ESSENTIAL NATURAL CAPITAL...

People's dependency on nature for food security, livelihoods, climate resilience

- Most essential natural capital still intact but mostly unprotected
- Multitude of management strategies for a more sustainable development
- Coarse national-scale priorities vs. finer scale data
- Need to measure nature's contribution to the economy



...TO ACCOUNTING: IMPLEMENTING ECOSYSTEM ACCOUNTING



Land Account

Ecosystem Extent

Ecosystem Services Account
(GEF-NCA Mangroves)



BETTER POLICIES AND DECISION- MAKING

- Greening Liberia's National Development Plan
- Climate mitigation
- Cross-sectoral planning and decision-making
- Supporting international commitments



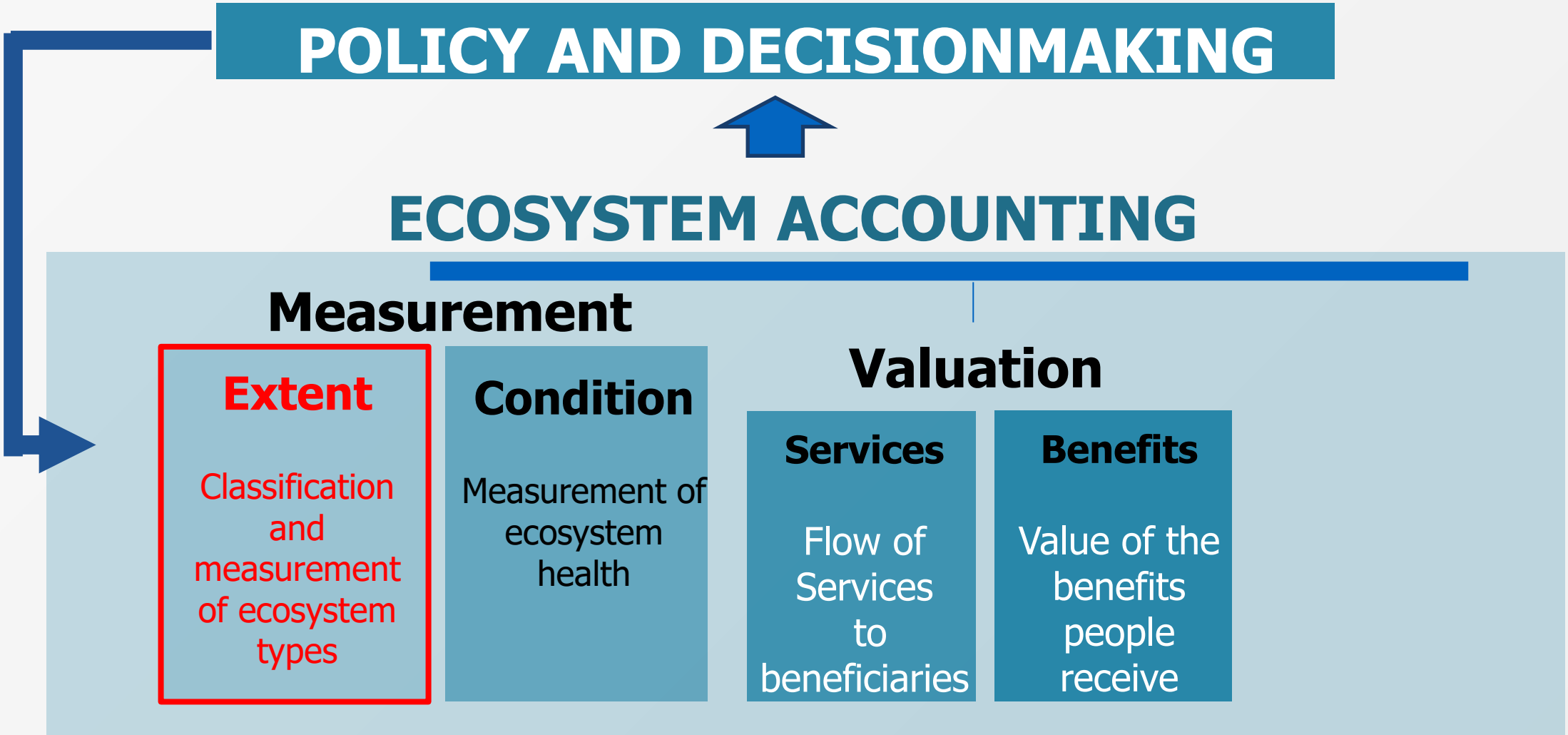


ECOSYSTEM EXTENT ACCOUNTS

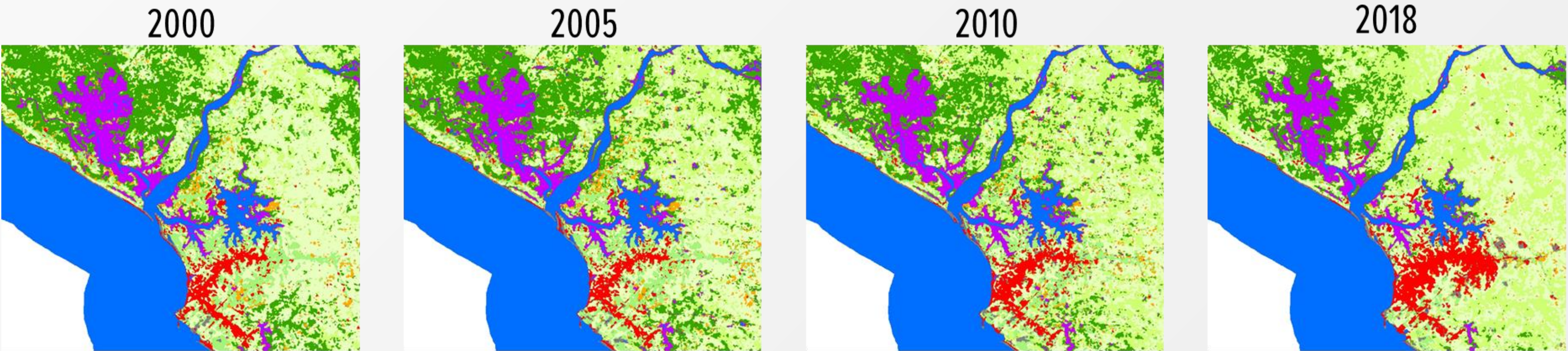
Miroslav Honzak

Sr. Science Director

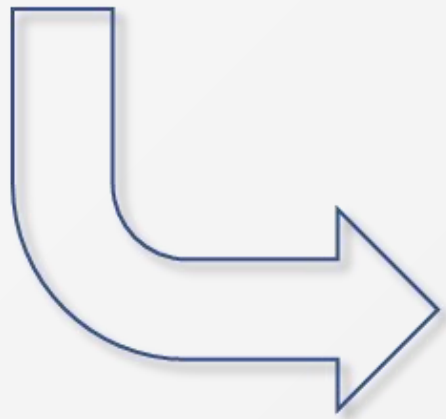
BACKGROUND TO EXTENT ACCOUNTING



STEP 1



STEP 2



| Year | Water bodies | Mangroves | Human settlements | Forestry plantations | Open areas | Other forest types |
|------|--------------|-----------|-------------------|----------------------|------------|--------------------|
| 2000 | Area (ha) | | | | | |
| 2005 | | | | | | |
| 2010 | | | | | | |
| 2018 | | | | | | |



WORKPLAN

1. Define ecosystem classes
2. Produce ecosystem extent map
3. Define Ecosystem Accounting Area (EAA)
4. Compile land and ecosystem extent accounts
5. Share data and capacity building



ECOS. CLASSES

The IUCN Global Ecosystem Typology v1.01: Descriptive profiles for Biomes and Ecosystem Functional Groups

David A. Keith, Jose R. Ferrer, Emily Nicholson, Melanie J. Bishop, Beth A. Polidoro, Eva Ramirez-Llodra, Mark G. Tozer, Jeanne L. Nel, Ralph Mac Nally, Edward J. Gregr, Kate E. Watermeyer, Franz Essl, Don Faber-Langendoen, Janet Franklin, Caroline E. R. Lehmann, Andres Etter, Dirk J. Roux, Jonathan S. Stark, Jessica A. Rowland, Neil A. Brummitt, Ulla C. Fernandez-Arcaya, Iain M. Suthers, Susan K. Wiser, Ian Donohue, Leland J. Jackson, R. Toby Pennington, Nathalie Pettorelli, Angela Andrade, Tytti Kontula, Arild Lindgaard, Teemu Tahvanainen, Aleks Terauds, Oscar Venter, James E. M. Watson, Michael A Chadwick, Nicholas J. Murray, Justin Moat, Patricio Pliscoff, Irene Zager, Richard T. Kingsford

