Uses, cultural significance, and management of peatlands in the Peruvian Amazon: implications for conservation

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Acknowledgements

The authors would like to thank the communities of Nueva York and Nueva Unión, Loreto, Peru, for agreeing to participate in this research. Further thanks are due to Sam Staddon and Mary Menton for advice on community benefits, Michael Gilmore on participatory mapping, Harry Walker on doing research in Urarina communities, Greta Dargie on peat and peatland characteristics, Eurídice Honorio Coronado, Tim Baker, Jhon del Aguila Pasquel, and Ricardo Zárate on the ecology of the area, and Althea Davies for comments on an earlier version of this manuscript. Funding from the Scottish Funding Council (Global Challenges Research Fund 2017-2018) and the Natural Environment Research Council (ref. NE/R000751/1) is gratefully acknowledged.

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Abstract

Tropical peatlands play an important role in the global carbon cycle by acting as significant carbon stores. South America's largest peatland complex is located in the Loreto Region of the Peruvian Amazon. Here we present the first study of human relations with these peatlands, including their uses, cultural significance and current management, as well as implications for conservation, based on qualitative research with people living in two riverine rural communities. Our results indicate that peatlands are culturally ambiguous spaces, used mainly for hunting, palm fruit harvesting, and timber, but feared due to the dangers of getting lost, sinking into the 'sucking' ground, and being attacked by anacondas and/or mythical creatures. While the difficult terrain and remoteness of peatlands have thus far acted as natural barriers to their destruction through conversion to different land uses, overuse of natural resources is nevertheless a significant concern for people living in the peat-dominated landscape of the Peruvian Amazon, mixed with frustration about the lack of outside support to foster environmental conservation and economic opportunities. We explore how evaluations of the present situation differ across one indigenous and one *mestizo* community. We identify a range of nascent peatland conservation strategies, including seedling planting to regrow valuable (palm) trees, and the climbing of palm trees for harvesting fruit as opposed to felling them. We argue that peatland conservation could be combined with the development of sustainable management strategies, but that this would require sustained engagement by outside organisations with rapidly growing local communities in these areas.

Keywords

Amazon; conservation; environmental management; peatlands; Peru; Urarina

1 Introduction

Tropical peatlands play an important and, until recently, underappreciated role for the global climate system, due to their capacity to process and store large amounts of carbon (Rieley & Page 2016). The largest known areas of peatland in the tropical latitudes are found in Amazonia, particularly in the Loreto Region of Peru (Draper et al. 2014; Lähteenoja et al. 2012), in Southeast Asia (Page et al. 2011), and the Congo Basin (Dargie et al. 2017). While Southeast Asian peatlands have been heavily affected by human uses and degradation (Dohong et al. 2017), South American and African peatlands are still comparatively intact, possibly due to the lower population density, continued availability of more suitable land for agriculture, and the comparatively higher cost of converting remote peatlands for agriculture, among others (Lilleskov et al. 2018; Roucoux et al. 2017).

Nevertheless, very little is known about local people's relations with peatlands in the Peruvian Amazon as most research on human uses, management and conservation of tropical peatlands has focused on Southeast Asia (e.g. Medrilzam et al. 2017; Nath et al. 2017; Tachibana 2016; Thorburn & Kull 2015). Globally, people's relationships with peatlands are shaped not only by material uses of their natural resources (Page & Baird 2016), but also by their cultural status (Byg et al. 2017; Lehtinen 2000; Wilson 2018), which may have implications for their conservation and management.

Similarly, socio-economic factors play an important role in shaping human-peatland relationships (Dohong et al. 2017; Medrilzam et al. 2017; Tachibana 2016).

People living in remote and rural communities are often the principal actors shaping ecosystem management in their surroundings (Álvarez Alonso 2012; Berkes 2004; Fabricius et al. 2007; Waylen et al. 2013), yet their voices and perspectives are seldom heard in wider debates. Here we address this gap by engaging with the views of people living in peatland areas of Loreto, Peru, based on findings from semi-structured interviews and participatory mapping with local community members in two Amazonian communities, and site visits with local guides to neighbouring peatland areas. We examine the material and intangible values local people place on peatlands, the uses they make of them, the forms of management and implications for peatland conservation. In this paper, we define 'local people' as 'people living in rural communities in the immediate vicinity of peatland areas'. Our findings are relevant to decision-makers from local to international scales, seeking to develop appropriate conservation and management strategies for tropical peatlands in the Peruvian Amazon and beyond.

2 Materials and methods

This is the first study to engage with local people's views on the uses, cultural significance, management, and conservation of peatlands in Peruvian Amazonia. We thus followed an exploratory research approach, using multiple qualitative methods. Twenty semi-structured interviews with 27 inhabitants of a small indigenous community of about 150 inhabitants (near the Chambira River, Loreto Region) and 31 interviews with 35 interviewees in a *mestizo* community[1] of about 1,200 inhabitants (near the Tigre River, Loreto Region) were carried out by a team of four Peruvian and British researchers [anonymised for peer review] between March and April 2018 (see Figure 1 for the study location within the wider Pastaza-Marañón Basin). Given the absence of previous research on the topic, we chose to do research in two very different communities. This allowed us to explore the potential role of cultural differences, as well as variations in factors such as community size, history, integration into wider Peruvian society and economy, among others, for people's relations with surrounding peatland areas. Both communities had been visited by members of the research team prior to our fieldwork, which we believe helped to establish the necessary trust to conduct effective research there.

[Insert Figure 1 around here]

The indigenous community is exclusively populated by members of the Urarina indigenous nation whose ancestors are likely to have lived in the area for centuries, although the exact location of the current community was only chosen about 30 years ago. Available infrastructure consists of a primary school and a church (each with their own small generator for electricity), a public speaker system, and a radio system to communicate with neighbouring communities. In contrast, the *mestizo* community was founded 85 years ago by (former) rubber tappers from a distant community elsewhere in the Peruvian Amazon, and is now inhabited by descendants of immigrants from many different parts of the Peruvian Amazon. Culturally, its inhabitants could thus also be classified as *ribereños* (Chibnik 1991), i.e. *mestizos* with cultural roots and significant environmental knowledge of the Amazon who have lived in the area for generations. Available infrastructure consists of generator-powered electricity for most of the community, a primary and secondary school, two

[1] *Mestizo* - Spanish for mixed race, an ethnic category that can be traced back to the times of Spanish conquest, which nowadays has mainly cultural connotations about differences in ancestral knowledge and practices.

churches, a community hall, a public speaker system, mobile phone coverage, a health post, a police station, two concrete pavements, two (modest) hotels, and a number of corner shops. Neither community had running water or sanitation infrastructure.

