Received: 22 November 2019 | Accepted: 24 April 2020

DOI: 10.1111/1365-2664.13690

Journal of Applied Ecology BRITISH ECOLOGICAL SOCIETY

PRACTITIONER'S PERSPECTIVE

A shared perspective on managing Amazonian sustainable-use reserves in an era of megafires

Jackeline Nóbrega Spínola[1] | Maria Jociléia Soares da Silva[2] | Jose Risonei Assis da Silva[2] | Jos Barlow[3,4] | Joice Ferreira[5]

[1]Instituto Chico Mendes de Conservação da Biodiversidade (ICMBio), Tapajos-Arapiuns Extractive Reserve, Santarém, Brazil

[2]Instituto Chico Mendes de Conservação da Biodiversidade (ICMBio), Tapajós National Forest, Laguinho, Santarém, Brazil

[3]Lancaster Environment Centre, Lancaster University, Lancaster, UK

[4]Department of Biology, Federal University of Lavras, Minas Gerais, Brazil

[5]Embrapa Amazonia Oriental, Trav. Eneas Pinheiro, Belém, Brazil

Correspondence
Joice Ferreira
Email: joice.ferreira@embrapa.br

Funding information
CNPq-PELD-CAPES, Grant/Award Number: 441659/2016-0; CNPq-Prevfogo-IBAMA, Grant/Award Number: 441949/2018-5; Natural Environment Research Council, Grant/Award Number: NE/P004512/1 and NE/S0184X/1

Handling Editor: Alexandro B. Leverkus

Abstract

1. Unprecedented forest fires are affecting large swathes of what were once fire-free Amazonian forests, including extensive areas of community-managed reserves. This shared overview of experiences of practitioners and researchers examines ways in which these reserves can be supported to reduce the risk of forest fires.
2. We highlight six considerations that are key to fire reduction: inclusive management and community leadership, adapting to demographic and cultural changes, identifying examples of good practice, socially just alternative livelihoods, forecasting and planning and bridging scientific research and innovation.
3. *Policy implications*. The escalating fire problem in Amazonia and elsewhere means we urgently need to learn from past experiences. Co-developed ecological and social research can support novel approaches to reserve management, but achieving this will require sustained investment and ongoing dialogue between communities, managers, researchers and the government.

KEYWORDS

Amazonia, anthropocene, climate change, co-design, forest fires, management, tropical forest

1 | INTRODUCTION

Amazonia faces a growing threat from globally and regionally driven climatic changes. Temperatures are increasing due to atmospheric changes (Nobre et al., 2016) and regional deforestation (Prevedello, Winck, Weber, Nichols, & Sinervo, 2019), and dry seasons lengths in some regions have increased by 6.5 days a decade (Fu et al., 2013). Such changes are exacerbated by the increasing frequency and intensity of climate anomalies, driven by El Nino events or changes in Atlantic sea surface temperatures (Chen et al., 2011). All this is superimposed upon an altered local context; decades of logging and deforestation have made many of the remaining forests hotter and drier, while deforestation has brought fire-dependent agriculture into contact with more forests (Davidson et al., 2012).

These local and global changes have combined to allow the spread of unprecedented forest fires into what were once fire-free Amazonian forests (Barlow, Berenguer, Carmenta, & França, 2019). Forest fires were first observed by scientists in the 1980s, and received prominent scientific attention following the 1998 El Nino (e.g. Cochrane et al., 1999). Since then, they have become even more frequent and extensive, and fire-driven forest degradation can even occur without nearby deforestation activity (Aragão et al., 2018). Despite their low intensity, Amazonian forest fires can kill up to 50% of the trees and are one of the major threats to the Amazon's integrity (Fonseca et al., 2019). The smoke increases the prevalence of respiratory illnesses in the region (Machado-Silva et al., 2020), while the changes in forest structure and composition greatly reduce the goods and services they provide to local people (Barlow et al., 2012).