Adapted from: 'Earth's ecosystems: a function-based typology for conservation and sustainable management'

| Realm | Biome | Ecosystem Functional Group (EFG) |
|-------------|---|--|
| Terrestrial | T1 Tropical-subtropical forests | T1.1Tropical-subtropical lowland rainforests |
| Terrestrial | T1 Tropical-subtropical forests | T1.2 Tropical-subtropical dry forests and scrubs |
| Terrestrial | T1 Tropical-subtropical forests | T1.3 Tropical-subtropi |
| Terrestrial | T1 Tropical-subtropical forests | T1.4 Tropical heath for |
| Terrestrial | T2 Temperate-boreal forests & woodlands | T2.1 Boreal and temperate woodlands |
| Terrestrial | T2 Temperate-boreal forests & woodlands | T2.2 Temperate decidu shrublands |
| Terrestrial | T2 Temperate-boreal forests & woodlands | T2.3 Oceanic temperate |
| Terrestrial | T2 Temperate-boreal forests & woodlands | T2.4 Warm temperate |
| Terrestrial | T2 Temperate-boreal forests & woodlands | T2.5 Temperate pyric h |
| Terrestrial | T2 Temperate-boreal forests & woodlands | T2.6 Temperate pyric s woodlands |
| Terrestrial | T3 Shrublands & shrubby woodlands | T3.1 Seasonally dry tro |
| Terrestrial | T3 Shrublands & shrubby woodlands | T3.2 Seasonally dry ten shrublands |
| Terrestrial | T3 Shrublands & shrubby woodlands | T3.3 Cool temperate he |
| Terrestrial | T3 Shrublands & shrubby woodlands | T3.4 Rocky pavements, |
| Terrestrial | T4 Savannas and grasslands | T4.1 Tropic savannas |
| Terrestrial | T4 Savannas and grasslands | T4.2 Pyric tussock sava |
| Terrestrial | T4 Savannas and grasslands | T4.3 Hummock savann |
| Terrestrial | T4 Savannas and grasslands | T4.4 Temperate woode |
| Terrestrial | T4 Savannas and grasslands | T4.5 Temperate grassla |
| Terrestrial | T5 Deserts and semi-deserts | T5.1 Semi-desert stepp |
| Terrestrial | T5 Deserts and semi-deserts | T5.2 Thorny deserts an |
| Terrestrial | T5 Deserts and semi-deserts | T5.3 Sclerophyll desert |
| Terrestrial | T5 Deserts and semi-deserts | T5.4 Cool temperate de |
| Terrestrial | T5 Deserts and semi-deserts | T5.5 Hyper-arid desert |
| Terrestrial | T6 Polar-alpine | T6.1 Ice sheets, glaciers snowfields |
| Terrestrial | T6 Polar-alpine | T6.2 Polar-alpine rocky |
| Terrestrial | T6 Polar-alpine | T6.3 Polar tundra |
| Terrestrial | T6 Polar-alpine | T6.4 Temperate alpine shrublands |
| Terrestrial | T6 Polar-alpine | T6.5 Tropical alpine m |