Our sample of interviewees ranged in age from 18 to 80 years old, with 34 male and 17 female respondents who were interviewed in Spanish (with the exception of seven female interviewees in the Urarina indigenous community who were interviewed in Urarina with the help of a local translator). Most male respondents were small-scale subsistence farmers who also engaged in hunting and fishing. A majority was also active in the seasonal trade of *aguaje* palm fruit (*Mauritia flexuosa*), *chonta* or *huasaí* palm hearts (from *Euterpe precatoria*), and a few agricultural products such as manioc (processed as *fariña*). Many had worked for oil companies and sold timber in the past (timber harvesting was ongoing in the *mestizo* community). A minority had additional professions with an associated monetary income, e.g. as school teacher, carpenter, or small-scale retailer. Female interviewees also worked in small-scale subsistence agriculture and fishing, and were primarily in charge of childcare, cooking, collecting firewood, washing clothes, and production of textiles. In the *mestizo* community, some female interviewees also worked in the trade of *aguaje* palm fruit and in retail.

Semi-structured interviews covered four main themes, namely (1) natural resource use (e.g. game species, palm fruits, timber trees or fish); (2) classification of the environment surrounding the communities into different ecosystems (see Authors 2019 for an overview of Urarina indigenous ecosystems, and Halme & Bodmer 2007 for an overview of some of the ecosystems recognised by *mestizos* in the northern Peruvian Amazon); (3) cultural and mythological importance of certain ecosystems, especially those likely to have peat-rich soils; and (4) environmental governance, including past, present, and potential future strategies for the conservation and management of areas surrounding communities, again with a particular focus on peatland ecosystems. All interviews were recorded and transcribed in Spanish, and analytical categories within the interview transcripts were coded with NVivo 11 to facilitate the qualitative analysis.

As part of the semi-structured interviews, research participants were asked to locate resources, locally defined ecosystems, and areas that they personally travel to on A3-size maps of the areas surrounding the two communities. Additionally, one community-scale workshop was conducted per community, with about 50 attendants each, to perform a participatory mapping exercise with large A0-size maps (which showed, as a starting point, only the location of the community and the main rivers and streams). The benefits of participatory mapping for safeguarding traditional ecological knowledge, strengthening territorial rights of local communities, and supporting environmental conservation have been well documented (Gilmore & Young 2012; Ramirez-Gomez et al. 2013). Moreover, this method can serve as a vehicle to start conversations about uses and management of the environment, beyond merely locating resources and areas on a map. Not least, participatory mapping is also an enjoyable activity for research participants, which can serve as a tool for education within communities when knowledgeable community members share their experiences about the local geography (Young and Gilmore 2013). Further information on peatland uses and management was gathered during a total of six site visits to neighbouring ecosystems and areas likely to be peatlands with local community members in both locations.

3 Uses, cultural significance, and management of peatlands in the Peruvian Amazon

Given that respondents were not familiar with peat as a type of soil, we relied on various proxy indicators to identify peatland areas around communities, such as the colour of soils and their

porewater (i.e. dark brown to black); 'sinkiness' of the ground (i.e. area where one sinks in easily); amount of water in the soil (i.e. permanently waterlogged areas); and, occasionally, vegetation appeared to be an indicator (i.e. areas where trees are shorter than usual; where there are only grasses and sedges). We were also able to visit local ecosystem types whose descriptions matched those characteristic of peatlands, based on information gained from the individual semi-structured interviews and participatory mapping exercises, and presence/absence of peat was further verified by probing with a pole.

In the indigenous community, two local ecosystem types known as *jiiri* and *alaka* are likely to be typically associated with peat (see Authors 2019). In the *mestizo* community, the waterlogged areas likely to be peatlands were often identified as 'ugly' areas, classified into *aguajal chupadera* (*Mauritia flexuosa* palm swamp with soft and wet ground), *aguajal raizal* or *aguajal champal* (*Mauritia flexuosa* palm swamp with comparatively firm ground where roots cover the soft and waterlogged soil), *aguajal varillal* (*Mauritia flexuosa* palm swamp with many short and thin trees; note that *varillal* by itself also exists as a vegetation category in common usage, and can be translated as 'pole forest' *sensu* Draper et al. 2014 or Laumonier 1997), and *piripiral* (sedgeland with very soft ground and lacking trees). Use of terms varied between individual respondents, with *aguajal chupadera* (i.e. 'sucking' *aguajal*) being the most common term to refer to areas that we identified later as having a peat substrate. *Aguajal chupadera* and *piripiral* were regularly identified as 'particularly ugly' areas (i.e. *"allá es feísimo"*, in Spanish), given the great difficulty walking on the soft, waterlogged soil typical of peatlands. In contrast, some respondents described areas with firm ground as 'beautiful areas' (i.e. *"allá es lindo"*, in Spanish). *Piripirales* (sedgelands) were also associated with 'dead lakes' (*cochas muertas*) in the *mestizo* community, with a special cultural status (see section 3.2 below). For an overview of local peatland terminology, uses, cultural significance, and current management and conservation strategies in the two studied communities, see Table 1.