Alarmingly, these forest fires are no longer restricted to forest edges or fragmented agricultural landscapes. Extensive wildfires during the 2015–2016 El Niño drought were linked

with extensive forest fires in some of the largest remaining patches of forest. For example, extensive wildfires were reported in the Kayapó reserve in Mato Grosso, the Arariboia reserve in Maranhao and across many sustainable use reserves (SURs; e.g. de Sousa Mascarenhas, Brown, & da Silva, 2018). These reserves include indigenous lands, as well as community-managed extractive reserves and national forests—classifications that make up the vast majority (73%) of the protected area coverage in the Brazilian Amazon. Within these reserves, many inhabitants are reliant on shifting farm-fallow agriculture to produce crops such as manioc and other diverse produce, using practices transmitted across generations that avoid the need for external inputs in the form of fertilizers or agrochemicals (Padoch, 2018). Yet, while these approaches rarely lead to escaped forest fires under normal climatic contexts, they have become increasingly risky given the changing climatic and local environmental context.

Our aim in this work is to examine ways in which SURs can be supported so they can reduce the risk of forest fires, bringing together the collective insights from reserve managers for SURs (Figure 1) at the forefront of the wildfire crisis in the Amazon—the Tapajos National Forest and the Tapajos-Arapiuns Extractive Reserve—and two researchers who have been working in the region for over two decades. We first briefly describe the study region and context and forest fire history and impacts, and then explore the lessons and challenges regarding fire management over the past 20 years. We believe that many of the issues will be relevant for natural resource management in complex socio-ecological systems facing changing environmental conditions.

2 | STUDY REGION

The Tapajos National Forest (FLONA, herafter) and the Tapajos-Arapiuns Extractive Reserve (RESEX, hereafter) cover 527,319 ha and 690,070 ha, respectively (Figure 1). They hold 97 communities in total (23 and 74, respectively), and over 18,000 people (3,000 and 15,000, respectively). These include a broad range of ethnicities, including at least ten indigenous groups (Arara Vermelha, Arapiun, Cobra Grande, Cumaruara, Jaraqui, Maitapu, Munduruku, Tapajo, Tapaiu, Tupinamba) and 'caboclos' with mixed indigenous, European and African ancestry. The livelihoods of the residents of the RESEX and FLONA are predominately based on farm-fallow shifting agriculture, with manioc as the main crop. This is supplemented by fishing and non-timber forest product (NTFP) extraction. Community management for timber extraction has also become an important revenue source in the FLONA.