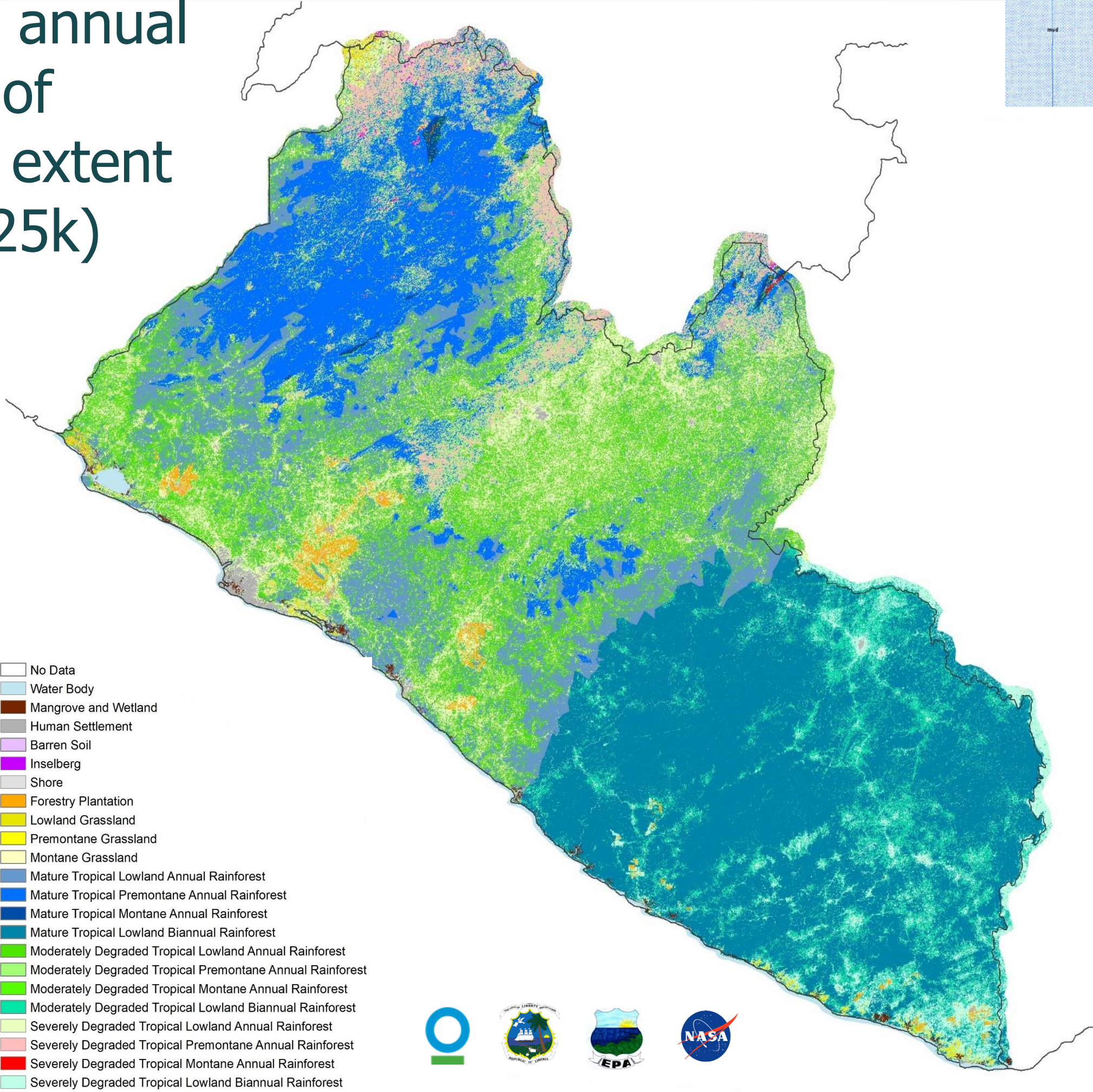
| Realm | Biome | Ecosystem Functional Group (EFG) |
|-------------------------------|--|--|
| Terrestrial | T7 Intensive land-use systems | T7.1 Croplands |
| Terrestrial | T7 Intensive land-use systems | T7.2 Sown pastures and old fields |
| Terrestrial | T7 Intensive land-use systems | T7.3 |
| Terrestrial | T7 Intensive land-use systems | T7.4 |
| Subterranean | S1 Subterranean lithic systems | S1.1 |
| Subterranean | S1 Subterranean lithic systems | S1.2 |
| Subterranean | S2 Anthropogenic subterranean voids | S2.1 |
| Subterranean-Freshwater | SF1 Subterranean freshwaters | SF1.1 |
| Subterranean-Freshwater | SF1 Subterranean freshwaters | SF1.1 |
| Subterranean-Freshwater | SF2 Anthropogenic subterranean freshwaters | SF2.1 |
| Subterranean-Marine | SM1 Tidal subterranean systems | SM3 |
| Freshwater-Terrestrial | TF1 Palustrine wetlands | TF1 |
| Freshwater-Terrestrial | TF1 Palustrine wetlands | TF1 |
| Freshwater-Terrestrial | TF1 Palustrine wetlands | TF1 |
| Freshwater-Terrestrial | TF1 Palustrine wetlands | TF1 |
| Freshwater-Terrestrial | TF1 Palustrine wetlands | TF1 |
| Freshwater | F1 Rivers and streams | F1.1 |
| Freshwater | F1 Rivers and streams | F1.2 |
| Freshwater | F1 Rivers and streams | F1.3 |
| Freshwater | F1 Rivers and streams | F1.4 |
| Freshwater | F1 Rivers and streams | F1.5 |
| Freshwater | F1 Rivers and streams | F1.6 |
| Freshwater | F2 Lakes | F2.1 |
| Freshwater | F2 Lakes | F2.2 |
| Freshwater | F2 Lakes | F2.3 |
| Freshwater | F2 Lakes | F2.4 |
| Freshwater | F2 Lakes | F2.5 |
| Freshwater | F2 Lakes | F2.6 |
| Freshwater | F2 Lakes | F2.7 |
| Freshwater | F2 Lakes | F2.8 |
| Freshwater | F2 Lakes | F2.9 |
| Marine-Terrestrial | MT3 Anthropogenic shorelines | MT3.1 Artificial shores |
| Marine-Freshwater-Terrestrial | MFT1 Brackish tidal systems | MFT 1.1 Coastal river deltas |
| Marine-Freshwater-Terrestrial | MFT1 Brackish tidal systems | MFT1.2 Intertidal forests and shrublands |
| Marine-Freshwater-Terrestrial | MFT1 Brackish tidal systems | MFT 1.3 Coastal saltmarshes |