[Insert Table 1 around here]

3.1 Uses of peatlands

People in the Peruvian Amazon do not use peat itself. Nevertheless, peatland areas provide livelihoods and economic income to local people indirectly, through the plant and animal resources that can be found there. A number of resources are collected primarily for subsistence and personal consumption, most notably meat from terrestrial mammals (e.g. tapir, peccary, agouti), monkeys (e.g. howler, squirrel monkey, monk saki), reptiles (e.g. caiman, tortoise), and birds (e.g. Spix's guan, great tinamou). While these animals can be found in peatland areas, most can equally be found in non-peatland areas, with tapirs and caimans most commonly mentioned as typical game species of peatland areas specifically. There was some limited intra-community trade of meat in the *mestizo* community, but not in the (much smaller) indigenous community. Further non-commercial resources found in peatlands, e.g. the leaves of the *shebón* palm tree (*Attalea butyracea*) used for traditional roofs (although these are increasingly replaced by corrugated metal roofs), and the fibre of *aguaje* palm trees (*Mauritia flexuosa*) used by members of the indigenous community to produce traditional textiles, were also important. Some respondents also mentioned limited harvesting of palm fruit from several palm tree species for personal consumption, such as *ungurahui* (*Oenocarpus batahua*) or *aguajillo* (*Mauritiella armata*) (see also Smith 2015). As with animals, these plant resources are not exclusive to peatland areas, although relatively common there.

Economically important products include fruit from the *aguaje* palm tree (Horn et al. 2018), and palm hearts from the *huasaí* or *chonta* palm tree (*Euterpe precatoria*) (Paniagua-Zambrana et al. 2017),

which members of both communities regularly harvested to sell to travelling traders. In the *mestizo* community, there was a simple commercial value chain whereby a network of intermediaries would buy these products from other community members and sell them in bulk to traders from Nauta and Iquitos (the two closest towns in the northern Peruvian Amazon). Due to the strong economic importance of this trade, one community member called their community by the nickname "*The capital of aguaje"*, although *aguaje* trade occurs on similar scales elsewhere in the region (Horn et al. 2018). Both *aguaje* fruit and *chonta* palm hearts are typically harvested by felling palm trees during the harvesting season, which lasts several months of the year. While *aguaje* palm trees do not need peat to grow, they are extremely common in areas with a persistently high water table and frequently form monodominant stands (locally known as *aguajales,* see Endress et al. 2013), which often overlie peat in this area (Freitas Alvarado et al. 2006).

Finally, wood and timber products were also harvested from peatland areas, mostly for personal use, and in the *mestizo* community, for trade and monetary income as well (in the indigenous community, timber harvest and trade ceased about five years previously). The most frequently mentioned species was *cumala* (*Virola* sp.); further timber species mentioned were e.g. *moena* (which may refer to several species of the *Lauraceae* or laurel family), *shiringa* (*Hevea brasiliensis*; rubber tree), *lagarto caspi* (*Calophyllum brasiliense*), although several interviewees commented that trees from peatland areas might have less durable wood of lower quality than from non-peatland areas. Beyond these timber tree species, stems of smaller trees typical of peatland palm swamps and pole forests were occasionally used as poles for construction (especially in the indigenous community), e.g. *punga* (*Pachira brevipes*). *Remo caspi* (*Aspidosperma rigidum*) was mentioned as a source of firewood in the *mestizo* community, despite traditionally being favoured for making oars (*remo* = *oar*). It should be noted, however, that *remo caspi* was more strongly associated with low-lying areas in general (*bajiales*), which may not necessarily be peatlands.

3.2 Cultural significance of peatlands

While peatlands themselves are not recognised as such by members of the two communities, the ecosystems typically associated with peat had a special cultural status among indigenous and *mestizo* respondents alike. In the Urarina indigenous community, the *jiiri* and *alaka* [peatland] ecosystems were considered to be the home of a mythical creature, the guardian spirit *Baainu*, who may trick people into losing their way (see Authors 2019 for a detailed discussion), with some similarities to forest guardian spirits elsewhere in the Amazon more broadly (see e.g. Smith 2015). They were also of special cultural importance as the source of *aguaje* fibre for textile production. *Aguaje* textiles play a central role in Urarina cosmovision and their creation myth, which includes an element in which a 'wise' woman is identified by her ability to weave *aguaje* palm-fibre cloth (Dean 1994). In the *mestizo* community, many guardian spirits were known, too, most commonly under the name *Yashingo* (other names used were *Chullachaqui*, *Sacharuna*, *Shapshico*, *Yacumama*, or simply *madre* [mother] or *dueño* [owner]), but most of these were not specific to peatlands as a broader ecosystem category. Instead, some *madres* or *dueños* inhabit specific individual lakes and their surroundings, which is a common pattern in Amazonia more broadly (see e.g. Mezzenzana 2018; Ricopa Yaicate 2009).

Some of these lakes belonged to a category locally known in the *mestizo* community as *cocha muerta* (dead lake). Based on respondents' descriptions, it appears that the areas around 'dead lakes' could have peat substrates. These were described as sedgelands (*piripirales*) or grasslands (*hierbales*) with "very ugly" soil, where one can sink in to an extent that it poses a risk of drowning. Trees were either absent or much shorter than usual, with the most common tree species being *renaco* (*Ficus* sp.

or *Coussapoa* sp.). In the wider surroundings, *aguaje* might be found as well. All respondents familiar with dead lakes also noted an abundance of aquatic plants such as *rayabalsa* (*Montrichardia arborescens*) and *huama* (*Pistia stratiotes*), i.e. their surface is usually covered by vegetation. The water of dead lakes was described as follows: "The water is brown […], like [Coca Cola], extremely ugly, like when you mix a soft drink with milk, […] a very thick water" (male respondent, *mestizo* community, 27 years). Contrary to their name, dead lakes are actually full of fish, and game species such as river turtles, tapirs, and monkeys can comparatively easily be found nearby, which is why a minority of settlers still visit them, despite being fearful.

Theories about the origin of the name 'dead lake' varied, with some attributing it to the lack of trees, and others citing their calmness which resembled a genuinely dead lake. It seems possible that the name for these comparatively remote lakes and ponds is as much related to their cultural status as taboo areas inhabited by particularly powerful and irritable 'mothers' and 'owners', as to the actual risk of death by attacking anacondas or caimans, or sinking into the soft ground. The 'mothers' of dead lakes can be angered easily by any sort of noise, such as from rifles used for hunting or boat engines, and will retaliate with instant thunderstorms. Such 'mothers' often take the shape of anacondas, and respondents noted being particularly fearful of anaconda attacks in dead lakes. Reportedly, these are also the home of giant black caimans with lengths of up to 12 metres. Also, the *renaco* trees growing near dead lakes possessed a special mythological role. Several respondents reported that felling a *renaco* would lead to the death of the person in question and their entire family, which effectively protected *renacos* from the timber trade. The degree to which community members believed in supernatural phenomena differed widely, and descriptions of dead lakes were not uniform either. Interestingly, such beliefs were sometimes held in parallel to Christian beliefs, introduced through missionary activities and maintained by two evangelical churches in the *mestizo* community.