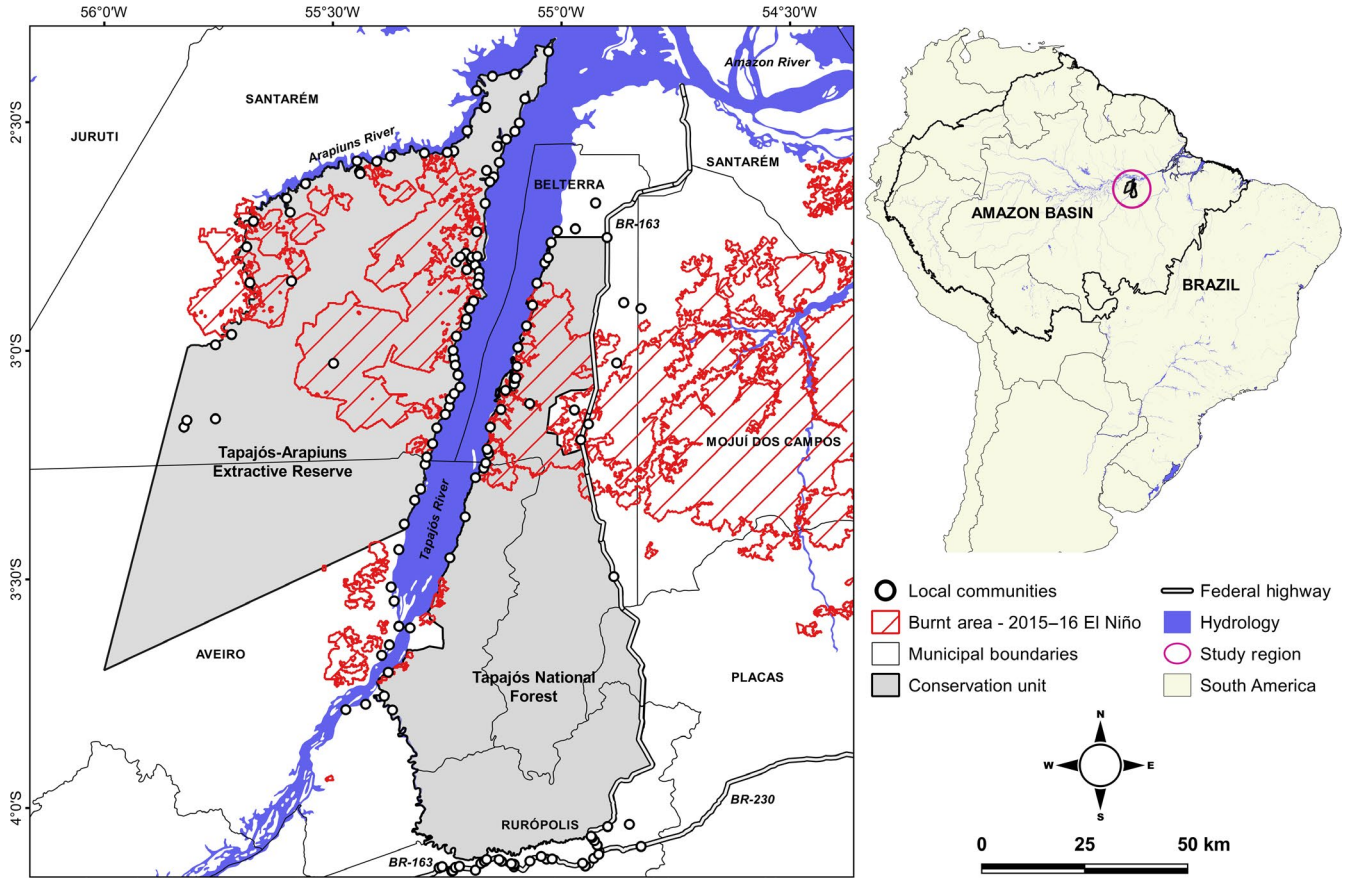

FIGURE 1 The Tapajos-Arapiuns Extractive Reserve (RESEX) and the Tapajos National Forest (FLONA), in Central Amazon, showing 2015–2016 fire scars. Burnt area data from Withey et al. (2018)

3 | FIRE HISTORY AND IMPACTS

Both reserves were affected by forest fires in 1998 (e.g. Peres, 1999), with one study revealing around 41,000 ha of burned forest in and around the FLONA in that year (Johnson, 2017). The burn extent in the 2015–2016 ENSO was much greater, with 240,000 ha in and around the FLONA (Johnson, 2017), and over 1 million ha in the region (Withey et al., 2018), affecting 28% of the RESEX and 14% of the FLONA (Figure 1).

These forest fires are known to bring about the mortality of *c*. 50% of trees (e.g. Barlow et al., 2012), leading to a long-term reduction in forest carbon stocks (Silva et al., 2018), and the populations of understorey bird communities (Mestre, Cochrane, & Barlow, 2013). Social consequences were diverse, including increase of respiratory illness from the smoke (Machado-Silva et al., 2020), and longer-term losses of hunting grounds and access to fruit trees, medicinal herbs and timber (J. Barlow, J. Ferreira, & J. Nóbrega Spínola, pers. obs.). Forest fires make forests even more flammable—and in 2017, the RESEX suffered another significant wildfire event even though the year had a 'normal' dry season (J. Barlow, J. Ferreira, & J. Nóbrega Spínola, pers. obs.).

4 | LESSONS AND CHALLENGES FOR MANAGEMENT

Our shared experiences highlight six key lessons for management.

4.1 | Inclusive management and fostering community leadership of environmental problems

Fire management requires participatory approaches that support and build upon local demand for action. While fire is an essential and highly beneficial tool in local agriculture, forest fires are extremely costly for local people, causing losses from fences to agricultural production and damaging human health (de Mendonça et al., 2004), which might increase risk perception and create incentive for change. Bringing about change in remote and dispersed populations is difficult (Salisbury & Schmink, 2007), but can build upon two key features of SURs. First, communities are directly involved in reserve management decisions via consultative (FLONA) or deliberative (direct power; RESEX) councils involving over 150 people in total. Second, the fact that many extractive reserves were created in response to demands from local communities has created a legacy of social and political organization, with communities organized into associations, which are aggregated into federations to strengthen representativeness.