| Realm (Level 1) | Biome (Level 2) | Ecosystem Functional Group (Level 3) | Liberian-Specific Coastal Ecosystem (Level 4) | Source Data/Method |
|-----------------|---------------------------------|--|---|--------------------------|
| Terrestrial | T1 Tropical-subtropical forests | T1.1 Tropical-subtropical lowland rainforest | Mature Tropical Lowland Annual Rainforest | NASA map |
| | | | Mature Tropical Lowland Biannual Rainforest | NASA map |
| | T7 Intensive land-use | T7.3 Plantations | Plantation | NASA map |
| | | | Built-up Area | NASA map |
| | | T7.4 Urban and industrial ecosystems | Barren Land | NASA map |
| Freshwater | F1 Rivers and streams | F1.2 Permanent lowland rivers | Rivers | NASA map/Global GIS data |
| | | | Lakes | NASA map/Global GIS data |
| | F2 Lakes | F1.2 Large permanent freshwater lakes | | |
| | F3 Artificial fresh waters | F3.1 Large reservoirs | Reservoirs | NASA map/Global GIS data |
| | | | | |



DATA WE HAVE

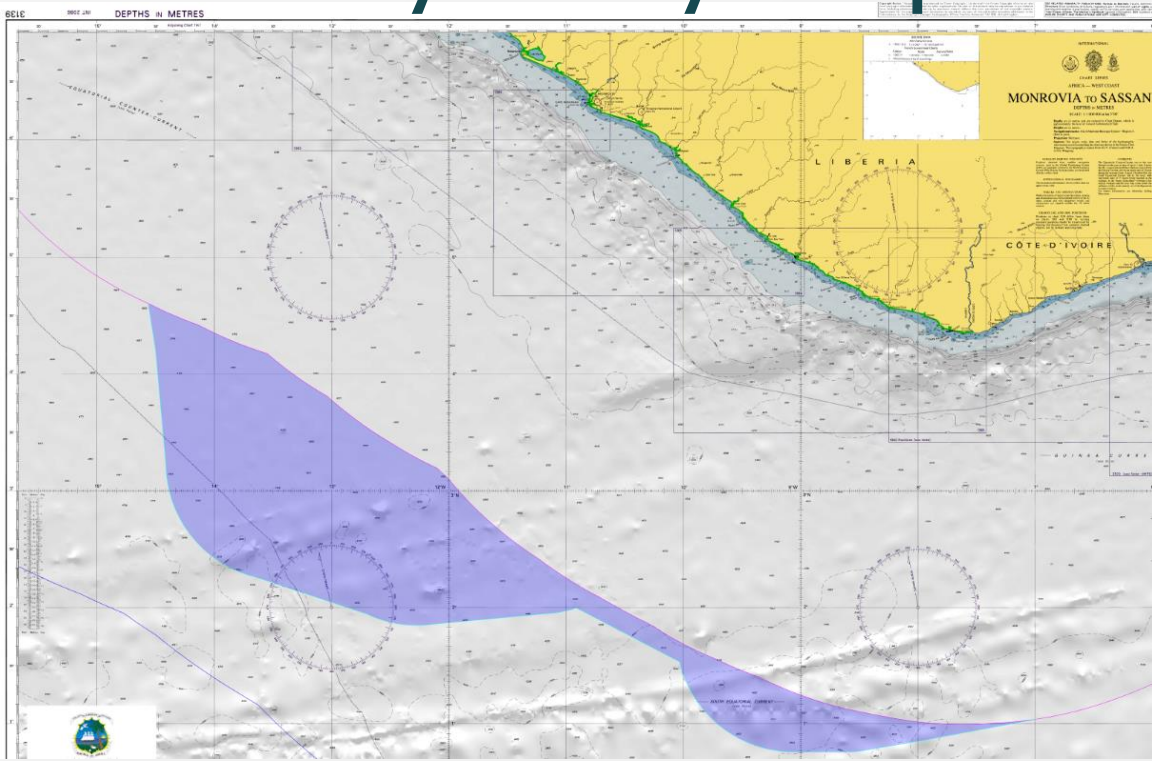
CI-NASA Partnership
2000-2018 annual
timeseries of
ecosystem extent
maps (1:125k)



