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### Authors

Carson, Savanna L  
Kentatchime, Fabrice  
Nana, Eric Djomo  
[et al.](#)

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## Indigenous Peoples' Concerns About Loss of Forest Knowledge: Implications for Forest Management

Savanna L. Carson<sup>a</sup>, Fabrice Kentatchime<sup>b</sup>, Eric Djomo Nana<sup>b</sup>, Kevin Y. Njabo<sup>a,c</sup>, Brian L. Cole<sup>a,d</sup>, and Hilary A. Godwin<sup>a,c,#</sup>

<sup>a</sup>Department of Environmental Health Sciences, Fielding School of Public Health, University of California, CA, USA

<sup>b</sup>Higher Institute of Environmental Sciences – IBAY Sup, Yaoundé, Cameroon

<sup>c</sup>Center for Tropical Research, Institute of the Environment and Sustainability, University of California, CA, USA

<sup>d</sup>Department of Health Policy and Management, Fielding School of Public Health, University of California, CA, USA

<sup>#</sup>Corresponding author. E-mail: [hgodwin@ucla.edu](mailto:hgodwin@ucla.edu)

### Abstract

Although indigenous populations' participatory rights are recognised as a worldwide priority in forest management, local practices vary in interpretation, scope, and efficacy. The next generation of sustainable forest policies will require a greater degree of self-determination from indigenous groups (i.e., the ability for use, ownership, management, and control of their traditional lands and resources). Our case study provides insights into how an indigenous population, the Baka in Cameroon, face barriers to participation in policy making, hindering recognition of rights to traditional forestland. The Baka interviewed herein expressed concern for how forest management impacts their livelihoods, threatens traditional ecological knowledge, and limits self-determination. Educational opportunities may provide co-benefits for indigenous stakeholders in forest management. To motivate indigenous inclusion specifically in forest management, we recommend educating forest managers in cultural competency and the importance of indigenous inclusion and knowledge. We recommend development of Baka educational programmes that are focused on promoting greater self-determination and enriching understanding of the forest management processes. These findings would help develop better relationships between indigenous peoples and forest management worldwide.

**Keywords:** forest governance, Baka, Indigenous populations, participatory forestry management, Cameroon, community-based action research, traditional ecological knowledge

### INTRODUCTION

Indigenous participation is argued to be a best practice in forest management<sup>1</sup> and biodiversity conservation for utilitarian, rights-based, and moral reasons. From a utilitarian perspective, the inclusion of indigenous priorities and knowledge

provides critical information. (Naughton-Treves et al. 2005; Gómez-Baggethun et al. 2013; Agarwala et al. 2014; Ives and Kendal 2014; Johnson et al. 2016; Bennett et al. 2017; Mantyka-Pringle et al. 2017). For instance, indigenous populations are sources of local ecological knowledge about environmental dynamics that influence forest sustainability (e.g., that have resulted from climate change) (Nyong et al. 2007; Berkes 2009; Green and Raygorodetsky 2010; Alexander et al. 2011; Abbott and Wilson 2015; Brugnach et al. 2017). Past studies have also demonstrated that inclusion (e.g., by providing indigenous populations with land rights) and securing indigenous rights can result in higher levels of biodiversity at lower overall cost (Robinson et al. 2014; Ding et al. 2016). From a rights-based perspective, greater indigenous self-determination in the management of their traditional lands is a matter of respecting

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international laws on indigenous rights (i.e., the ability for use, ownership, management, and control of their traditional lands and resources) described by the Free Prior and Informed Consent (FPIC) principle, recognised as a basic international right of indigenous populations (ILO 1989; Colchester 2000; United Nations 2007; UNEP 2015)(United Nations 2007; Murphy 2014). Finally, supporting the capacity of local communities to determine their affairs is also an issue of moral rights (Sen 2005; Holland 2015; Binder and Binder 2016; Bockstael and Watene 2016). Despite international agreement on the importance of including indigenous groups in forest management, inclusion practices vary in interpretation, scope, decision-making, and efficacy (Lund 2015; Maldonado et al. 2016; Mistry and Berardi 2016; Sterling et al. 2017). Recent calls to improve indigenous inclusion in forest management encourage adaptive management, dialogue with local communities, stakeholder equality, identification of community priorities, and place-based decision making (Adams et al. 2014; Martin et al. 2016; Rist et al. 2016; van Kerkhoff and Pilbeam 2017). However, many studies lack recognition of the indigenous voices and cultural competency affecting effective participation.