There is promising evidence that community involvement has the potential to bring about better fire-management practices (Mistry, Schmidt, Eloy, & Bilbao, 2019). Following the 1998 fires, the reserve management councils incorporated changes to their agricultural practices. These were incorporated into the overall management plans in the Tapajós reserves and elsewhere, and included commitments to arrange when and how to burn with neighbours, and to organize a group of people collectively responsible for administering and controlling the burns. Unfortunately, many communities or families found it difficult to implement these actions (e.g. Carmenta, Vermeylen, Parry, & Barlow, 2013), but the magnitude of the forest fires in 2015 has resulted in communities in the RESEX to push for these rules to be revisited and reinforced in council meetings held in July 2019.

Links between reserve residents and park management authorities have also helped the establishment of community-based fire combat. A local programme has been launched through community firefighters that act across the reserves during the dry season. This stems from a national programme run by ICMBio that hires 1,900 firefighters each year across many of Brazil's federal conservation units (Morello et al., 2020). Although around 430 of these fire fighters will be allocated to the Amazon region in 2020, they will be present in just 7% of the region's reserves (25 of 352). Furthermore, even where they are allocated, the average density will be just one firefighter per 48,800 ha of protected area. In the FLONA, just 12 residents of the conservation unit or its surroundings are engaged in the programme each year.

The brigades have two key roles. The main one is helping combat forest fires using a range of fire-fighting techniques such fire breaks in the forest and back burns. Additionally, they can help prevent fires by supporting the licensing of agricultural burns and developing environmental education activities. Working during the dry season, from August to February, they also help to control fires in neighbouring reserves, such as in the RESEX, that can only count on voluntary work due to the category of the reserve where the residents are co-responsible for protecting the area.

The community firefighters played a key role in preventing the further spread of forest fires that affected the RESEX in 2017. However, their actions were limited by many challenges. First, the number of firefighters is clearly insufficient to deal with large conflagrations, and even where numbers have gone up, this has not been matched by an increase in funding for much-needed equipment. Second, these numbers do not change according to the risk of fire in a given year—climate variability demands a more flexible system, and the rapid deployment of reserves previously trained in fire-fighting techniques could be effective. Finally, developing true community participation is always challenging due to the inherent asymmetry between managers, council representatives and local communities. This can be exacerbated when discussions are led by outside organizations, as local people may not be able to express their views in full, or engage with other forms of knowledge including science. In this case, managers have a key role in fostering dialogue that overcomes these barriers. This is especially true when the management councils are only consultative, as community inclusion is highly dependent on the openness and engagement of managers.

4.2 | Understanding demographic and cultural changes

In the past, fire used to be set and controlled collectively through the assembly of the family and neighbours, a practice known as '*Puxirum*' in the local indigenous language. However, this has been undermined

by migration from the reserve to urban areas, especially by younger age groups who leave in search of education and employment opportunities: in 2017, 70% of the local population was composed of young (under 20) and older people (≥55 years). As a result, locals have reported that decreasing family sizes and reduced interaction between neighbours has meant that the burning of slashed vegetation has become a less collective practice, increasing the risk of agricultural fires getting out of control. These demographic changes partly explain the failure of co-developed fire-management plans developed in the early 2000s, and demonstrate that any attempt to promote alternative management practices requires understanding the full set of constraints faced by local people (e.g. Carmenta et al., 2013).

4.3 | Identifying and promoting examples of good practice

The reserves are culturally diverse, encompassing many different ethnic groups, including several which have recently re-identified as indigenous. Although fire is a common problem across communities, important differences may help in designing protocols to improve fire control. For example, while the majority of communities in the RESEX experienced uncontrolled fires in 2015 or 2017, a number of communities that have internet access reported being able to control fires, by messaging people within and between communities using commonly used apps to communicate fire risk, and by promoting collective action to combat fires spreading between neighbouring communities. Exploring the reasons for these fire-management 'brightspots' could help inform more effective management in other communities and other reserves.