In the *mestizo* community, other types of ecosystems likely to be peatlands (i.e. the various types of *aguajal* mentioned above) did not appear to have a similar cultural significance for local mythology as dead lakes. Nevertheless, through their strong *socio-economic* importance as the source of *aguaje* fruit, they still had a great influence on everyday life in the community, and in this way, on local culture. Indeed, the *aguaje* palm tree could be understood as a cultural keystone species in the sense proposed by Garibaldi and Turner (2004), with great importance for ecology and local culture alike. For example, the *aguaje* harvest is a very important element of the community's seasonal calendar and, at harvesting times, would dominate community life. Nevertheless, most respondents also emphasised (and maybe lamented) the physically difficult environment in which *aguaje* grows. This difficult environment tends to shape peatlands' perceptions as culturally ambivalent spaces in Peru (Authors 2019) as elsewhere around the globe (Boaden 1981; Byg et al. 2017; Lehtinen 2000; Wilson 2018).

3.3 Current management and conservation of peatlands and potential threats

Neither of the two communities studied had specific management practices in place for peatlands. If anything, the cultural taboos surrounding dead lakes in the *mestizo* community, and fear of the *Baainu* in the Urarina community, may act as (weak) indirect incentives for environmental conservation of some peatland areas specifically. Nevertheless, both communities had local agreements in place with a view to conserving their natural resources, including those in peatlands, which were complied with to varying degrees.

The most effectively implemented strategy to conserve natural resources concerned their protection against outsiders. Any non-members of the community caught fishing, hunting, or harvesting timber inside the community territory would be sanctioned, either with verbal warnings, fines, temporary detention, or confiscation of their equipment and boat engines. In the larger *mestizo* community, a police post was in place to take care of any potentially illegal activities by outsiders, mostly by monitoring river traffic day and night. The indigenous community also had agreed on a ban on using poison for fishing, which is a very effective, but unsustainable traditional fishing method. While this is illegal according to Peruvian law, people in both communities were generally only aware of the regulations agreed within their own local governance systems.

These community agreements were framed by respondents as the result of community deliberation and self-governance, but also appeared to be strongly related to the initiative of incumbent local leaders, who in turn may have been influenced by interacting with state authorities, NGOs, and other institutions (see e.g. Cossío et al. 2014). Both communities used a dual governance system typical for indigenous communities, in which indigenous leaders (officially known as *apu* and *vice-apu*) and state-recognised leaders (known as *teniente gobernador* and *agente municipal*) would be elected by community members and govern collaboratively. In the indigenous community, there was also a *madre indígena* ('indigenous mother') who represented women's concerns specifically. This position has been developed relatively recently as a result of state and other outside demands for better representation of women's interests and needs in indigenous communities. These demands were passed to communities via indigenous federations, which in turn unite representatives of several communities within a certain geographical area. However, most major decisions would be taken by the community as a whole, and both communities had a formal register of decisions taken, signed by all attending community members. The local police post of the *mestizo* community was established due to lobbying of the state authorities by local leaders, following an incident in which a group of criminals murdered a member of the community and injured two others (the reason for the incident remained obscure, but might have been related to drug trafficking; see Perú21 2012).

Both communities had also formally agreed to limit their use of natural resources through the local governance system, including fish, meat, and timber, but compliance was mixed at best. In the *mestizo* community, a monthly limit on selling fish had been agreed, but different respondents cited different figures (between 20 kg and 50 kg/month/family), and many openly admitted that non-compliance with this rule is the norm. This was mostly attributed to the lack of alternative sources of livelihoods, the need to provide for one's family, and, when referring to other people's behaviour, their indifference to environmental conservation (in the sense of a symptom of the broader undesirable character trait of carelessness). In the indigenous community, a former local authority had brokered a temporary agreement among community members during his tenure, to stop all commercial timber harvesting activities to let trees regrow (possibly related to the presence of an environmental NGO in the community at the time, see Cossío et al. 2014), which seemed to be complied with. However, some respondents suggested that this was entirely due to the recent appearance of alternative economic opportunities, in the form of employment in the maintenance of a local oil pipeline corridor (conversely, the former local authority cited the agreement as a local environmental management success). Thus, experiences in both communities highlight the need for diversifying conservation strategies beyond simple resource use bans, which may also disproportionately affect the most marginalised community members, given that these typically lack alternative livelihood strategies.

Despite the problems with community-level environmental management strategies, almost all respondents noted the need to protect natural resources to ensure the sustainability of local livelihoods. Concerns about resource depletion and ecological change, including in areas which we

identify as likely to be peatland areas, were common in both communities but much more pronounced in the *mestizo* community. While in the indigenous community some respondents commented on the disappearance of commercially valuable timber species such as mahogany (*Swietenia macrophylla*, known as *caoba* in local Spanish) or *cedro* (*Cedrela odorata*) in the past few decades, there was no sense that survival of the community and traditional livelihood strategies (hunting, fishing, small-scale farming) were at stake. In the *mestizo* community, however, there was a sense of doom about disappearing natural resources, i.e. fish, game species, and *aguaje*, which was often related with the (possibly idealised) abundance of the past:

> "Here we used to have a lot of fish… if you pointed a torch at the river at low water levels, the eyes of the caimans were shining like electric light […] just here at the mouth of the Tigrillo River, you could see the *fasacos* [*Hoplias malabaricus*, a local fish species] on the river margins, we did not care, they appeared to be [as abundant as] wooden sticks. […] Same thing with the *aguaje*, you used to find it right here, but nowadays people have to walk the whole day to harvest two, three, four bags… they started destroying right here […] and they continue destroying until today." – male respondent, *mestizo* community, 72 years

Overall, overuse of natural resources, caused by the lack of alternative livelihood strategies and population growth, was the most common threat identified by members of the *mestizo* community.

