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Katherine Roucoux is Senior Lecturer at the School of Geography and Sustainable Development at the University of Saint Andrews - Scotland. She is a doctor who specializes in long-term ecology and palaeoclimatology. She has developed specialized studies in tropical (particularly Amazonian) peatlands, investigating carbon dynamics, ecological change, and the effects of human activities on the function of the peatland ecosystem. She leads several interdisciplinary research projects executed with the Peruvian Amazon Research Institute.

Peatlands are a type of wetland that you have studied a lot. They are spaces that stand out from others due to their importance in mitigating climate change. Could you explain in a few words what peatlands are and why they are so important?

Peatlands are a special kind of wetland where the soils are extremely rich in organic matter and known as 'peat'. Peat is defined as having 65% or more organic matter and with a depth of at least 30 cm. It builds up in places where soils are water-logged for most of the year. The low levels of oxygen this

causes slows down the rate of decay thus letting undecayed, or partially decayed, organic matter accumulate over time. Peat is composed mainly of plants, their leaves, roots, stems, branches and trunks. Peat is very different from most other types of soil which tend not to accumulate upwards or contain as much well-preserved preserved organic material.

There are so many reasons that peatlands are important, it is difficult to know where to start. They are perhaps becoming most well known for their ability to take up carbon dioxide from

the atmosphere and store it below ground, in organic carbon. This process locks away carbon from the atmosphere permanently as long as the ground remains wet and the vegetation remains intact, making them incredibly important for the mitigation of climate change. Another, perhaps less well known feature of peatlands is that, being essentially made up of layer upon layer of the remains of past ecosystems, they have a remarkable ability to record their own history. This is how my interest in tropical peatlands started; we can use fossil pollen extracted from the peat to reconstruct past ecosystems and the environment that sustained them, with deeper layers representing the increasingly distant past. Peatlands today are also of course important ecosystems in themselves, supporting a great diversity of specialist plants and animals, many of which provide essential resources for people living in and around peatland regions.

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For example, aguaje fruit, of the palm *Mauritia flexuosa*, grow in huge abundance in peatland palm swamps as well as in other flooded areas. We’re beginning to learn too of the great cultural importance of peatlands in Amazonia, for example, as the source of materials for creating the elegant woven

textiles of the Urarina people, and also as a place of stories and of “bog spirits”, which are a feature common to peatland cultures across the world. Scotland has several of its own traditional bog spirits which seem to have similar attributes to those which co-exist with the Urarina people in the Chambira Basin.

In the course of time in which you have carried out research in the Amazon, do you think that the conservation of Amazonian wetlands has improved or, on the contrary, do you think that it has worsened?

I started working on peatlands in Peru in 2010 and at that time it certainly seemed that these environments were not high on the country’s conservation agenda as “peatlands” per se, although certain aspects of peatland, such as the aguaje palm swamps, were already receiving attention because of the dedicated work of IIAP. It had not been long since these areas of wetland with their very particular peaty characteristics had been described, starting with the work of Freitas et al. in 2006 and continuing with the mapping work of Finnish scientist Outi Lähteenoja in 2009 and our student Freddie Draper in 2014. Since then, peatlands have certainly risen higher in the conservation agenda globally and in Peru. The creation of the international Global Peatlands Initiative, to which IIAP belongs, is one manifestation of the increase in prominence of peatlands in efforts to mitigate climate change and preserve biodiversity. With the leadership of MINAM and advice from peatland researchers, efforts are now beginning to catalogue all of Peru’s

peatlands, those on the coast and in the mountains as well as those in the Amazon basin. The aim will be to document their location, biodiversity, state of degradation, and size of their carbon stores. This will enable the contribution of peatlands to Peru's commitment to reduce carbon emissions to be established. There are also several recent examples of conservation projects and national nature reserves being established in part because the geographical regions concerned include areas of peatland. In 2010, this was not yet happening, so this is all cause for optimism.

