CongoPeat

NEWSLETTER #5
MARCH 2021

Editorial

by S Lewis, University of Leeds

While Covid-19 still disrupts life and work, the impressive pace of discovery of the CongoPeat team continues unabated. Fieldwork in Ekolongouma continues, which in March 2021 completes two years of monthly field measurements. Fieldwork finishes there in April after a wrap-up short trip to tidy the camp and bring any non-biodegradable material out of the peatland. Then we hope that Jonay Jovani Sancho (U of Nottingham) and Selena Georgiou (U of Edinburgh) will be back there in August, Covid permitting. In both RoC and DRC wet season fieldwork was completed, an impressive feat given the water table levels. Thanks to everyone for their hard work in the field. The successful linking of data from fieldwork to models makes CongoPeat such a unique project.

Welcome to new CongoPeat PhD student Shona Jenkins (U of Edinburgh). As a social scientist, Shona opens up an extremely exciting new stage of the project. Her PhD title is "Assessing human uses of the central Congo Basin peatlands." Also welcome to new CongoPeat associate PhD student Charlie Hackforth (University College London), bringing another new direction. His PhD is to study the pollinator insects of the peatlands.

Lastly, CongoPeat project assistant Helen Plante is temporarily leaving us from 24 May - 13 Sep to go on maternity leave. I'm sure we all wish Helen and her family all the best. Requests that would have gone to Helen after 24 May, please send to me, when I will then be far less efficient at answering them!

FAO/GPI mapping workshop

by G Dargie, University of Leeds

On 1 Feb 2021, Greta Dargie and Simon Lewis took part in the first of four webinars in the "Peatland mapping: workshop for national stakeholders" virtual training series organised by the Food and Agriculture Organization of the United Nations (FAO). The virtual training is part of the Global Peatland Initiative's "Assessing, Measuring and Preserving Carbon from Peatlands" project. The workshops aim to introduce stakeholders in the DRC, RoC and Peru to the process of peatland mapping and will be accompanied by an on the ground field workshop in the DRC (location to be confirmed) for Congolese stakeholders. Greta and Simon presented the previous and current mapping efforts in the Cuvette Centrale region of CongoPeat members.

NEXT PROJECT MEETING ONLINE:

10 -13 May 2021
Agenda items: please send to admin@congopeat.net

CONTENTS:

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A rare and unique experimental facility in the Congo Basin

by S Averti Ifo, Marien N'GOUABI University

A research visit was undertaken to the Congolese peatlands in January 2021 by Ifo Suspense Averti, Co-Investigator on the CongoPeat project. The objectives were as follows: (i) review fieldwork being undertaken by two PhD students of Marien N'GOUABI University (Ms Mackline Mbemba and Mr Wenina Emmanuel Mampouya); (ii) identify future scientific opportunities.

The CongoPeat project confirmed the existence of a vast, unique peatland complex in the Congo Basin (Dargie et al. 2017). In an extremely remote part of the ecosystem, experimental (GEM) plots have been set up to collect a diverse range of ecological and environmental data. A rich scientific dataset is being compiled that will enable better prediction of the impact of future climate change on the overall functioning of the ecosystem. An autonomous weather station has been set up to collect unique weather data throughout this very wild area.

Autonomous weather station in Likouala Department, RoC. Credit: Suspense Averti Ifo

Explaining importance of quantifying heterotrophic respiration in the soil carbon budget. Credit: Suspense Averti Ifo

Soil respiration measurements have also been taken for nearly two years. Combined with measures of heterotrophic respiration, they will make it possible to better quantify net carbon sequestration in the soil.

At the end of this research visit, it is important to state what an opportunity it is for the Republic of Congo to have such a rare and unique experimental facility in the Congo Basin.

I urge the research community far and wide to work together on finding the funds that will make it possible to maintain the equipment on site and continue data collection over an extended period of time. This will give us a better understanding of future interactions between this ecosystem and the environment.