While community-level conservation strategies appeared to be difficult to enforce, individual members of the *mestizo* community had developed their own environmental management strategies to address unsustainable *aguaje* harvesting practices (this also echoes comments e.g. by Waylen et al. 2013 about the importance of recognising intra-community differences in conservation). This has important implications for peatland conservation, given that *aguaje* mostly grows in peatlands in the Pastaza-Marañón Basin, and degradation of *aguaje* stocks may reduce the carbon storage function of *aguaje*-dominated peat swamp forests (Bhomia et al. 2018). These can be roughly grouped into three broad themes: (1) climbing, rather than felling, *aguaje* palm trees for harvesting the fruit; (2) planting of *aguaje* seedlings to restore depleted areas; (3) identification of alternative monetary income strategies. The first two strategies are closely related given that at present, climbing palm trees is only possible indirectly, where other trees are planted next to *aguaje* palm trees to act as a ladder. Other trees have branches that can be used for climbing, unlike the single-stem *aguaje* palm trees, which also grow very tall when mature, making them impossible to climb without suitable specialist equipment (not known in the community prior to our fieldwork). Considering time spans of between seven to nine years for *aguaje* to bear fruit for the first time (Gonzáles Coral & Torres Reyna 2010), planting seedlings requires a relatively long-term vision, but was portrayed as worth the effort by the small minority of community members who engaged in it:

> "I have planted [*aguaje* palm trees] right here [in my orchard]. Now this takes away my stress when sometimes I don't have money, I sell some [*aguaje* fruit] and I get money. I tell people from here, if you don't have [money], it's because you don't plant [*aguaje*], it's really because you don't want to." – female respondent, *mestizo* community, 69 years

Similarly, felling of *aguaje* palm trees was occasionally described as an income strategy of last resort:

> "I feel sad felling *aguajes* […], because sometimes when you fell an *aguaje* […], sometimes it is full of fruit, and the next year it's not going to be there. […] That's why I hardly go… only when I don't have work here I might sometimes go there [to harvest *aguaje*]." – male respondent, *mestizo* community, 33 years

The same respondent also noted having trained as a carpenter to avoid relying on harvesting natural resources for his monetary income, and had planted several *aguaje* palm trees in his orchard so that his children would have a sustainable supply of *aguaje* in the future. Other parents were hoping for their children to study and train as teachers, nurses, and other professions so that they would not have to rely on the dwindling natural resources of their community.

In the indigenous community, there had been some planting of seedlings of timber species by an environmental NGO in the past (see Cossío et al. 2014: 11-12), which was generally welcomed by community members at the time. They had also received some training in environmental management. Yet, not long after the NGO left, replanting activities were discontinued, indicating a need for sustained support if communities are to obtain a benefit from external involvement in resource management (Davies & White 2012).

Despite the numerous obvious benefits of planting (*aguaje*) seedlings, this strategy also comes with a number of challenges. Planted seedlings would be considered as economically valuable investments by those planting them, potentially requiring the allocation of more formal land use rights if this was taken up on a larger scale. At present, community members are typically free to cultivate any unoccupied land they find available, subject to approval by the community. Large-scale monoculture plantations of *aguaje* would likely not be viable due to the species' susceptibility to numerous pests and diseases (Smith 2015). And not least, it is a dioecious palm species, i.e. it takes years to find out whether seedlings are male or female, a problem reported by several interviewees. Expert guidance suggests that the best way to deal with this uncertainty is to adopt a long-term perspective, which involves gradually replacing male trees with new seedlings, which will then increase the share of female trees over time (Gonzáles Coral & Torres Reyna 2010). Further recommendations for *aguaje* management include felling older trees, which may not be as productive, to accelerate the growth of younger, fruit-carrying trees; as well as letting some fruit-bearing branches fall to the ground, to allow natural dispersal of seeds via *aguaje*-consuming animals (Aquino 2005).

4 Implications for conservation

4.1 Cultural and ecological degradation as a related process

As noted e.g. by Pröpper and Haupts (2014), culture and ecology are often closely linked among people living in remote rural settings, to an extent that culture does not exist separately of the natural landscapes that people rely on for their (subsistence) livelihoods. It follows that ecological degradation may go along with cultural degradation and vice versa. In the two studied communities (i.e. both indigenous and *mestizo*), such processes seem evident as well. Several respondents commented that formerly resource-rich areas used to be populated by numerous 'mothers' and spirits, which might attack humans; see for example, the following vivid description of the turbulent past of a major lake near the *mestizo* community (which here emphasises spiritual and mythological aspects of culture):

> "You could not go to that lake. You arrived there and would hear a loud noise, thunder, rain, you could not enter, its water boiled. That is what my grandfather told me […]. 'Son, when I arrived there, immediately lightning would strike, it was a very rough lake.' The Supay [River] as well, because of the anacondas. That's what my grandfather told me when I used to walk around with him. The entire area was very rough." – male respondent, *mestizo* community, 36 years

However, such fighting back by 'mothers' and spirits via (super-)natural phenomena (sudden thunderstorms; anaconda attacks) was said to disappear as more and more humans visited an area to hunt and fish. While the noise of boat engines would initially anger the 'mothers', persistent disturbance would eventually make them flee, just like game species and fish. A fully degraded area would be empty of spiritual beings as well, suggesting a particularly close link between ecology and culture.

In the indigenous community, there was evidence for such linkages as well. For example, some younger people would consider traditional ecological knowledge, as well as knowledge of cultural traditions and customs, as being beyond their expertise, and would try to redirect our queries to the two oldest male community members. Other cultural-ecological traditions were still maintained to some degree, for example the practice of using *aguaje* fibre for textile production. This is of strong cultural importance to the Urarina, given e.g. the central role that *aguaje* textiles occupy in everyday culture and their creation myth (Dean 1994), as mentioned in section 3.2.

Nevertheless, while under threat, cultural and ecological knowledge was still better conserved in the indigenous community than in the *mestizo* community, as evidenced by the continued practice of producing *aguaje* textiles among the Urarina, for example (see further examples below). This is maybe not surprising, as their ancestors had lived in the area for centuries and most community members would not usually leave the area, except for community leaders and their families. Family links were exclusively with other Urarina communities in the region. In contrast, the *mestizos* had been present for 85 years at most and their ancestors originated from many different areas (as far away as Portugal) and had family all over Peru (and beyond, with one respondent mentioning her cousin visiting from the US). In the 31 interviews conducted there, 53 different towns and settlements were mentioned where people had travelled or knew someone (without this being an explicit focus of our research).