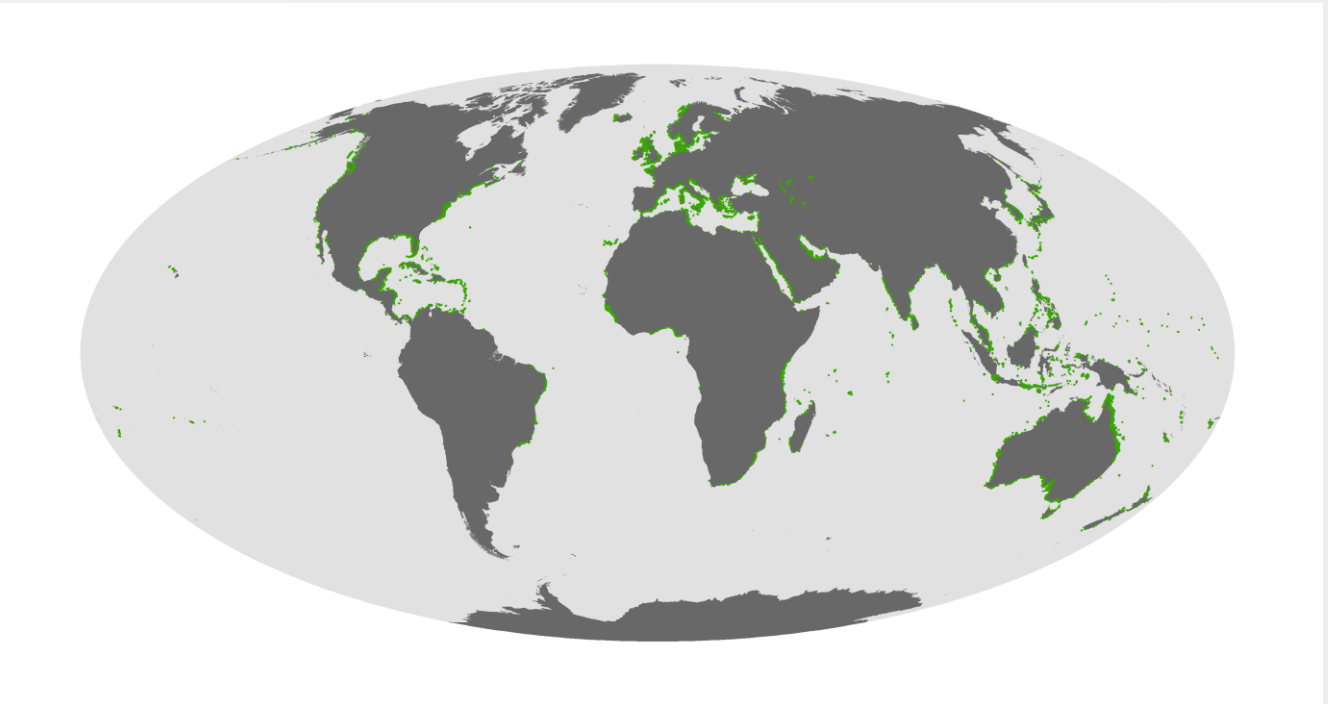
Topographic map (1:250k)



Bathymetry map



Global maps



OUTSTANDING ISSUES

Finalize selection of ecosystem classes (e.g., which classes to keep vs. drop)

- Land use maps (e.g., agricultural, aquacultural, residential, recreational, commercial)
- Ground observation data (e.g., forest inventory data, georeferenced photos)

Define EAA (e.g., environmental vs. administrative vs. ecological boundary)

- Acquire accurate coastline and national boundary produced at 1:100k scale or better

Environmental:
Average annual
temperature

Annual average temp. (pink) and 12NM EEZ boundary (blue)

Administrative
Districts-1

District boundaries adjacent to shore (yellow) and 12NM EEZ boundary (blue)



DISCUSSION QUESTIONS

Finalizing ecosystem classes

- What criteria should we use to finalize the selection of ecosystem classes to determine which classes should be retained vs. dropped?
- Who can facilitate an access to relevant data/mapping products (e.g., land use maps, ground truth, forest inventory data)?

Finalizing boundary of Ecosystem Accounting Area

- Is there a formal definition or existing boundary for the coastal area of Liberia to be used for ecosystem accounting (i.e., EAA)?
- If not, how do we define one (e.g., environmental vs. administrative vs. ecological)?
- Who can facilitate an access to relevant data/mapping products (e.g., digitized coastline and national boundary at 1:100k or better, 1:50k map sheets)?