ECR update

by G Dargie, University of Leeds

The ECR collaborative review paper entitled “A research agenda for the Cuvette Centrale peatland complex” has been submitted for review in *Bois et Forêts des Tropiques*, and the group awaits the outcome.

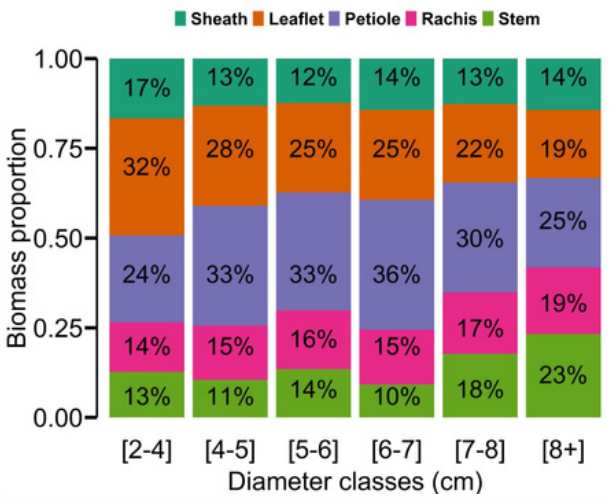
The next ECR meeting will take place the week before the main CongoPeat meeting on the 7th May, 2-4 pm BST. The meeting will be held virtually on Zoom.

Allometric equation to estimate *Raphia laurentii* biomass

by Y Bocko, Marien N'GOUABI University

Two forest types are found in the forested peatlands of the Cuvette Centrale: one dominated by trees (dicots) and one dominated by *Raphia laurentii* De Willd. palms (monocots). We are currently able to estimate tree biomass, but not the biomass of *Raphia laurentii*. However, *Raphia laurentii* cover a vast area of the Cuvette Centrale peatlands. For this reason, the CongoPeat project funded work to construct an allometric equation which is essential for *Raphia laurentii* biomass estimation in the Congo Basin. Ninety individuals were felled, split into six classes according to the mean diameter of the palm fronds. The physical parameters selected were as follows: diameter at the base of the Raphia, total diameter of the palm fronds, mean diameter of the palm fronds, number of palm fronds and total height of the Raphia. Data analysis has shown that biomass distribution between the different palm frond compartments (sheath, petiole, rachis and leaflets) and the stem seems to be consistent between different diameter classes. The biomass of the palm fronds is greater than the biomass of the stem.

Statistical analysis of the data has revealed that the total diameter of the palm fronds is the best predictor of biomass for *Raphia laurentii* for models with a single predictor. However, adding in total height and wood density improves biomass estimation for *Raphia laurentii*.