Such different levels of cultural and ecological knowledge have significant environmental management implications, including for peatland areas, as also noted by Paniagua Zambrana et al. (2007). Where cultural traditions erode, for example through integration into mainstream Peruvian society, this may create challenges for environmental conservation, whereas the conservation of traditional practices can be beneficial to prevent ecological degradation. For example, it appears that the Urarina tradition of moving community locations from time to time (described also by Kramer 1979) is a suitable strategy to cope with resource 'depletion' in a certain area, which is still being practiced today. As mentioned above, the indigenous community we visited had only been in their current location for about 30 years. And earlier in 2018, a neighbouring community had also changed their location, in this case from a smaller tributary to the shores of the much larger Chambira River. In fact, Urarina hunters or fishermen do not appear to be particularly selective when choosing which animal or fish to catch. Thus, one could imagine a similar dynamic of gradual disappearance of natural resources to occur over the longer term, as described in the *mestizo* community, which would then be mitigated by moving location.

While from an ecological point of view, moving an entire community may be beneficial, it can create legal problems. The Peruvian state is slow to recognise such moves and land titles are usually fixed to a certain territory – indeed the Urarina community we visited was still lobbying to have their new location officially recognised through an enlargement of their territory, which still only covers the area around their previous location. The state may also be reluctant to concede comparatively valuable non-wetland territory to communities, given that the Urarina usually settle in small dry patches surrounded by wetlands, including peatlands. Many other Urarina communities

in the region do not have any legal recognition at all and are thus simply ignored by the state (Walker 2013).

Strong solidarity between community members, expressed for example by sharing meat and fish (Álvarez Alonso 2012) is another important traditional Amazonian strategy to cope with food insecurity, which is inherent to a subsistence lifestyle that is based on hunting and fishing. These practices were present in the indigenous community where no shops existed and monetary exchange was only practiced with non-community members, if at all. In the *mestizo* community, sharing of food and natural resources also existed to help those less well off, but a clear tendency towards market transactions was evident from the existence of several shops, as well as from comments about trade between community members:

> "Here we have a tariff for selling meat to each other, it is very well established. We have our norms well thought out. For example for the meat, we charge each other 4 soles when it is fresh, and 4.5 soles when it is dried." – male respondent, *mestizo* community, 57 years

Similarly, if the inhabitants of the *mestizo* community were to disperse and move to different currently uninhabited areas, it is possible that they could start subsistence hunting, farming, *aguaje* harvesting, and fishing afresh, in order to let populations recover at their current location. Yet, we would argue this is unlikely to happen as they do not share the same traditions as their indigenous counterparts. Going forward most inhabitants of the *mestizo* community seem to favour integration into the wider Peruvian economy over continuing with subsistence livelihoods. The practical challenges of achieving this type of economic development in the *mestizo* community could potentially generate and exacerbate intra-community conflict, as well as an increasing sense of desperation among local people and strong expectations of support from visiting outsiders, state institutions, NGOs, business, and research (see following section).

4.2 Peatland science and implications for conservation

As might have been expected, our research has shown that peatlands as a particular landscape category are not of concern to local people in the Peruvian Amazon. Even among university-educated Peruvians elsewhere in the country, only some specialists would be familiar with the Spanish term for peatlands (*turberas*), because peat has had no historic uses in Peru, unlike in many other countries (Braadbaart et al. 2012; Cruickshank et al. 1995; Gapsalamov 2015). Nevertheless, our research has also shown that peatlands are sufficiently distinct and recognisable to potentially allow local or collaborative management of these areas, and that there are local terms for ecosystems that are typically or frequently associated with peat.

Respondents in both communities suggested that these areas could be protected by temporary bans on the use of certain natural resources, the planting of seedlings of commercially valuable (palm) trees, including *aguaje* and *cumala*, and the creation of alternative economic opportunities. While the origin of the ideas for these conservation strategies is unclear, they may have been informed to varying degrees by previous interactions with environmental NGOs, state development institutions, commercial actors, and academic researchers, who have been active in the region for decades (Schleicher et al. 2017; Zinngrebe 2016), not least in the very large and relatively near Pacaya-Samiria National Reserve (see Figure 1; Kilbane Gockel & Gray 2009). In the *mestizo* community, several respondents also suggested that commercial agriculture could replace subsistence farming, fishing, and hunting in the future once local fish and game species were depleted. Given the poor

soils and seasonal flooding regime, this may not prove to be practical, however, and experience elsewhere in the Amazon also shows that such shifts from subsistence to commercial agriculture often lead to displacement and marginalisation of the original small-scale farmers (Ioris 2017).

The desire for alternative monetary income sources was especially pronounced in the *mestizo* community where, overall, there was clearly a joined-up understanding that environmental conservation was inseparable from the underlying issue of insufficient economic opportunities for community members (even if levels of concern for environmental conservation differed considerably between respondents). This was to be achieved through combining conventional economic development with better assistance from state authorities, NGOs, and international donors. The most frequently mentioned option to create jobs was to build a processing factory for *aguaje* fruit in the community, an idea which had reportedly been mooted by Korean investors in the past, and remained popular even after the investors disappeared. It would be essential, however, to combine this with verified sustainable harvesting practices to avoid increasing pressure on already degraded *aguajales*. Nevertheless, processing of sustainably sourced *aguaje* fruit would relate well with the idea of peatland conservation, given that *aguaje* is common in peatland areas in the Peruvian Amazon (Freitas Alvarado et al. 2006).

Conservation of peatlands is a science-driven endeavour, in the sense that without the recent efforts to quantify carbon storage capacities of Peruvian tropical peatlands (Draper et al. 2014; Lähteenoja et al. 2012), peatland conservation would not be on any environmental management agenda in Peru. This makes peatland scientists, voluntarily or not, one of the key actors in any debates on peatland conservation, both with local, national, and international stakeholders, as well as with local people in peatland areas. The need for peatland scientists to reflect on peatland conservation has also motivated the present study. Having identified the magnitude of carbon storage in Peruvian peatlands (Draper et al. 2014; Lähteenoja et al. 2012), lobbying for their conservation to avoid negative implications for the global climate seems to be a logical next step, even if it is often difficult to be heard by relevant decision-makers.