ECOSYSTEM CONDITION ACCOUNTS

Timothy "Max" Wright

Director, Spatial Planning

BACKGROUND

- Ecosystem condition is the quality of an ecosystem measured in terms of its abiotic and biotics characteristics
- Ecosystem condition is assessed with respect to ecosystem structure, function, and composition which, in turn, underpin the ecological integrity of the ecosystem, and support its capacity to deliver ecosystem services
- The goal of the condition accounts is to assess the state of ecosystem based on characteristics that are both dynamic and quantifiable



WORKPLAN

- Identify important coastal ecosystems in Liberia
- Develop the Ecosystem Condition Typology (ECT) and condition variable

| ECT Group | ECT Classes | Ecosystem Characteristics - Mangroves |
|---------------------------|---------------------------|--|
| Abiotic Characteristics | Physical state | Sedimentation rate, Plastics |
| | Chemical state | Salinity, Heavy metals, Soil organic carbon |
| Biotic Characteristics | Compositional state | Biodiversity, Species composition |
| | Structural state | Canopy height, NDVI, Age diversity |
| | Functional state | n/a |
| Landscape Characteristics | Landscape characteristics | Migration potential, Patch size, Fragmentation |

- Determine method for identifying the reference condition and reference levels
- Collect earth observation (EO) and field data for selected condition variables
- Develop condition indicators from condition variables and reference levels
- Create condition indices that are relevant for policy and decision-making



DATA NEEDS

- Quantifying the condition variables will require a combination of EO-derived and field data
- EO data could be used to stratify and target field data collection
- Some variables may require inter-annual monitoring as dynamics can shift (ex. wet season vs dry season)

| Ecosystem Characteristics | Ecosystem Variables | Data type | Data collection methods |
|---------------------------|--|----------------|--------------------------------|
| Sedimentation rate | mm of sediment accumulated per year | Field survey | Field measurement |
| Plastics | oz plastics per ha | Field Survey | Survey |
| Salinity | Parts per thousands of dissolved salt | Field survey | Field measurement |
| Heavy metals | Parts per million of lead and mercury | Field survey | Field measurement |
| Soil organic carbon | Tons per hectare of carbon | Field survey | Sediment core |
| Biodiversity | Abundance of indicator species (mollusks, crabs, coastal birds...) | Field survey | Field measurement |
| Species composition | Species diversity (vegetation, marine) | Field survey | Survey, eDNA? |
| Canopy height | Canopy height (m) | Remote sensing | Lola's dataset, UMD datasets |
| NDVI | Maximum annual NDVI | Remote sensing | GEE |
| NDVI | Annual difference NDVI | Remote sensing | GEE |
| Age diversity | Vertical structure (unit unknown) | Remote sensing | GEDI, ask Lola |
| Age diversity | Age profiles | Field Survey | Field measurement |
| Migration potential | Meters of migration potential without obstruction | Remote sensing | DEM, Land-cover map |
| Patch Size | Patch size (ha) | Remote sensing | Landcover map |
| Fragmentation | Fragstats (clumpy, perimeter-edge ratio, | Remote sensing | Landcover, Fragstats R package |



OUTSTANDING ISSUES

- Identify other relevant coastal ecosystems to include in the account (from extent)
- Survey that existing data that has been collected, particularly within mangroves, and assess how it could be used to support condition accounting
- Determine the most appropriate institutions to lead future data collection and account creation
- Identify “pristine” sites for determining reference condition and reference levels



DISCUSSION QUESTIONS

- Who would be the best person or institution to review the ecosystem condition typology and condition variables for mangroves?
- Where are good field sites for determining reference condition?
- Which other coastal ecosystems should be considered for developing condition accounts?