4.4 | Explore and encourage socially just alternative livelihoods

One approach to reducing the risk of forest fires involves reducing community dependence on farm-fallow agriculture (e.g. Barlow et al., 2012). An observed decrease in fire-dependent agricultural practices in the FLONA can be attributed to the development of community-managed timber production that was initiated 20 years ago with the creation of a community-led logging cooperative (COOMFLONA). This is not without its own risks, as selective logging has long been identified as a factor that makes forests drier and more flammable (Holdsworth & Uhl, 1997). A key challenge therefore involves ensuring that these alternative livelihoods do not have perverse outcomes—especially if ignition sources come from outside the reserves.

Tourism can also help some communities to decrease their dependence on farm-fallow agriculture. ICMBio records show that the FLONA receives around 30,000 visitors each year including tourists, researchers and students. In the RESEX, a number of initiatives supported by local NGOs foster projects that involve the local population, especially the younger age groups, to increase empowerment and appreciation of traditions and territories, including entrepreneurship in community-based tourism, handcrafts, forest restoration and agroforestry. There is a huge challenge, though, to scale up these activities to make a difference at a large scale. One important step is to ensure that the lessons learned from a series of small and often isolated projects (often supported by local NGOs and/or international agencies) are captured, and used to design public policies by national agencies.

4.5 | Improving forecasting and planning

There is a big inter-annual variation in fire risk, as forest fires remain strongly linked to dry season severity (Aragão et al., 2018). In wetter years, even the riskiest agricultural practices will fail to cause forest fires, while in drier years, even best practice approaches could by risky. Managing this variation in risk requires understanding agricultural fires, and detecting forest fires.

To understand local practices, the ICMBio team distributes a questionnaire to its residents at the beginning of each year with questions regarding the intention to use fire for agricultural practices in the following dry season. The questions are designed to assess whether farmers intend to create new agricultural plots (*roças*) in the next planting season, the total area to be converted, the current land cover of areas to be converted, the week and month and time of day that burning will take place and if there are any plans to build fire breaks and, if so, their dimensions. The collected responses allow managers to predict the potential risks, the requirement for action, as well as to monitor and enforce if the rules are being followed. This programme of monitoring the fire risk through previous information about *roças* was implemented in response to suggestions of the councils. Despite the potential of the initiative, monitoring is still challenging as the two reserves have around 2,000 roças established each year to be monitored by just 21 employees (16 at the FLONA and five in the RESEX). The scheme has many limitations, from access to remote places to limited budgets for purchasing equipment and fuels, meaning follow-up monitoring is not feasible.

The challenges inherent in these local approaches could be partly overcome through the development of systems that integrate remote sensing and fire risk forecasting. Currently, an office at ICMBio in the capital, Brasilia, collates and sends information to the reserves on fire and deforestation based on the various deforestation and fire monitoring products (BD Queimadas, PRODES and DETER) collated or developed by the National Institute for Space Research (INPE). The aim is to aid law enforcement and control of wildfires, yet many alerts go unchecked due to the financial and logistical difficulties faced by local teams. More recently, managers and scientists are discussing the development of an alert system created in a participatory way with the local

communities, through the collation of various levels of local information that together inform fire risk and vulnerability, including land uses, logging areas, forest condition, population density and existence of radio stations for communication. The development of such systems is in the scope of the 'Sem-Flama' research project jointly funded by the environment agency's fire prevention programme (Prevfogo) and the Brazilian Research Council (CNPq), developed by a project team including the authors of this paper. The project aims to place local communities at the forefront of the initiative to co-develop the alert and combat system, with the aim of overcoming some of the logistical constraints faced by a limited number of park managers. By using technology to aid communication between federal and regional institutions and local people, the initiative could also help capture and disseminate information about better fire-management practices and alternative fire-free livelihoods.

4.6 | Making the most of scientific research

Both reserves have been fundamental to the advance of scientific knowledge in the Amazon. The FLONA is the most studied conservation unit in the Brazilian Amazon, with more than 520 registrations of scientific projects and more than 130 of educational activities since its creation, while the RESEX is the most studied extractive reserve in the state of Pará. Studies on topics such as forest management for timber production and silviculture have been developed since the 1970s in the FLONA by the federal agency EMBRAPA (Brazilian Agricultural Research Corporation). Other important research networks involving different institutions have been developing long-term ecological studies in the last decade such as the National Biodiversity Program (PPBio) and the Sustainable Amazon Network (RAS). Since 2011, FLONA managers and scientists have co-organized a seminar aiming to disseminate results of research projects developed in the reserve and to encourage new ones. From 2018 onwards, this seminar has been also co-organized by the RESEX management team through a collaborative programme called 'The river that joins us' ('O Rio que nos une', in Portuguese).