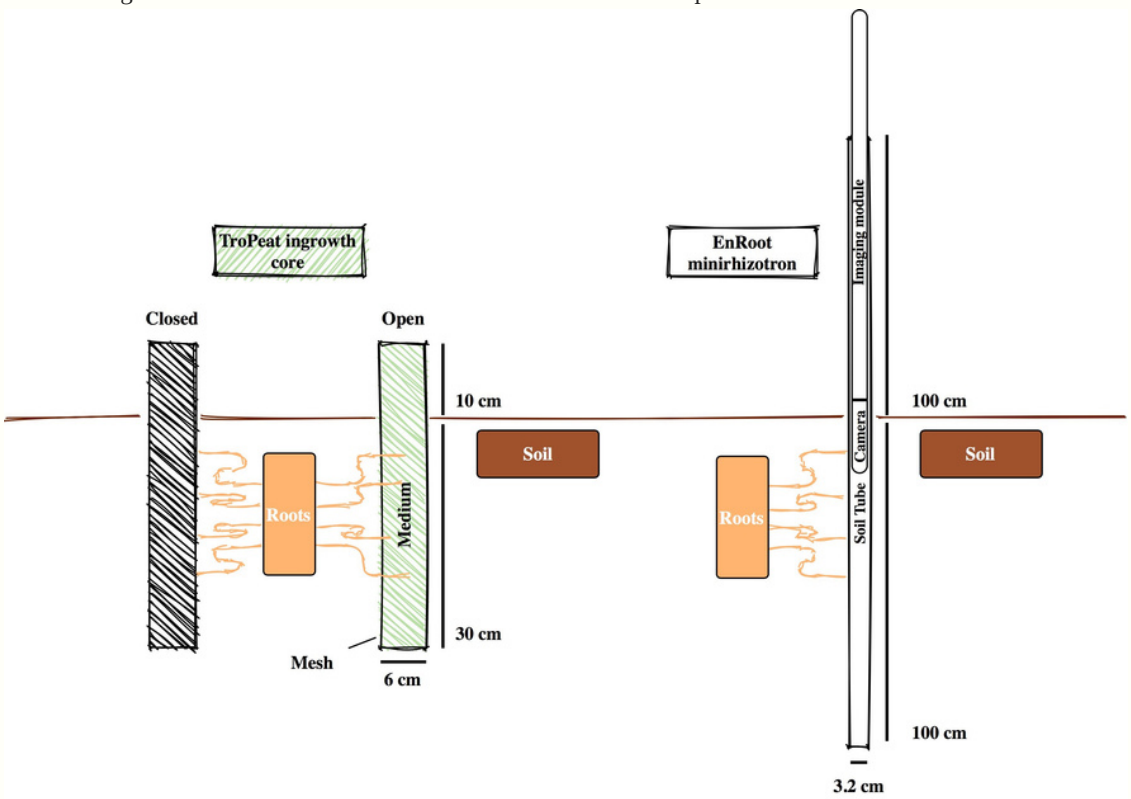
Biomass distribution

Fine root production in the peatlands of the Congo Basin

by M Sciumbata, Vrije Universiteit Amsterdam

Root production measurements in peatland are hampered by high water tables and intricate superficial root mats. As part of my MSc thesis, I estimated fine root production in the tropical peatlands of the Congo Basin by implementing two new methodologies: a modified (TroPeat) ingrowth core and the EnRoot minirhizotron. Plots were distributed in two types of swamp forest (hardwood and palm dominated) and one *terra firme* rainforest, in the area close to Ekolongouma, Republic of Congo. The data collection was carried out monthly between March and June 2020. The TroPeat is composed of paired pipes, filled with homogenised root-free peat, that block or let new roots grow inside. The EnRoot allows monitoring fine root length changes via an endoscope camera inserted in clear tubes positioned in the soil. The TroPeat and EnRoot methodologies yielded similar measurements that are comparable with other tropical forests. However, the minirhizotron tended to have slightly higher estimates compared to the ingrowth core. Fine root production did not differ across plots, and more than 90 % of fine root production was found in the upper 30 cm of soil. Although

both methods are robust, the minirhizotron is a better option since it is less destructive, estimates root production at greater depths than the ingrowth core and allows root measurements during floods. As the first root production evaluation for the central Congo peatlands, this study improves our knowledge of the carbon fluxes in one of the world's most carbon-dense ecosystems. Ongoing fine root production data is being collected to give seasonal estimates and improved annual estimates.