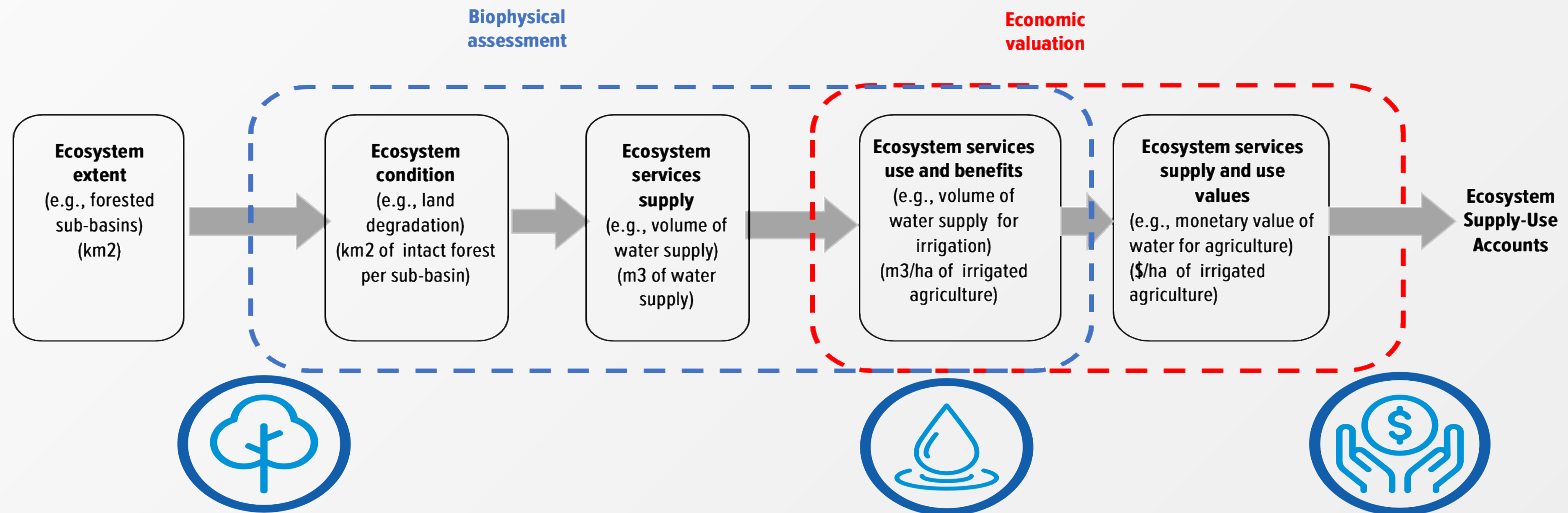
ECOSYSTEM SERVICES ACCOUNTS

Mahbubul Alam

Research Economist

BACKGROUND

- Ecosystem services account connects the ecosystem assets that produce benefits, with consumers of those benefits: households, businesses, governments
- The account identifies the sources of services in a spatially explicit way, measures them in biophysical and monetary terms and finally reports in a supply-use table



WORKPLAN

5-points plan:

- (1) **Selection of ecosystem services** based on priority, relevance, data;
- (2) **Assessment of data** for development of methods for each service;
- (3) Implementation of **biophysical modeling** of each service;
- (4) Implementation of **monetary valuation**;
- (5) Development of biophysical and monetary **supply-use tables**;

Additional analysis: Identifying and implementing **post-accounting policy applications** for specific intervention



DATA NEEDS

Principal data sources

- **Existing databases** housed in different agencies (e.g. HIES survey, forest inventory)
- **Household surveys:** e.g. demographic info, consumption of fish, bushmeat (kg/day), firewood (kg/year), timber (m3/year), water (m3/day), NWFP etc.
- **Market surveys:** e.g types of bushmeat and fish species sold, unit price of products (e.g. \$/m3 timber, \$/kg fish etc.), seasonal variation of products sold

| | | Biophysical modeling | | | Economic valuation | | |
|--------------|-------------------------------|---|---|--|--|---------------|--|
| | | Method | Model | Data needs | Method | Models | Data needs |
| PROVISIONING | Biomass provisioning services | Crop provisioning services | map extent of major crop areas -> estimate yield/ha and multiply with extent | Spatial: mapping crop area; biophysical: estimating total production Ag map, yield data | Calculate ag rent/ha, multiply total area | Resource rent | Total yield (from bio analysis), product price, input costs |
| | | Timber provisioning services | Map concession areas (TSC, FMC) -> calculate harvest rates (m3/ha) | Spatial: mapping concession areas; biophysical: estimating total harvest Concession maps, harvest volume | Calculate resource rent per concession types, multiply by timber volume | Resource rent | Harvest volume, sales price, input costs |
| | | Non-wood forest products (NWFP) | select nwfp (e.g. wild food) -> estimate consumption -> map supply areas | biophysical: quantifying nwfp consumption/household; mapping: allocation of supply consumption data from household surveys | demand side: multiply consumption by unit price | Shadow price | total consumption, market price of similar products |
| | | Wild animals, plants and other biomass provisioning services (incl. those related to hunting and trapping and bio-prospecting activities) | Focus on bushmeat -> identify species types -> estimate per capita consumption (households, restaurants) | households consumption, restaurants consumption, species types, hotspots map | multiply total consumption (tons) per households by market price of bushmeat | Market price | # households harvesting, restaurant consumption data, market price, hunting cost |
| | | Fish and other aquatic products provisioning services | Identify/map catch areas -> estimate total catch from govt stats -> allocate total catch to fishing spots | spatial: map location of coastal catch areas; biophysical: estimate total catch number of fisherment, total catch, consumption per hh | multiply total catch by unit price of fisheries products | Market price | total fish harvest, market price, cost of catch |



OUTSTANDING ISSUES

Key issues that will determine modeling of individual services:

- **Benefits:** for each services what are the key corresponding benefits e.g., what species of fish is being fished and have nurseries in mangroves, what species of mangroves are used for what?
- **Beneficiaries:** Who are the different beneficiaries for different services (e.g., fish for subsistence by households)?
- **Location:** Where are the locations of services (e.g., where are the fishing grounds and nurseries, where the water comes from)?



DISCUSSION QUESTIONS

- What are some of the most important ecosystem services provided by coastal ecosystems in Liberia?
- How important is water supply services in coastal areas and what role mangroves play in water supply and erosion control?
- What are the key agricultural crops in coastal areas that should be measured as part of food security services?