This research has a value in its own right, helping, for example, quantify losses of carbon stocks and biodiversity following forest fires, understanding the interactions between climate and local stressors and informing strategies for conservation. But the presence of scientists and scientific research in reserves can have other, less obvious benefits. Scientists have helped draw attention to the wildfire crisis (e.g. Barlow et al., 2019), informing reserve management plans, supporting outreach with communities, training reserve managers and technicians in how to integrate remote sensing into their plans, promoting responses. These have been helped by large networks such as the large scale biosphere atmosphere experiment (LBA), which has provided logistical support and a bridge between researchers and locals. Naturally, important knowledge gaps remain, and more science is needed to support the urgent actions needed and to improve integration. After all, this is necessary to understand wildfire risk at a local scale and to assist communities to manage burns more safely. Further research is also required to develop forms of farming, such as agroforestry that can be used to create permanent fire breaks that physically separate slash-and-burn agriculture from forests, and to provide a stable income for local communities. All this will be fundamental to encourage sustainable and safe use of fire in local agriculture.

5 | ADDRESSING THE CHALLENGES

Despite the local, regional and global importance of preventing forest fires in tropical forests, the experiences over the past two decades have not been promising. The actions put in place in response to the 1997–1998 El Niño event did not prevent a much larger fire crisis during the 2015–2016 event; and forest fires have occurred even in relatively wet years such as 2017. But that does not mean we cannot learn from the experiences, and it is important to remember that these community-managed reserves are also relatively new, and that the issue of forest fires has been just one of many challenges faced by local peoples as they adapt to the changing socio-environmental context.

While the range of initiatives we present has the potential to make a real difference, scientists and practitioners will need to continue to search for alternative solutions that provide viable alternatives to the current development paradigm through innovation and by providing benefits to local people (e.g. Nobre et al., 2016). Whether we improve existing measures or develop new ones, long-term financial support will be crucial. It is therefore unfortunate that the current context is far from favourable with up to 95% cuts in public spending on fire prevention activities in 2019. These cuts in public financing are exacerbated by the loss of the Amazon Fund that supported government bodies and military fire brigades to prevent and combat fires in protected areas, as well as supporting a National Fire Information System to integrate information on fire licenses (Amazon Fund Activity Report, 2018). Moreover, cooperation between researchers, managers and teaching institutions has also been threatened by vast cuts to budgets for research and training young scientists (Nobre, 2019). Diminishing budgets for science and reserve management represent major challenges to the consolidation of the learning networks necessary to solve complex multifaceted problems, such as wildfires in Amazonian reserves.

ACKNOWLEDGEMENTS

This work resulted from collaborative activities between the managers and researchers primarily supported by the Brazilian Research Council CNPq-PELD-CAPES (PELD-RAS; 441659/2016-0), CNPq-Prevfogo-IBAMA (SEM-FLAMA; 441949/2018-5) and the Natural Environment Research Council (NERC; NE/P004512/1 e NE/S0184X/1). We would like to thank all members of the AFIRE

and Sem Flama projects for their support and discussions, Erika Berenguer and Filipe França for their long-standing commitment to research in the Santarém region, Dr Luke Parry for comments on a draft, Paulo Tavares and Rodrigo Oliveira for support collating data and developing the figure and two anonymous reviewers for their detailed input and suggestions.

AUTHORS' CONTRIBUTIONS

All authors were involved in the development of ideas and the revision of the text. The writing in English was led by J.B. and J.F., and all authors gave final approval for publication.

DATA AVAILABILITY STATEMENT

This article does not use data, therefore, there are no data archived.