The indigenous Baka in Cameroon provide a case study for exploring how exclusion, cultural misunderstanding, and systematic political marginalisation have affected indigenous culture, well-being, knowledge, and degree of self-determination. As a result, the Baka capacity for effective participation in sustainable forest management policy is reduced, dismissed, and ignored (Nguiffo 2003; Assembe Mvondo 2006; Ngefor 2013; Pemunta 2013; Awuh 2016). Even though the Baka, traditionally nomadic hunter-gatherers, possess intimate knowledge of the forest, biodiversity, and sustainable uses of forest resources (Gadgil et al. 1993; Yasuoka 2006; Brisson 2011; Pyhälä 2012; Yasuoka 2014; Reyes-García et al. 2016), the incorporation and translation of their forest knowledge is rare in forest governance. Democratic Baka participation in forest policy has been limited due to discriminatory cultural practices, a complex social history, pressure to assimilate, and a lack of knowledge or understanding about Baka local livelihoods from decision makers (Sharpe 1998; Jackson 2004; Graziani and Burnham 2005; Pemunta 2013). Baka face logistical, linguistic, and geographical barriers to participation in governance (Pyhälä 2012; Pemunta 2013). Due to the lack of respect, rights, and the inclusion of Baka populations in forest management—which affect traditional culture, knowledge, and livelihood—Baka face increasing obstacles for inclusion, education, and self-determination. Considering how prior forest management in the region has impacted the Baka would provide critical insights leading to policy recommendations into how to improve inclusion and benefit indigenous populations in future conservation planning.

Baka culture has been impacted as a result of forest management pressure to push Baka from nomadic forest camps to roadside settlements, the culmination of a series of *sedentarisation* policies implemented over the last 80 years in Cameroon. A nationwide sedentarisation policy was implemented in the late 1950s under French colonisation,

which continued after independence (Bailey et al. 1992; Joiris et al. 1998; Hewlett 2000). The policy encouraged relocation of indigenous populations living in protected areas, inclusive of the Baka, relocating them to the periphery of any reserves. The policy is reflective of other national sedentarisation policies that have occurred internationally and similar pressures worldwide influencing indigenous populations' livelihoods and rights to native lands (Kent 1995; Maruyama 2003; Awuh 2011; Ikeya 2017). The stated goal of Cameroon's relocation policy was twofold: to improve indigenous access to resources such as health clinics and promote indigenous people's participation in the local economy (including paying taxes) through the production of cash crops (Dowie 2011). The relocation dramatically influenced the cultural norms of the Baka from 1950 to today. The Baka have suffered negative social and cultural consequences due to relocation resulting in a lack of land rights or land tenure to either current or traditional lands (Althabe 1965; Hewlett 2000; Nguiffo 2003; Betti 2004; Colchester and MacKay 2006; Leonhardt 2006; Njounan Tegomo et al. 2012; Pemunta 2013; Awuh 2015; Tetinwe 2017). Despite sedentarisation, Baka still maintain a deep multifaceted relationship with the forest. However, as sedentarisation pressures continue to grow, traditional Baka knowledge continues to erode (Gallois et al. 2017). Dialogue with Baka can provide insights into the state of, exchange of, and continued use of the Baka's traditional ecological knowledge.

The purpose of this study was to engage local Baka communities in community-based action research to assess local Baka communities' evolution of the human-forest relationship as well as to illustrate current barriers to inclusion within forest governance. Community-based action research works to combine the skills and knowledge of academic researchers with the local expertise and experiences of community participants in order to solve a problem, empower communities, build capacity, influence change, and provide guidance to policymakers (Israel et al. 1998; Minkler and Wallerstein 2011; Johnson et al. 2016). Herein, we obtained first-hand perspectives to illustrate resulting regional effects of forest management on Baka populations regarding livelihood, the degree of self-determination, and traditional knowledge preservation. Using the Baka interviews as a case study for indigenous inclusion in forest management, we provide recommendations for both regional and international forest management practices that incorporate indigenous participation, priorities, cultural competency, and education for effective indigenous inclusion.