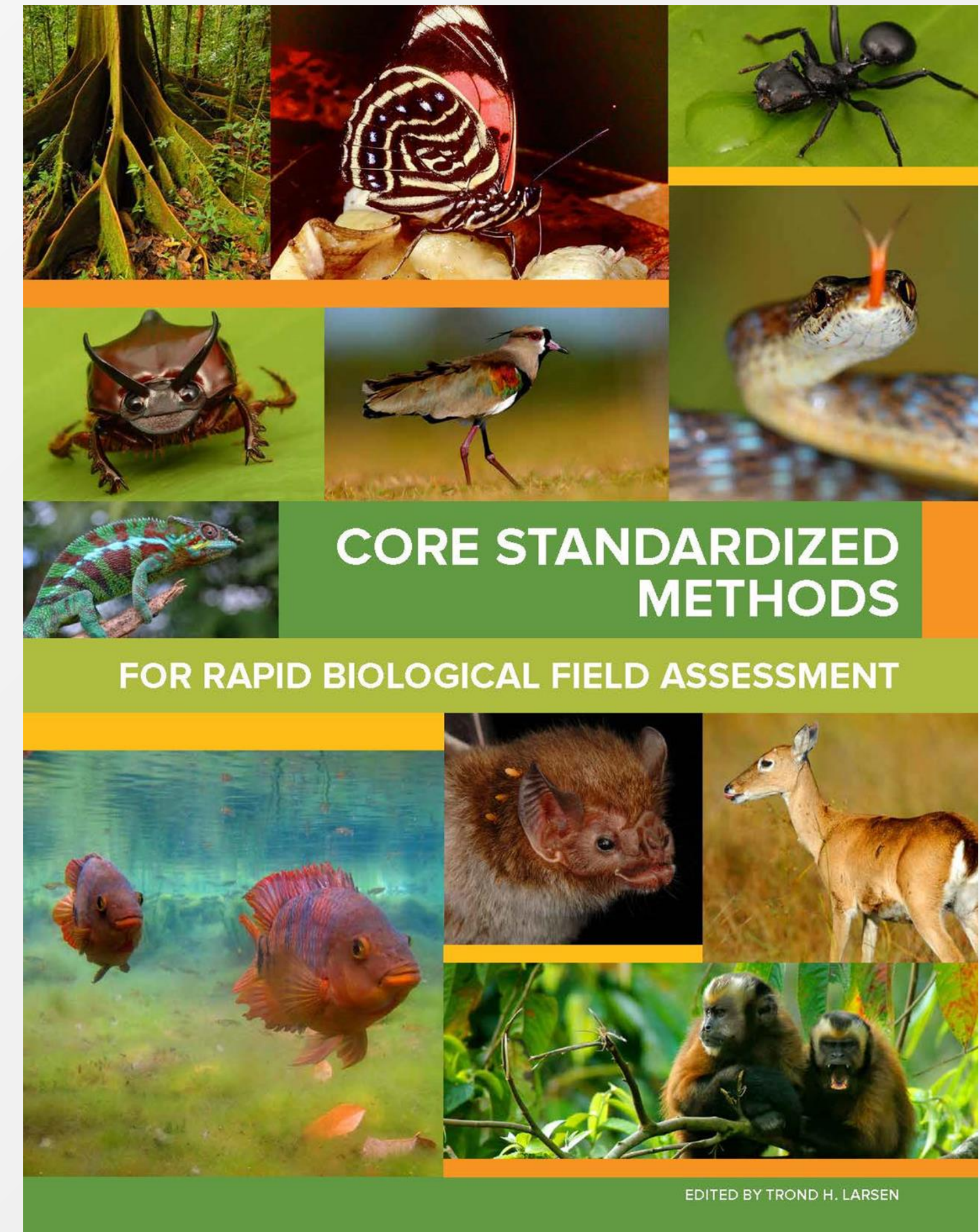
NCA FIELDWORK AND ECOLOGICAL ASSESSMENT

Trond Larsen

Director, RAP

BACKGROUND

- Natural capital accounting requires up to date data across a range of ecosystem types and disturbance regimes to inform extent, condition, services and biodiversity accounts
- Fieldwork needed to fill knowledge gaps; RAP is a mobile, flexible and cost-effective tool
- Integrated, innovative and standardized methods



WORKPLAN

- Identify coastal ecosystem types to survey
- Prioritize which biophysical and socioeconomic data to measure
- Select field survey sites
- Assemble RAP science team and prepare field logistics
- Determine survey methodology
- Conduct field surveys
- Data analysis and synthesis, incorporate data into relevant accounts



DATA NEEDS

- Ground-truthing and calibration of ecosystem types for extent account
- Measure abiotic and biotic characteristics for condition and thematic biodiversity account
 - Sedimentation rate, salinity, heavy metals (sediment cores), soil organic carbon, plastics, canopy height/vegetation structure, biodiversity (key functional and/or indicator groups, e.g, birds, fishes, molluscs, crustaceans, plants; eDNA?)
- Household surveys to measure demographic info, fish and bushmeat consumption, firewood, timber, water, NTFPs, etc.
- Market surveys of bushmeat and fish species, unit price, etc.



OUTSTANDING ISSUES


- Ideally will assemble team of Liberian and international scientists, but COVID travel restrictions impact timing
- Difficult to survey every ecosystem type, especially with replicates, but mangroves and other coastal ecosystems are highly heterogeneous
- Need to optimize selection of field sites to balance as broad coverage as possible at national scale but also feasible in terms of time and resources, as well as accessibility
- Some data can be collected rapidly and only once, while other data require repeated field visits/long-term monitoring



DISCUSSION QUESTIONS

- What are highest priority coastal ecosystem types to survey, and can we capture these within three general survey areas?
- If we select three survey areas, where should they be along the coast? Should we target places with existing studies and data, or entirely new sites?
- Who are the most appropriate field biologists/social scientists to conduct the surveys?



A scenic view of a mangrove forest. In the foreground, a large, dense green tree stands on the left, its branches extending over a body of water. The water reflects the sky and the surrounding greenery. In the background, more trees line the shore under a blue sky with scattered white clouds.

OPEN FLOOR

Q & A

GENERAL DISCUSSION

- What do you envision the role of technical advisory committee should be for successful implementation of the NCA project?
- Where do you see synergies with other ongoing projects led by your agency?
- What management and statistical systems are in use in Liberia and what are data sharing policies? Who is managing the system?
- Who will be the data custodian and who will be trained in ecosystem extent accounting?





NEXT STEPS & CLOSING REMARKS

THANK YOU!