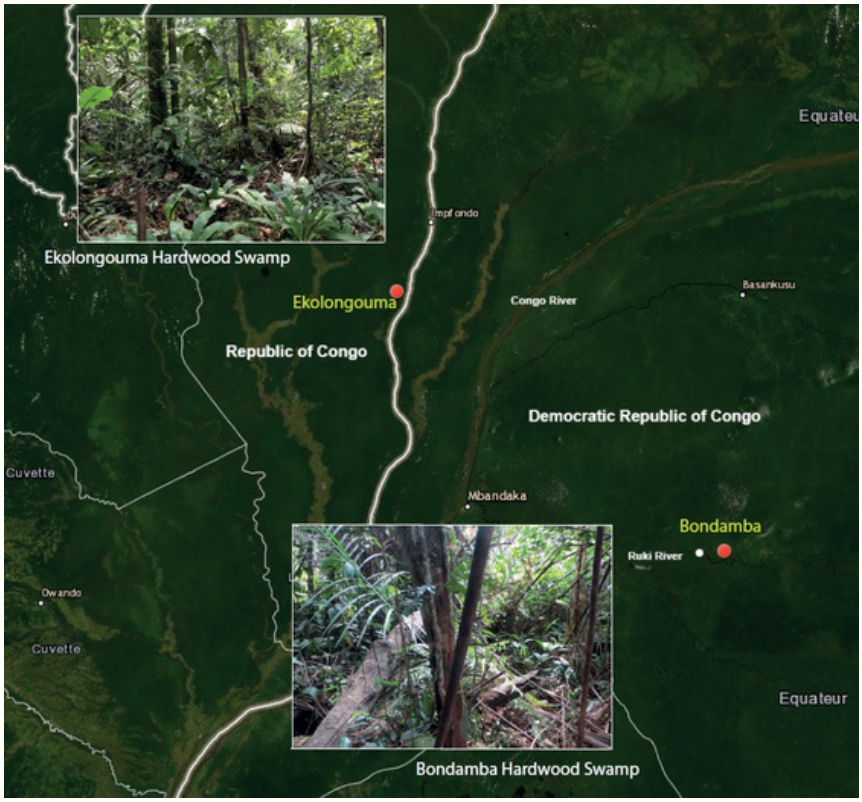
Sketch portraying the TroPeat ingrowth core and the EnRoot minirhizotron methodologies and their primary components. The medium used for the ingrowth core is homogenised peat from layers below the root mat.

DigiBog_Congo update

by D Young, University of Leeds

Developing and testing DigiBog_Congo has focussed on two aspects. First, using reconstructed climate inputs we have been testing the sensitivity of the model to different combinations of reductions in net rainfall (precipitation minus evapotranspiration) and the duration of the reductions. DigiBog_Congo currently uses the litter addition functions from HPMTrop. These functions combined with high rates of oxic decay (also from HPMTrop) mean that although peat accumulates rapidly when the peatland surface is inundated, it is also lost quickly when exposed to oxic conditions even if the annual average net rainfall is the same as the modern (800 mm year-1). As a result, we see that peat accumulation is sensitive to both net rainfall seasonality and surface-water storage. We therefore need to understand the mechanisms of water losses from evapotranspiration and water storage on the peatland's surface and how these can be represented in the model.

We've also been working on adding to the model a belowground root litter function, which is now nearing completion and in testing. In the original version of DigiBog, all new plant litter is added to a peatland's surface, but for CongoPeat we wish to add some of the root litter down the peat profile. There are four stages to the new function; 1) calculate the rooting depth; 2) identify the peat layers within the rooting depth; 3) distribute the new litter amongst the layers; and 4) recalculate the mass of the layers accounting for the new root litter. Once this function has been tested, a hardwood plant functional type will be added based on data from the GEM plots.



Map showing location of peat cores taken in Bondamba, DRC and Ekolongouma, RoC. Top left picture, Ekolongouma hardwood swamp Credit: Donna Hawthorne Bottom centre picture, Bondamba hardwood swamp Credit: Bart Crezee

Palaeo-environmental update

by D Hawthorne, University of St Andrews

Work has continued on the central peat core from Bondamba, DRC. The palynological analysis is largely complete and gives insights into vegetation changes over time in a new study area of the Congo Basin. The vegetation composition at Bondamba, particularly during the period of peat initiation, appears to contrast with the record from the previously studied central core near Ekolongouma, and possibly indicates different site conditions during the time of peat formation. Radiocarbon dating from the base of the core at Bondamba suggests it is similar in age to the central core at Ekolongouma (c. 17,000 years old – much older than the dates reported in Dargie et al., 2017). More radiocarbon dates have been submitted from this core and we await the results. Macroscopic and microscopic charcoal analysis on the Bondamba core is also complete and will give insights into the level of fire activity in the landscape in the past. Work has also progressed with the testate amoebae analysis and an assessment was conducted on selected core samples, however the results show that the preservation and diversity of taxa at Bondamba is poor. Additional analyses on this core are also underway at U of Leicester and U of Nottingham to provide isotopic and inorganic geochemistry data.