Despite extensive ethnographic studies on the Baka forest-relationship (Joiris et al. 1998; Hewlett 2000; Köhler and Lewis 2002; Betti 2004; Leonhardt 2006; Pyhälä 2012; Ngefor 2013; Hattori 2014; Lueong 2016), studies on Baka perspectives regarding the impacts of forest policy on the extent of self-determination and their livelihood are still needed to inform sustainable forest management design. Community-based Baka priorities need to be identified to inform evidence-based decisions about future forest management. Evaluation of barriers to inclusion of Baka perspectives in previous forest management

regimes would guide increased community partnership and improved knowledge-sharing in future programmes. Local community-based research will be important for developing engagement approaches to reach sustained inclusion between communities with forest management because colonisation, regional development (logging, hunting tourism, roads), neighboring community relationships<sup>2</sup>, and varying degrees of local pressure to assimilate have resulted in differences between Baka communities and their livelihoods as it relates to the forest (Hewlett 2000; Shikongo 2005; Lueong 2016). For instance, it has been reported in the literature that some Baka populations are aware of indigenous marginalisation and their lack of indigenous rights, whereas others have reported the use of the term indigenous only reinforces historical primitive pygmy stereotypes and marginalisation (Lueong 2016).

## METHODS

Key informant in-depth interviews were conducted in July 2014 with Baka resident populations in the Northern Dja region near the 526,000 ha Dja Biosphere Reserve, the largest reserve in Cameroon. The reserve has been protected since 1950 and UNESCO dedicated the reserve as a World Heritage Site in 1987. This community-partnered study was conducted with approvals from the University of California, Los Angeles Institutional Review Board, the Cameroon National Ethics Committee, the Cameroon Ministry of Science and Innovation, and the regional delegation of Cameroon Ministry of Public Health in the area studied.

Study participants were recruited based on purposive sampling (Palys 2008) with collaboration and approval of the two settlement chiefs. Upon arrival in each settlement, community meetings were organised to explain the research aims, the importance of their community's thoughts and opinions, the collaborative purpose of the research, to explain confidentiality measures (no personal identifiers would be collected or used), and to introduce the research team. A community activity was then organised after the community meeting to familiarise the research team with community members, such as bracelet making, a tour of the village, or initiating games with children. Settlement chiefs were then asked to assist with facilitating participant lists using inclusion criteria. The inclusion criteria were: (1) over 18 years of age, (2) availability (i.e., the interview would not be a burden to daily activities), and (3) reasonable fluency in French and/or Baka language. Individuals were solicited to ensure equal gender representation in each settlement.

We interviewed a total of 15 study participants (eight males and seven females) from two Baka settlements. Nine participant interviews were obtained from a 300-person settlement designated as "Settlement 1," and six participant interviews were obtained from a 60-person settlement designated "Settlement 2." Settlement chiefs and interview contacts were given gifts (tote bags) regardless of agreement to participate in the study. Private interviews were conducted for 30-90 minutes each in the residents' homes, churches, or location of choice. Interviews

were conducted with the assistance of local translators who were familiar with the local French and/or Baka dialect. Verbal informed consent was received from each study participant. Before verbal consent was obtained, interviewers individually reiterated the confidentiality of the study (no personal identifiers would be collected), the voluntary nature of the interview, and the ability to stop the interview process at any time, and the importance of participant thoughts and opinions to each interview contact. No individuals declined to participate in the study. All surveys were completed except for one interview that was stopped because the participant appeared to be inebriated.

The semi-structured interview guide was developed as part of a larger study aimed to explore local population's perceptions near the Dja Faunal Reserve regarding local relationships with forest management, use of forest resources, livelihood, community traditions, and health practices. The guide was developed based upon a literature review of previous anthropogenic studies on local Dja populations and consultation with local scholars who had previously conducted biodiversity research in the area. Questions were framed to elicit participants' insights into community traditions, to provide insights beyond the individual's environment, to offer participants the experience of speaking as experts on their communities, and to minimise disclosure of any personal use of banned forest resources (i.e., poaching). Additionally, questions were framed using a community asset-mapping framework to establish relationships, empower participants, and focus on positive aspects of their communities (Sharpe et al. 2000; Goldman and Schmalz 2005).

A six-step thematic content analysis (Braun and Clarke 2006) was used to identify themes representative of participants' perspectives resulting from interview questions asked about food security, livelihood, health, community traditions, and forest management. Interviews were audio recorded and subsequently transcribed verbatim by a native speaker. One coder reviewed transcripts using ATLAS.ti software and discussed emerging themes with two other researchers. Iterative analyses continued with all three coders until saturation of major themes was achieved. We looked for consistencies, inconsistencies, and frequency of themes to determine areas of significance.