More pessimistically, perhaps pressures on peatlands are increasing. This is more difficult for me to judge as a scientist, but it looks as though economic pressures to develop transport links, to continue the pursuit of oil extraction, to expand the area available for commercial crops such as oil palm and cacao are ever-present. These activities have the potential to threaten the integrity of Loreto's peatlands by increasing accessibility to what are currently very remote areas and by changing their ecosystems and water-balance through forest clearance and drainage. Unless official protection is put in place for peatlands, which requires them to be clearly defined, mapped, and recognized for the importance of the carbon they lock up, then I think there is a danger that peatlands can be seen as wastelands, unproductive, mosquito infested swamps, at risk of the "land use conversion" to palm oil plantations that became so ubiquitous in peatlands of Indonesia.

Are Amazonian peatlands in the same danger as Indonesian peatlands?

All peatlands share the characteristic of having very large below-ground carbon stores, much larger than their above-ground carbon stock would suggest. Another characteristic they share is that this carbon store depends on a continuously high water table; they need to be flooded or at least water-logged for most of the year. Thus, all peatlands share the same vulnerability in that if they are drained to artificially lower the water table by, for example, digging drainage ditches or canals, then the water table falls, the upper layers of peat dry out. No longer waterlogged, oxygen gets in and decomposition speeds up, releasing the carbon that had been built up over thousands of years to the atmosphere as carbon dioxide. The dry peat also becomes susceptible to burning, which further increases the rate of carbon dioxide release. As peatlands have been cleared and drained, primarily for palm oil plantations, across large areas of Indonesia's peatlands, the result has been huge carbon dioxide emissions from decomposing peat, frequent toxic haze events across the region from peat fires, and land subsidence as the peat is lost. But Peru is not Indonesia. The political, social, and economic situation is different, and the geographical limitation on land availability is different, so I sincerely hope that this fate can be avoided in Peru. I think, now that the threats have been recognized and that the peatlands have been recognized as vulnerable to those threats, combined with the increased visibility and understanding of peatlands in policy

circles, things could turn out okay. Let's hope so; the alternative is awful to contemplate.

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How do you evaluate the research carried out between the University of Saint Andrews and the Research Institute of the Peruvian Amazon??

I would evaluate the work we have done together very highly. I come from a country which drained many of its peatlands long ago and is only recently starting to make serious efforts to restore them, so it is a privilege to have been allowed to study the peatlands in Peru where they remain largely intact. I have learned so much and been overwhelmed by the generosity of our IIAP partners these past ten years: they have enabled field work to take place in some of the most remote and inaccessible parts of the Amazon, they have welcomed our students and postdocs into the institution and into their research teams, they have shared their knowledge of Amazonia and its people, and have become as enthusiastic as we are about peatlands (or so it seems)! Our collaborative work has been published in some top academic journals and, importantly, is beginning to have a significant impact on conservation and management policy. There are many more papers still in the pipeline, particularly about the interdisciplinary research we have

started in the last two years. So, I think we can conclude that the collaboration has been a success.

In general, european universities have favorably internalized the importance of interdisciplinary research in the Amazon. Could you explain to us from your research area the importance of interdisciplinarity and mutual collaboration between research institutions?

That's a good question, and it gives me the opportunity to say that our peatland research in Peru would be unthinkable for us without the collaboration, both between disciplines (ecology and social science) and between institutions (IIAP and several UK universities including Saint Andrews, Leeds and Edinburgh). Using scientific approaches we are learning about how intact forested peatlands function, how they develop over time, what makes them vulnerable, and how important they are to the carbon cycle.

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Through the methods of social science we are learning about the practical and cultural importance of peatlands to forest communities, and about the challenges these people face including threats to their way of life, health and wellbeing. For the peatland science to be meaningful, for it to have a positive

impact on conservation and land management policy and to avoid unintended socioeconomic consequences we really need to understand the human context as well; together they reveal that the peatlands are not just carbon stores, they are also a place which provides a home, livelihood, and sense of identity to large numbers of people, which makes their preservation all the more important.

Our collaboration between institutions, which also happens to be between two nations, has allowed us to share knowledge and expertise, funding and facilities, to carry out research that would otherwise have been impossible. By coming together to do the best

research we can, I hope that we can have a positive influence on the future Peru's peatlands and that the lessons learned there can have a positive influence on the future of peatlands elsewhere, be that understanding the importance of restoration where they have been degraded, or the protection of peatlands which remain undisturbed.

BIBLIOGRAPHIC REFERENCE:

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