ORCID

Jos Barlow https://orcid.org/0000-0003-4992-2594
Joice Ferreira https://orcid.org/0000-0002-4008-2341

REFERENCES

Amazon Fund Activity Report. (2018). http://www.fundoamazonia.gov.br/export/sites/default/en/.galleries/documentos/rafa/RAFA_2018_en.pdf

Aragão, L. E., Anderson, L. O., Fonseca, M. G., Rosan, T. M., Vedovato, L. B., Wagner, F. H., … Saatchi, S. (2018). 21st century drought-related fires counteract the decline of Amazon deforestation carbon emissions. *Nature Communications*, *9*(1), 536. https://doi.org/10.1038/s41467-017-02771-y

Barlow, J., Berenguer, E., Carmenta, R., & França, F. (2019). Clarifying Amazonia's burning crisis. *Global Change Biology*, *26*(2), 319–321. https://doi.org/10.1111/gcb.14872

Barlow, J., Parry, L., Gardner, T. A., Ferreira, J., Aragão, L. E. O. C., Carmenta, R., … Cochrane, M. A. (2012). The critical importance of considering fire in REDD+ programs. *Biological Conservation*, *154*, 1–8. https://doi.org/10.1016/j.biocon.2012.03.034

Carmenta, R., Vermeylen, S., Parry, L., & Barlow, J. (2013). Shifting cultivation and fire policy: Insights from the Brazilian Amazon. *Human Ecology*, *41*, 603–614. https://doi.org/10.1007/s10745-013-9600-1

Chen, Y., Randerson, J. T., Morton, D. C., DeFries, R. S., Collatz, G. J., Kasibhatla, P. S., … Marlier, M. E. (2011). Forecasting fire season severity in South America using sea surface temperature anomalies. *Science*, *334*(6057), 787–791. https://doi.org/10.1126/science.1209472

Cochrane, M. A., Alencar, A., Schulze, M. D., Souza, C. M., Nepstad, D. C., Lefebvre, P., & Davidson, E. A. (1999). Positive feedbacks in the fire dynamic of closed canopy tropical forests. *Science*, *284*(5421), 1832–1835.

Davidson, E. A., de Araújo, A. C., Artaxo, P., Balch, J. K., Brown, I. F., Bustamante, M. M., … Wofsy, S. C. (2012). The Amazon basin in transition. *Nature*, *481*(7381), 321–328. https://doi.org/10.1038/nature10717

de Mendonça, M. J. C., Diaz, M. D. C. V., Nepstad, D., da Motta, R. S., Alencar, A., Gomes, J. C., & Ortiz, R. A. (2004). The economic cost of the use of fire in the Amazon. *Ecological Economics*, *49*(1), 89–105. https://doi.org/10.1016/j.ecolecon.2003.11.011

de Sousa Mascarenhas, F., Brown, I. F., & da Silva, S. S. (2018). Desmatamento e incêndios florestais transformando a realidade da Reserva Extrativista Chico Mendes. *Desenvolvimento E Meio Ambiente*, *48*. https://doi.org/10.5380/dma.v48i0.58826

Fonseca, M. G., Alves, L. M., Aguiar, A. P. D., Arai, E., Anderson, L. O., Rosan, T. M., … Aragão, L. E. O. C. (2019). Effects of climate and land-use change scenarios on fire probability during the 21st century in the Brazilian Amazon. *Global Change Biology*, *25*(9), 2931–2946. https://doi.org/10.1111/gcb.14709

Fu, R., Yin, L., Li, W., Arias, P. A., Dickinson, R. E., Huang, L., … Myneni, R. B. (2013). Increased dry-season length over southern Amazonia in recent decades and its implication for future climate projection. *Proceedings of the National Academy of Sciences of the United States of America*, *110*(45), 18110–18115. https://doi.org/10.1073/pnas.1302584110

Holdsworth, A. R., & Uhl, C. (1997). Fire in Amazonian selectively logged rain forest and the potential for fire reduction. *Ecological Applications*, *7*, 713–725. https://doi.org/10.1890/1051-0761(1997)007[0713:FIASLR]2.0.CO;2

Johnson, G. (2017). *Temporal and spatial distributions of burn scars in Tapajós National Forest* (MSc thesis). Lancaster University.