## RESULTS

Emerging themes coded from interviews include Baka insights regarding the current Baka-forest relationship, recent changes in livelihoods due to forestry resources, portrayals of community self-determination (i.e., the extent to which Baka are agents in their development, forestry policy, or benefits), and changes in livelihoods due to living on the roadside versus in the forest.

### **Forest knowledge and knowledge of medicinal plants are community strengths**

The majority of the Baka interviewed described the knowledge of the forest and traditional medicines as community strengths



(10/15 participants with at least one mention). Baka individuals were proud of their unique traditional knowledge of the forest and spoke to the advantage of traditional forest knowledge in comparison to neighboring communities, “Our strength here is based on knowledge of the forest because many people know nothing of the forest” (Male, Baka Settlement 2) and, “We get our medicinal plants from the forest which makes us stronger than the Bantu<sup>3</sup> who do not know” (Female, Settlement 1). Knowledge of traditional medicines and plants is seen as unique to the Baka in comparison to neighboring communities. Every Baka participant mentioned using traditional medicine as a strength when discussing community health practices (15/15 participants with at least one mention), and many asserted that traditional medicine is in demand. For example, one participant noted, “My old man back home is one of the few who possesses the know-how and is still alive. Many people come from Yaoundé to get treatment from him” (Male, Settlement 1).

### **Expression of both positive and negative impacts of relocation to outside the forest**

The Baka we interviewed were acutely aware of the impacts—both positive and negative—caused by forest-roadside migration. Although no interview questions addressed relocation as a topic directly, most participants spontaneously reflected upon the changes between forest camps and roadside settlements when asked about any community cultural changes (13/15 participants with at least one mention). Baka described the history of relocation and differences in access to resources because of migration. For example, one participant recalled:

Things are different these days compared to the past. In the past, our forefathers didn't know about many of the things we know today such as a school for our kids. Also, in the past, we the Baka lived only in the forest, but today we have been forced out by the government. We now live in towns. (Male, Settlement 1).

Although participants were able to highlight positive results of the relocation such as access to education, for instance, “we build our houses in the villages... we work farms, wear clothes, speak French and even send our kids to school... [and] life is much better today compared to the past” (Female, Settlement 2), not all participants agreed with the lifestyle changes and several expressed concern about how relocation may affect future generations. One man commented, “Life is much worse for the youngsters of today. That is why I am against the white man who wants to remove the Baka from the forest to take him to the village” (Male, Settlement 2).

In spite of the differences in perspective regarding how relocation has affected Baka livelihoods, a common theme emerged among the individuals we interviewed that moving “back” to the forest was not realistic, with the current state of forest degradation. For instance, although Baka often still spend certain times of the year in the forest during hunting season—one participant noted that “when resources such as honey are abundant, we usually spend up to 4 months in the

forest, but when resources are scarce, we spend just 2 months” (Female, Settlement 2). Participants were unsure of how their communities would survive in the forest year-round as past generations did because of the current state of the forest resources, as one explained, “Because we want to have plenty of food, we can't go back to the forest” (Male, Settlement 1).

### **Worries about future generations retaining traditional forest knowledge due to loss of biodiversity**

Baka participants expressed concern for future generations and how future generations may never know of the biodiversity of certain animals due to forest degradation. For example, a participant asserted, “If everyone thought like me then the forest would be conserved for our children because the rates at which the game is disappearing, our children will no longer know these animals” (Female, Settlement 2).

Many Baka interviewed described how the loss of animals due to forest degradation had affected the Baka community (9/15 participants with at least one mention). For instance, one interviewee stated, “species of animals such as the giant pangolins and bush pigs, and big antelopes we are no longer able to find today” (Female, Settlement 1). Interviewees reported that the loss of animals had affected the Baka's ability to hunt game, which has in turn affected historical sustenance patterns. One participant stated,

Finding the game isn't easy today like in the past where you could set up a trap behind your house. Today you have to journey for close to 15 to 20 km in the forest to kill the game. There are too many guns and poachers today. (Female, Settlement 1)

### **Baka interviewees highly regarded education as important for community improvement, but some worry about loss of traditional ecological education due to generational livelihood changes**