Among local community members, Peruvian and especially international scientists are often perceived as potential development workers, a role that they are then forced to engage with, if only to explicitly reject it. For example, one respondent (a former community leader) suggested the introduction of what, for scientists, would be termed as a type of Payments for Ecosystem Services (PES) scheme (which already exist elsewhere in the Pastaza-Marañón Basin, see e.g. Roucoux et al. 2017 for a summary of a carbon-based conservation initiative of the Green Climate Fund[2]). In a long narrative indicating his experience with the wider framing of development and conservation initiatives in the region, he explained the need for developed countries such as Scotland to pay community members for conserving peatlands and palm swamps:

> "Previously, there was a project here in Peru, […]. We heard that foreign countries were sending money to every family of a village, and they all had a limited area, of about ten or twenty hectares to look after, let's say, where they had to plant trees. But there were conditions for having this salary, planting and conserving trees, […], and in return, they went to the bank to get their payment […]. We heard about this [project] in Nauta, and we asked ourselves, why did they not come to Nueva York [i.e. the *mestizo* community]? […] It is always like that, you go there [to the regional authorities in Nauta] and they say a project is coming, but they cheat you and it actually doesn't come. […] And then [when you return to Nauta] the project is completed already. […]

[2] More information is available here: https://www.greenclimate.fund/projects/fp001

> Then they say, we are going to extend the project, but *pucha*, we don't know what's happening, we haven't seen anybody. […] Several communities were going to be part of this, but nothing happened.
>
> […]
>
> Scotland is a developed country, right? […] I would like to suggest, […] this idea that I have, maybe you could take it to your country: a project [like the above], […] about reforestation, […] that way we would have had a way to sustain ourselves, we wouldn't be cutting neither the *aguaje* palm trees nor the *chonta* palm trees, nor the timber trees, all that. It might already not be for our own benefit, but for the future generations that are coming." – male respondent, *mestizo* community, 53 years

Such (perhaps overly ambitious) demands for foreign intervention are not uncommon when foreign researchers visit remote rural communities (see e.g. Staddon 2014; Townsend 1995). Nevertheless, these are often difficult to navigate on the ground even when prior consultation and the parameters for engagements and desired outcomes for communities have been agreed between all parties. An example of this occurred in a previous scoping visit for this project when the researchers suggested that the project could facilitate a palm tree climbing workshop with community members, in which they would learn how to climb *aguaje* palm trees, rather than cutting them, for harvesting fruit. (This approach has numerous ecological and economic benefits, and strongly enhances sustainability of *aguaje* fruit trade [Smith 2015]). At the time of prior consultation, in a meeting attended by 50 adults (21 women/29 men), the community had seemed strongly supportive of this idea. When it came to implementing the workshop, however, attendance was very low (it proved popular mostly with children and adolescents). Of course, low turn-out in such contexts usually has a range of explanations (Cheng & Mattor 2006; Davies & White 2012; Messerschmidt 2007). In this particular case, timing may well have been an issue as people were rushing to save their manioc harvests from being flooded by unexpected rises in the river at that time.

Yet, it is also important to recognise the legacies of the experience of past projects on undermining trust. Local people reported their negative memories of NGOs, government entities, businesses, and others disappearing without a trace after announcing grand development plans (e.g. building an *aguaje* processing factory). They mentioned their time being wasted by ineffective programmes like teaching vegetable production and then handing out low quality seeds unsuitable for local soils. Others cited how their money had been stolen in different ways – for example a monetary investment was required to participate in an initiative but the programmes were never completed or their payments disappeared via corrupt channels including, in some cases, within the community.

Thus, more sustained engagement with local communities is needed to regain local people's trust, particularly following this series of disappointments (see also Davies & White 2012). It is clear that past outside interventions, which were inadequately planned and did not fulfil their promises, served as a reference point for community members. The long shadow cast by such breaks in trust needs to be taken seriously if sustainable development partnerships are to be built. A scientific agenda alone is thus insufficient for effective conservation. Research in other contexts following sustained experiences of community organising around indigenous planning initiatives, for example by Laurie et al. (2002), indicates that such disappointments influence negotiations over funding, collaboration and investment from outside actors at a community level in unpredictable ways no matter how well-grounded in local needs they are.

5 Conclusions

Until now, no empirical research has investigated human relations with peatlands in the Peruvian Amazon. Using an exploratory approach with qualitative empirical research methods (semi-structured interviews; participatory mapping; guided site visits) in two different local communities (one small indigenous community and one comparatively large *mestizo* community), we found that peatlands are valuable to local people because of their natural resources (palm fruit; wood and timber; game species) and their cultural importance (as important areas for the local mythology), even if 'peatlands' per se are not a category of concern to them. Peatlands also occupy a culturally ambiguous position due to the dangers associated with them, such as sinking into the waterlogged ground or being attacked by anacondas and evil spirits. Nevertheless, we also found that the biophysical characteristics of tropical peatlands make them sufficiently distinct to potentially allow peatland-targeted environmental management and conservation activities in collaboration with local communities, who may refer to peatland areas with specific local terms (such as *aguajal chupadera*, or 'sucking' palm swamp; see also Authors 2019).

At present, management of these areas is extremely limited as it mostly consists of keeping out non-community members, while the mounting degradation of peatlands was recognised especially by members of the *mestizo* community who participated in our research. They ascribed degradation to overuse, overpopulation, carelessness, as well as lack of outside support and alternative economic opportunities.

It also appeared that ecological degradation is strongly linked with a loss of cultural heritage, with potential implications for peatland conservation. The Urarina still practice the cultural tradition of moving the location of their community every few decades, which allows palm trees, as well as animal populations to recover, but then struggle to have these moves legally recognised by the Peruvian state. *Mestizos* are instead hoping to modernise their community and switch to a fully monetary and capitalist economy, which seems comparatively less compatible with peatland conservation (even if carbon conservation projects may have potential elsewhere in the Peruvian Amazon, see Roucoux et al. 2017).