These and further laboratory preparations and additional analyses on the Bondamba core and two planned future study sites have been significantly impacted by the ongoing Covid restrictions. Two new central peat cores remain in cold storage in the UK and await analysis once labs reopen. This laboratory downtime has however allowed focus to be shifted to microscope work, data analysis and manuscript preparations. A draft manuscript for the palaeoecological work on the central core at Ekolongouma has been prepared and will be circulated to co-authors soon for comment. The manuscript details how this area of peatland likely initiated and developed over time, and how the vegetation cover responded to disturbances in the past such as fire and climate changes.

PhD student George Biddulph has completed the majority of his analyses on the spatial cores at Ekolongouma, RoC, including pollen, geochemistry and sedimentary analyses. Upon the reopening of labs, material for radiocarbon dating will be sent to the SUERC Radiocarbon Laboratory to help contextualise the palaeoecological information obtained from these cores. George has also begun work on the spatial cores at Bondamba, DRC, as well as modern surface samples from across the Cuvette Centrale. Analysis of pollen rain from surface samples from different environmental settings across the region will help strengthen our interpretation of palaeoecological information obtained from the palaeo cores taken from these peatlands.

Gas sampling from stems (left) and from peat (right)
Credit: Ovide Emba

DRC peatlands: first wet season greenhouse gas measurements

by O Emba & P Bola, ISP-Mbandaka

In October 2020, the local CongoPeat field team in Mbandaka, Ovide Emba and Pierre Bola, from ISP-Mbandaka, led a scientific expedition to collect wet season greenhouse gas (GHG) data in the Democratic Republic of Congo's peatlands in Équateur province. This followed on from their work in September to complete the March 2020 Congo River expedition, which had been cut short earlier in the year due to Covid-19.

The October expedition, organised with U of Leeds and U of Nottingham, was undertaken in the following villages: Lokolama (Bikoro territory), Mpeka (Ingende territory) and Ipombo (Bomongo territory). The objectives were to: (i) collect GHG data (CH4, CO2, N20) in the wet season; (ii) measure physical and chemical parameters which relate to GHG fluxes in the wet season, including pH, redox potential, dissolved oxygen, conductivity, turbidity and peat temperature.

At all three sites, there was a welcoming, collaborative atmosphere and impressive team spirit. 966 vials of gas samples (from peat, stems and a combination of water and air) and 63 plastic tubes of water samples were taken. All this was accomplished despite repeated bee attacks and heavy flooding particularly around Ipombo (river).

Analysis resulting from the data collected will be used for the BSc dissertation that Ovide Emba is writing in 2021 on the highly topical subject of the peatlands. This sampling complements the same wet season GHG data collection on three transects in Rep. of Congo by Mackline Mbemba, Wen Mampouya and Dafydd Crabtree, giving six transects with matching dry and wet season GHG flux data.

We would like to thank all members of the CongoPeat team for their support.

Greenhouse gas update

by J Jovani Sancho, U of Nottingham

Laboratory analysis has continued at U of Nottingham. To date, we have processed most of the gas samples collected at the GEM plots between months 1 and 15. There are only two months' worth of samples from stem fluxes left to analyse. In addition, all ground fluxes from last year's field expedition in the DRC (wet and dry seasons) have been analysed. Ongoing laboratory work is focusing on analysing the stem gas samples from Ipombo, Lokolama and Mpeka transects.

In addition to the laboratory work, we have been working on calculating the greenhouse gas fluxes for the first 12 months at the GEM plots. As part of the data analysis, a workshop was held in early March. The workshop was focused on sharing the preliminary results, the quality control of the data and on capacity building. Additionally, greenhouse gas data from the DRC wet season sampling (Ipombo, Lokolama and Mpeka transects) was provided to Ovide Emba as this will form the basis of his dissertation, focusing on CH4 fluxes from peat measurements.