The Baka we interviewed were enthusiastic about the benefits of education in roadside communities and described benefits to community advancement as a result of education but worry about the loss of traditional culture and ecological forest knowledge. As most of the children in the villages are of the first generation of Baka who attend school, or “formal education,” there is tension between the loss of traditional and ecological forest knowledge which is formed by Longitudinal livelihood practices (Gallois 2015). We found education was highly regarded within the community, regardless of the context (14/15 participants with at least one mention). If Baka mentioned formal education, the Baka often subsequently expressed the importance of literacy in advancing self-determination within the community. For instance, one participant shared,

Life is much better today because I do not need a Bantu to speak for me today or to write a letter for me. For example, in the past when the government sent a letter...

my grandfather had to send for a Bantu, about 2 km away, to come read the letter and translate to the Baka what the letter was all about. (Male, Settlement 1)

Traditional cultural and ecological education places emphasis on tradition, as a Female from Settlement 2 states, “there is a rhythm of life in the forest we are not prepared to forget. Women teach young girls fishing techniques and how to look for wild yams. Men teach young boys how to harvest honey, climb trees, cut trees, and hunt.” Another participant shared, “We the Baka have traditions that we transmit from generation to generation, and no matter what we do in life, we can never forget. Once a child is born, the child is taught these cultural values which he will carry all through his life.” (Male, Settlement 2).

Many interviewees reflected on the requisite passing down of traditional knowledge to maintain Baka tradition. Baka explained the importance of youth learning from Baka elders and making sure younger generations are given a chance to learn traditional knowledge. For instance, one participant stated, “If I know something, I make sure I teach the young ones so that when they grow up, they can also do it” (Male, Settlement 2). Although the reverence for formal education is seemingly strong, some participants expressed concern about the loss of traditional education and cultural traditions:

Many of our customs are disappearing like in the past, our ancestors practiced circumcision, but nowadays, maybe just one member of the community knows how to do that. In the past, everybody knew how to make spears and machetes, but today only two or three people know how to do that per village.” (Female, Settlement 2)

A concern for the loss of traditions and skills due to migration from the forest is also described due to generational differences in livelihoods. As a Female, Settlement 1, states,

Our grandparents lived only in the forest and did many things in the forest, but for us today who live in the village, there are things that we no longer know. [For instance] things like harvesting honey. Our fathers used lianas to climb tall trees and harvest honey for us; today we cut down the branch.

### **Uncertainty regarding current approaches to forest conservation and management**

Many of the Baka interviewed expressed a lack of inclusion in, or a feeling of exclusion from, forest management and a paucity of benefits (11/15 participants with at least one mention). Several participants expressed frustration and potentially a lack of understanding of forest management, due to an inability see the direct benefits of forest governance. To this effect, one participant asserted:

The government does nothing here to protect that forest. In my opinion, they rather try to destroy the forest because they authorise timber companies to come here and cut down our big trees. We the local people gain nothing from this exploitation of our forest. (Male, Settlement 1)

Participants provided specific examples of times when Baka were excluded or marginalised from forest management projects, such as the following:

When the ECOFAC project [a Dutch-funded ecological development project that assisted the Dja Reserve management from 2003- 2006] was here, they were supposed to recruit the Baka as well as forest guards. But they practiced a kind of tribalism in which they recruited only Bantu men despite the fact that we could very well protect the forest. (Male, Settlement 1)

Several of the individuals we interviewed expressed skepticism about the current model of forest management in the region and questioned why Baka communities had been excluded from access to decision-making and participation. For example, one participant stated, “I believe it is not important to protect the forest from someone like me because I live in the forest and have no job in government nor any project” (Male, Settlement 2). Another asserted, “The government doesn’t even ask our opinion” (Male, Settlement 1).

### **Awareness of the lack of Baka rights to traditional land tenure in forestry management**

The Baka may feel marginalised in forest management, not only due to exclusion from participation but also because of the lack of Baka rights to land tenure or land rights. A few of the individuals we interviewed stressed community unhappiness about the lack of rights to land tenure in the areas they now reside (3/15 participants with at least one mention). For example, one participant said:

I can’t tell you what the government does to protect the forest here because I don’t know. We do our best to conserve the forest except that in this area where we live the Bantu are a real nuisance. They tell us that we don’t have any rights here because the place belongs to them. We own no land, and we usually tell the timber companies who come here that we are forest people who once lived in the forest, but the government forced us out and settled us here. Where then are our rights in the forest? (Male, Settlement 1)

Land tenure also affects the way Baka can participate in selling food in local markets, as they are unable to farm or have limited farming land. One participant noted:

Our main worry here is that of farmland. Because of this problem we don’t know how to live here due to no food security. If a solution could be found for that, then things would be much better for us. (Female, Settlement 2)

The lack of land rights also induces further dependence on local Bantu communities. For example, a participant expressed:

I would first like to talk about a big problem we face here. It is about land. Now is the season for sowing crops, and the Bantu who own all the land usually make us work very

hard on their farms before they can authorise us to sow crops for ourselves. (Female, Settlement 2)

## DISCUSSION

Baka study participants noted the importance of the Baka-forest relationship and recent influences on the Baka-forest relationship due to forest management, such as restricted access to forest resources and inhabitation. Biodiversity degradation, including declines in animal species, was a concern for the Baka because of the difficulty of imparting traditional forest knowledge to the next generation. Baka have struggled with traditional cultural hunting practices because of the noted loss of animal populations (Yasuoka 2006; Yasuoka 2014). Baka participants explained how relocation and migration from forest camps to roadside settlements had affected their communities' cultural identity and livelihoods; all exacerbated by a lack of land tenure rights. Relocation has restricted the traditional and customary lifestyle to a new semi-sedentary lifestyle near roads and other communities (Hattori 2014). Consistent with the literature, positive impacts of relocation, such as access to education, were recognised by study participants (Awuh 2015).

Baka study participants noted issues with the current approaches to forest management in the region due to a lack of benefits to traditional lands and resources, and a lack of inclusion in forest management decision-making. Other Baka communities in the region reporting forest management conflicts, explicitly because of a lack of forest rights, have been documented in populations near the Western areas of the Dja Reserve (Tchoumba and Nelson 2006) and the Eastern Area of the Reserve (Samndong and Vatn 2012). Tchoumba and Nelson (2006) mapped the extensive, customary, and sustainable use of forest resources by Baka, in addition to describing discriminatory conflicts between forest guards and Baka. Samndong and Vatn (2012) documented forest resource conflicts with logging companies as a direct result of current forest policy preferentially granting rights to logging companies without consultation of local Baka indigenous populations. Notably, Samndong and Vatn found that Baka communities preferred solutions focused on sustainable regulation of rights to forest resources in comparison to financial benefits or other proposed resolutions to forest management conflicts (Samndong and Vatn 2012).

### Listening to the Baka: implications for forestry management

Forest management practices reflecting the voices, perspectives, and priorities of local indigenous populations are necessary to rectify the ongoing negative impacts of forest management practices with Baka communities. Interview results regarding the degradation of the Baka-forest relationship, along with published literature (Nguiffo 2003; Assembe Mvondo 2006; Leonhardt 2006; Tchoumba and Nelson 2006; Pyhälä 2012; Ngefor 2013; Awuh 2015; Awuh 2016; Lueong 2016; Tetinwe

2017) suggest that robust participatory action is needed to ensure the inclusion of Baka in forest management. Recommendations provided should be evaluated as integral guidance for improving Baka self-determination in future forest management exchanges. Implications for participatory best practices for Baka inclusion in forest management include the following:

1. **Baka want to be included in forest management; however, reform is needed to promote engagement and inclusion of Baka in planning, policy, and management of customary lands.** This study is not the first to illustrate the lack of inclusion of Baka in forest management, nor is it the first to recommend policy reform to improve inclusion of Baka in forest management (Leonhardt 2006; Pyhälä 2012; Assembe-Mvondo 2013; Pemunta 2013; Ichikawa 2014; Awuh 2016). However, this is the first study that we were able to identify which gives voice to the Baka's concerns about the loss of traditional ecological knowledge and the importance of being involved in forest management to protect such knowledge. Baka are underrepresented in forest governance; thus, strategic efforts should be made to increase Baka self-determination and to recognise indigenous rights for the Baka in the management of traditional lands. Baka interviewed herein described disadvantages of the current approaches to forest management, and desire positive change for the forest and its resources. The Baka we interviewed were unable to describe direct benefits of forest conservation and therefore may not understand current strategies and resulting outcomes in regional forest management. Baka empowerment and education through participatory processes are needed to ensure integration, buy-in, and the effective inclusion of Baka within forest management decisions.
2. **Strategic efforts that include cultural competency and building capacity for engagement are necessary to improve forest management approaches to relationships with the Baka.** The Baka referred to strained forest management relationships due to a lack of recognition, inclusion, and respect for traditional lifestyles. As Cameroon government forest management agencies currently hold legal authority over the forests, capacity building for promoting change and inclusion must be considered in initiating, motivating, and sustaining participatory processes. Forest managers should also respect the rights of Baka to prioritize and maintain cultural traditions and relations to the forest. As the inclusion of Baka indigenous populations will be new to forest management, training on recognition of bias, cultural competency, and the education of indigenous rights and value of indigenous forest knowledge in protecting forests will be critical for effective collaboration. Learning from other collaborative co-management forestry programmes will assist in improving strategic participatory change such as capacity building that reduces power differentials, increases self-determination of indigenous populations, improves equilateral beneficial outcomes, and involves continuous feedback, reflection, and quality improvement in forest management (Kellert et al. 2000; Castro and Nielsen 2001; Brechin et al.