The main conservation strategies advocated by locals in both communities were limiting access and resource use, sowing new (palm) trees, and above all, creating alternative economic opportunities. These might either be related to peatland use, such as the construction of *aguaje* fruit processing plants, or unrelated, such as working for oil companies, and in this way, mirror classic debates about the need to combine environmental conservation and economic development.

Nominally, most community members approached potential conservation and development strategies with pragmatism. For example, *mestizo* community members were supportive of the idea of developing markets for sustainable peatland products (see also Roucoux et al. 2017), especially *aguaje* palm fruit, which could be harvested by climbing palm trees. At present, they are already heavily involved in the unsustainable palm fruit market. Nevertheless, it is also likely that such ideas would face implementation challenges, notably gaining local people's trust for using novel harvesting techniques after a history of failed development interventions in the area.

Declaration of interests

The authors declare no conflict of interests.

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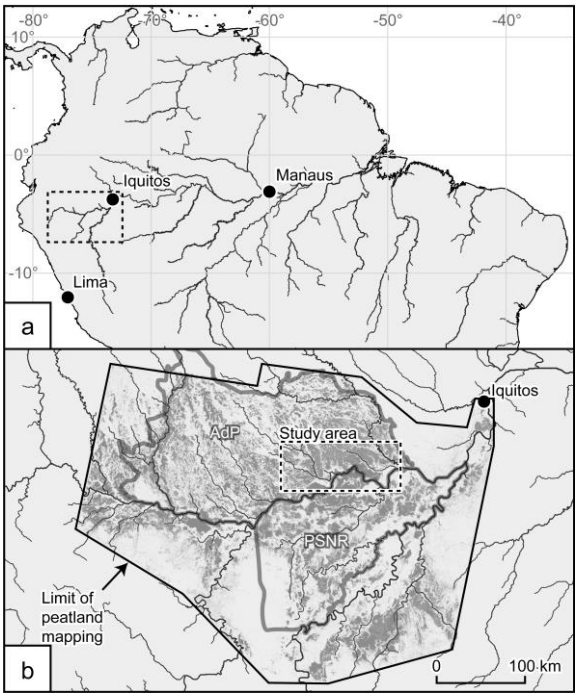

Figure 1: (a) Location of the Pastaza-Marañón Basin in western Amazonia (dashed box); (b) inset showing the Pastaza-Marañón Basin, with the modelled distribution of peatlands following Draper et al. (2014) in grey. The study area, around the Chambira and Tigre River Basins of Peru's Loreto Region, is indicated. AdP stands for 'Abanico del Pastaza', a Ramsar wetland site; PSNR stands for Pacaya-Samiria National Reserve, a protected area.

Table 1: Summary of uses, cultural significance, and current management of peatlands in two communities of the Peruvian Amazon (explained in depth in sections 3.1-3.3)

	***Mestizo* community**	**Indigenous community (Urarina)**
Local terms likely associated with peatland areas	*Aguajal chupadera* ('sucking' palm swamp dominated by *Mauritia flexuosa*) *Aguajal raizal/ champal* (palm swamp with comparatively firm ground dominated by *Mauritia flexuosa*)	*Alaka* (palm swamp forest; permanently to seasonally wet ecosystem)
	Aguajal varillal (*Mauritia flexuosa* palm swamp with short and thin trees like pole forest) *Piripiral* (sedgeland) *"Allá es feísimo."* ("very ugly" areas)	*Jiiri* ('open space'; permanently wet ecosystem including open peatland areas and pole forest)
Uses (section 3.1)	Palm fruit for own consumption (*Mauritia flexuosa; Oenocarpus batahua; Mauritiella armata*)	Palm fruit for own consumption (*Mauritia flexuosa; Oenocarpus batahua; Mauritiella armata*)
	Palm fruit for trade (*Mauritia flexuosa*), including intra-community intermediaries and travelling traders	Palm fruit for small-scale trade (*Mauritia flexuosa*) with travelling traders

	Palm leaves (*Attalea butyracea*) for roofing	Palm leaves (*Attalea butyracea*) for roofing
	Palm hearts for trade (*Euterpe precatoria*), including intra-community intermediaries and travelling traders	Palm hearts for small-scale trade (*Euterpe precatoria*) with travelling traders
		Palm fibre for textile production (*Mauritia flexuosa*)
	Wood and timber for personal use and trade (e.g. *Virola sp.*; *Lauraceae*; *Hevea brasiliensis*, *Calophyllum brasiliense*)	Wood and timber for personal use (mostly *Virola sp.*)
	Hunting (e.g. tapirs, caimans, peccaries, agoutis, various monkey species, Spix's guan, great tinamou)	Hunting (e.g. tapirs, caimans, peccaries, agoutis, various monkey species, Spix's guan, great tinamou)
Cultural significance (section 3.2)	Home of various locally confined guardian spirits (but not exclusive to peatlands)	*Jiiri* and *alaka* as home of the *Baainu*, a dangerous guardian spirit
	Area where 'dead lakes' can be found (cultural taboo areas where natural resource use carries risks for one's life)	Area where *Mauritia flexuosa* grows, with importance for Urarina creation myth (Dean 1994)
Current management and conservation (section 3.3)	Local community self-governance with dual system of indigenous and state-recognised authorities, and community assemblies	Local community self-governance with dual system of indigenous and state-recognised authorities, and community assemblies
	Safeguarding from resource use by non-community members	Safeguarding from resource use by non-community members
	Trade limits for fish; fixed prices for intra-community trade of fish and meat; very limited compliance	Ban on timber harvesting and use of fish poison, mostly complied with
	Strong sense of resource depletion, including game species, palm trees, timber	Limited sense of resource depletion, including game species, palm trees, timber
	Individual adoption of sustainable practices, such as climbing *Mauritia flexuosa* palm trees, planting *Mauritia flexuosa* seedlings, alternative monetary income strategies	Limited adoption of sustainable practices, such as planting of tree seedlings (with NGO support)
	Community has been in the same place since foundation in 1933, area of depleted resources is gradually expanding outwards	Community has been in the same place since the 1980s, change of community location every few decades to allow resource regeneration

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