Machado-Silva, F., Libonati, R., Melo de Lima, T. F., Bittencourt Peixoto, R., de Almeida França, J. R., de Avelar Figueiredo Mafra Magalhães, M., … DaCamara, C. C. (2020). Drought and fires influence the respiratory diseases hospitalizations in the Amazon. *Ecological Indicators*, *109*. https://doi.org/10.1016/j.ecolind.2019.105817

Mestre, L. A. M., Cochrane, M. A., & Barlow, J. (2013). Long-term changes in bird communities after wildfires in the central Brazilian Amazon. *Biotropica*, *45*(4), 480–488. https://doi.org/10.1111/btp.12026

Mistry, J., Schmidt, I. B., Eloy, L., & Bilbao, B. (2019). New perspectives in fire management in South American savannas: The importance of intercultural governance. *Ambio*, *48*(2), 172–179. https://doi.org/10.1007/s13280-018-1054-7

Morello, T. F., Ramos, R. M., Anderson, L. O., Owen, N., Rosan, T. M., & Steil, L. (2020). Predicting fires for policy making: Improving accuracy of fire brigade allocation in the Brazilian Amazon. *Ecological Economics*, *169*, 106501.

Nobre, C. (2019). To save Brazil's rainforest, boost its science. *Nature*, *574*, 455. https://doi.org/10.1038/d41586-019-03169-0

Nobre, C. A., Sampaio, G., Borma, L. S., Castilla-Rubio, J. C., Silva, J. S., & Cardoso, M. (2016). Land-use and climate change risks in the Amazon and the need of a novel sustainable development paradigm. *Proceedings of the National Academy of Sciences of the United States of America*, *113*(39), 10759–10768. https://doi.org/10.1073/pnas.1605516113

Padoch, C. (2018). Swidden cultivation. *The International Encyclopedia of Anthropology*, 1–4. https://doi.org/10.1002/9781118924396.wbiea2324

Peres, C. A. (1999). Ground fires as agents of mortality in a Central Amazonian forest. *Journal of Tropical Ecology*, *15*(4), 535–541. https://doi.org/10.1017/S0266467499000991

Prevedello, J. A., Winck, G. R., Weber, M. M., Nichols, E., & Sinervo, B. (2019). Impacts of forestation and deforestation on local temperature across the globe. *PLoS ONE*, *14*(3), e0213368. https://doi.org/10.1371/journal.pone.0213368

Salisbury, D. S., & Schmink, M. (2007). Cows versus rubber: Changing livelihoods among Amazonian extractivists. *Geoforum*, *38*(6), 1233–1249. https://doi.org/10.1016/j.geoforum.2007.03.005

Silva, C. V. J., Aragão, L. E. O. C., Barlow, J., Espirito-Santo, F., Young, P. J., Anderson, L. O., … Xaud, H. A. M. (2018). Drought-induced Amazonian wildfires instigate a decadal-scale disruption of forest carbon dynamics. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *373*(1760). https://doi.org/10.1098/rstb.2018.0043

Withey, K., Berenguer, E., Palmeira, A. F., Espírito-Santo, F. D. B., Lennox, G. D., … Barlow, J. (2018). Quantifying immediate carbon emissions from El Niño-mediated wildfires in humid tropical forests. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *373*(1760). https://doi.org/10.1098/rstb.2017.0312

BIOSKETCHES

The first three authors are managers at the Chico Mendes Institute for Biodiversity Conservation (ICMBio), the branch of the Environmental Ministry that manages Brazil's federal conservation units. The last two authors are researchers who have worked in the Amazon for two decades.

Jackeline Nóbrega Spínola has a professional master's degree in the management of protected areas in the Amazon. Working at the Tapajós-Arapiuns Extractive Reserve, she is in charge of environmental monitoring, connecting actors at an institutional level, environmental licensing and implementing public policies within traditional communities.

Maria Jociléia Soares da Silva has a professional master's degree in the management of protected areas in the Amazon. She works in the management of the Tapajós National Forest coordinating environmental education, conflict management, voluntary programmes, conservation management plans, participatory work and public policies.

José Risonei Assis da Silva is the manager in chief of the Tapajós National Forest. He has a post-graduate diploma in forest management and his actions involve coordinating strategic plans and monitoring, as well as implementing environmental regulations within the reserve.

How to cite this article: Nóbrega Spínola J, Soares da Silva MJ, Assis da Silva JR, Barlow J, Ferreira J. A shared perspective on managing Amazonian sustainable-use reserves in an era of megafires. *J Appl Ecol*. 2020;00:1–7. https://doi.org/10.1111/1365-2664.13690