2002; Berkes 2009; Tengö et al. 2014). Lessons learned from recent integrative indigenous participation systems in natural resource management programmes specifically include recommendations for focus on indigenous reconciliation and equity (Stefanelli et al. 2017), relationship building between governors and indigenous populations (Natcher et al. 2005; McLeod et al. 2015), embracement of humility, transparency and openness, and elasticity in the process of inclusion (Berkes 2009; Berkes 2009), the inclusion of well-being in outcome metrics (Milner-Gulland et al. 2014), and the wholesome recognition of the critical value of indigenous knowledge to environmental management (Ens et al. 2015; Ens et al. 2016).

**3. Facilitating inclusion by the Baka in forestry management will be critical for sustained engagement.**

Logistical barriers to inclusion should be considered for facilitation of Baka communities in forest management planning and decision-making (i.e., adequately informing Baka about important dates for meetings, providing translators, providing transportation to meetings, etc.). Structuring future discussions with Baka will require a recognition of traditional Baka egalitarian culture (Hewlett 2014; Lueong 2016). True egalitarian engagement in forest management affairs may require longitudinal participatory timelines that allow for community-based consultation, community meetings, and the potential desire for community discussions versus one-on-one or small-group interviews. Baka traditional ecological knowledge should be obtained with respect for how systematic forest knowledge recollection transpires (i.e., traditional semantic knowledge recognition) and longitudinal knowledge acquisition (Reyes-García et al. 2016; Reyes-García et al. 2016; Gallois et al. 2017). The extent to which Baka socialise and network between neighboring Baka communities and travel within the forest should be valued as social capital. As Baka communities can exchange ideas and knowledge, as well as communication between villages and regions with ease, collaborative and beneficial participatory forest management could present positive impacts both for remediating negative historical forest management impacts and in implementing new initiatives or ideas in improving forest management capacity.

**4. Education of Baka regarding forest governance and participatory processes will be critical to the efficacy of technocratic participation and may help to create buy-in.**

The Baka hold high regard for education in advancing their communities and the skills of younger generations. While significant differences in philosophy, culture, education, and *raison d'être* may exist between forest managers and Baka indigenous populations, the Baka show willingness to gain advancement and would seemingly be open to education regarding current models of participatory forest governance and brainstorming for effective change. Recognition of differences in learning and memory will be important for forest managers to understand, such as respect for ways in which Baka recall knowledge within

their own experiences and livelihoods (Reyes-García et al. 2016; Reyes-García et al. 2016) or the potential opportunities for Baka knowledge crowdsourcing, as differences exist between Baka generations' ecological knowledge (Gallois 2015; Gallois et al. 2017).

**5. Baka forest knowledge is at risk and of critical value to inform sustainable approaches to forest management.**

The Baka we interviewed expressed concerns about how changes in the world around them have put their traditional knowledge at risk. The risk of knowledge loss is particularly unfortunate because the Baka's traditional forest knowledge could be used to improve and educate other stakeholders on sustainable sustenance practices and strategies for forest management (Berkes et al. 2000; Ichikawa 2014; Tengö et al. 2014). For instance, the sustainable harvesting of bush mangoes, wild yams, honey, mushrooms, and palm grubs from the forest employed by the Baka for generations, could serve as a model for developing policies that allow residents to continue to benefit from forest resources without hampering conservation activities. In this way, recognising the value of Baka forest knowledge can enhance conservation efforts by linking sustainable food sources for local populations to good forest stewardship. The Baka also have detailed knowledge about a wide range of forest species that forest managers can leverage when monitoring biodiversity goals. As Gupta explained, "Conserving biodiversity without conserving associated knowledge systems is like building and maintaining a library without a catalogue" (Gupta 2004). Bantu and neighboring groups recognise Baka traditional forest knowledge through soliciting of Baka's knowledge of traditional medicines (Betti 2004; Betti and Mebere 2011; Betti et al. 2013). Bantu recognition of Baka forest knowledge of traditional medicines could be leveraged to convince forest managers of the importance of sustaining such knowledge.

The strength of our study design was exploring local perceptions of livelihoods and forest management in Baka one-on-one interviews. Our study included a limited geographical range, as we interviewed only two settlements near the northern buffer around the Dja Reserve. Although saturation of themes was reached in the interviews obtained, differences in perspectives between participants and Baka from other regions or other forest-dependent populations near the Dja would need to be explored more fully before generalising the results reported herein. Also, further study would be informative to explore how evolving Baka lifestyles influence views, for instance by comparing the opinions of Baka settled in villages near Bantu villages versus Baka maintaining a more traditional and customary lifestyle. We also did not reciprocally interview forest managers' perceived obstacles for indigenous inclusion.

**CONCLUSION**

Despite the Baka's deep knowledge about the forest and how indigenous ecological knowledge may be utilised for forest



management, Baka inclusion and self-determination are unrepresented in local governance, forestry policy, and forest management. The Baka hold a complex, intimate relationship with the forest that is changing due to the management of protected areas, the pressure to assimilate, forest degradation, and the migration to roadside settlements from forest camps. The lack of rights and inclusion degrades critical Baka indigenous forest knowledge, well-being, and self-determination. The Baka serve as a case study for how reduced capacity of indigenous populations deteriorates indigenous knowledge and thus the advancement of science in forest management sustainability.

The threat of the loss of indigenous ecological knowledge must be a driving force in recognising the value of immediate strategies to foster the inclusion of indigenous populations in forest management. Inclusion and recognition are imperative to preserve the culture, rights, and forest relationship that sustain indigenous ecological knowledge. Legal frameworks protecting indigenous rights, livelihood practices and traditions that sustain indigenous knowledge, and institutionalising inclusive decision making will enable evidence-based policy decisions, recognition of indigenous rights, indigenous knowledge streams critical for sustainable forest management, and effective indigenous participation within forest management.

To promote inclusion and self-determination of indigenous populations, community-based action research may be used to illuminate indigenous populations' concerns and barriers related to inclusion in policy issues that may affect indigenous well-being. Community-based action research works to inform policymakers of the traditional indigenous customs, knowledge, and livelihood practices to help them understand, prioritise, and make decisions that reduce harm created by future forest policy. Capacity building in engagement will be critical to maximising understanding of the knowledge exchange among indigenous populations, policy experts, and conservation scientists. Capacity building and education are imperative for indigenous populations to understand the goals of forest management, acknowledge the purpose of engagement, build appreciation for the participatory process, and help increase self-determination of indigenous populations. Education is central to sustaining indigenous culture and knowledge, and thus presents an opportunity for investing in indigenous stakeholders and effective inclusion.

To facilitate collaboration between indigenous populations and forest management, innovative education is needed for forest managers to develop the skills and motivation to promote change for the inclusion of indigenous populations. Education for forest managers in cultural competency, indigenous rights, cognitive bias, the value of indigenous knowledge, and ethical decision-making is essential for resolution of past exclusion. As the pursuit of global conservation science aims to improve human capacity and indigenous rights through inclusion, we must not forget to also educate regional forest managers in the practice of resolution, bilateral exchange, the importance of cultural diverse knowledge streams in conserving biodiversity, and the importance of increased self-determination of indigenous populations in forest sustainability.

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## NOTE

- 1 We refer to forest management herein as the planning, decision-making, social and economic impacts, and resulting practices of forest policy, regulation, protection, conservation and/or restoration.
2. Regional government may not recognize all Baka villages and chiefs. Some villages are considered Baka camps with camp leaders subordinate to Bantu villages; discouraging official Baka engagement and political inclusion (see Lueong 2016).
3. Bantu is the colloquial name given to Bantu-speaking neighboring communities to the Baka and are estimated to have migrated to the area about ~2,500 years ago. Bantu should not be seen as a homogenous ethnic group and may represent larger Bantu speaking groups regionally, including the Badjoue, Nzime, Mbulu, and Fang-Nzaman. These groups have traditionally participated in both agriculture and hunting. When the Baka were relocated from the forest, many of them settled adjacent to existing Bantu villages.

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