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► **To cite this version:**

Ruppert Vimal. Monitoring for conservation in African tropical national parks: An agenda towards policy-relevant science. *Biological Conservation*, 2017, 214, pp.127-135. 10.1016/j.biocon.2017.07.014 . hal-02456298

HAL Id: hal-02456298

<https://hal.science/hal-02456298>

Submitted on 27 Jan 2020

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Short communication

Monitoring for conservation in African tropical national parks: An agenda towards policy-relevant science



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ARTICLE INFO

Keywords:

Monitoring
 National parks
 Social drivers
 Evidence-based conservation
 Biodiversity
 Africa

ABSTRACT

Monitoring as an instrument to quantify human and wildlife activities has been increasingly recognized as fundamental towards efficient biodiversity conservation strategies. Promoting the need to direct management based on scientific guidance, monitoring reflects the rise of evidence-based conservation approaches. Nonetheless, in tropical national parks, monitoring programs can fail to address conservation issues and divert scarce resources away from management priorities. In this manuscript, drawing on the literature and recent empirical observations in seven tropical national parks, I argue that the implementation of monitoring must go beyond the rational model of transfer from science to policy and focus on the processes of co-construction between knowledge and action. An increase in social engineering is needed among partners, services and hierarchical levels of parks to ensure a coherent strategy of knowledge production and its use for decision. I provide concrete recommendations as levers of action towards monitoring efficiency and policy-relevant conservation science.

1. Introduction

Tropical national parks have been widely recognized as fundamental strategic areas for the protection of major biodiversity hotspots and critically endangered species (Beaudrot et al., 2016; Saout et al., 2013). Such areas, however, often face many different threats, political instability, and their effectiveness in protecting nature might be questioned (Miteva et al., 2012; Tranquilli et al., 2014). As an instrument to quantify human and wildlife activities, monitoring is fundamental for natural resources management (Margoluis and Salafsky, 1998; Stem et al., 2005). It attempts to provide scientific guidance towards reliable action, management efficiency and increasing conservation outputs. Hence, monitoring can be considered as a tool for evidence-based conservation (Pullin and Knight, 2001).

However, it has been widely reported that, in developing countries, monitoring efforts are often ineffective in addressing conservation issues (Burton, 2012; Danielsen et al., 2005a; Gardner et al., 2008; Lund, 2013). Rather, monitoring can divert managers from conservation priorities (Sheil, 2001) and exacerbate bureaucracy (Lindenmayer and Likens, 2010a). Although monitoring represents a major investment in “knowing in order to conserve”, it often fails to integrate the information produced into decision-making (Danielsen et al., 2003) and appears to be “data rich but information poor” (Ward et al., 1986). Therefore, instead of increasing performance and cost-effectiveness of

conservation strategies, monitoring can divert scarce resources (Nichols and Williams, 2006; Sheil, 2001).

Monitoring raises issues related to the interaction between knowledge production and decision-making in environmental policies. How can parks managers and their partners build a policy-relevant conservation science? During the last decade, in order to improve monitoring efficiency, scholars have proposed frameworks and typologies focusing predominantly on long-term ecological measures (e.g. Green et al., 2005; Lindenmayer and Likens, 2010b). However, the relationships between knowledge and action, scientific rigor and political value, as well as the social dimension of expertise have been poorly considered (but see literature on participatory and locally-based monitoring Danielsen et al., 2005b, 2010).

Monitoring combines both the need to preserve a scientific authority and the willingness to provide efficient management (Desrosières and Naish, 2002; Lascoumes and Le Galès, 2005; Rottenburg et al., 2015). Therefore, the implementation of monitoring programs relates to contexts where science and policy are difficult to distinguish. In order to frame this “policy-driven science”, scholars have proposed different concepts such as regulatory (Jasanoff, 2009), post-normal (Funtowicz and Ravetz, 1993) or contextualized (Gibbons, 2000) sciences. They argue that the quality of expertise is highly related to the stakeholders' capacity to deal with complexity and uncertainty and stress the need to consider the production of scientific facts as

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<http://dx.doi.org/10.1016/j.biocon.2017.07.014>

Received 24 February 2017; Received in revised form 6 July 2017; Accepted 14 July 2017
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socially and politically embedded (Carolan, 2006; Latour, 1987, 2004). Such approaches suggest a new model of rationality (Cronje and Fullan, 2003), in which the social drivers involved in the simultaneous construction of science and action appear as the key components of a successful innovation.

In this manuscript, I argue that monitoring and, by extension, evidence-based conservation, must rely on a new concept of the construction and use of knowledge for decision-making. Accordingly, I describe the relevant issues in terms of mediation and propose key objectives to be achieved by national parks managers and their partners. I then offer some practical recommendations as levers of action (Grundmann and Stehr, 2012) towards efficient monitoring programs in Africa.

2. Monitoring in African tropical national parks

My analysis and propositions rely on a combination between the existing literature and some recent observations made in the context of a larger project over seven national parks: Taï (Ivory Coast), Campo Ma'an (Cameroon), Odzala-Kokoua (Republic of Congo), Salonga and Virunga (Democratic Republic of Congo), Bwindi (Uganda) and Gunung Leuser (Indonesia). I surveyed all monitoring programs involving data collection i) on a permanent or regular basis, ii) still running, iii) inside or around the park in a 20 km buffer zone, iv) oriented towards management and/or research. I focused on scientific monitoring programs measuring the state of environmental issues for management purpose rather than on programs evaluating human resources management, accountability, administration or logistic (see Mascia et al., 2014 or Stem et al., 2005 for typologies of monitoring and evaluation). Appendix 1 lists all the monitoring programs identified in the considered parks between 2014 and 2016. Fig. 1 is based on these observations and provides a simple illustration of what I consider here as the main components of monitoring programs in such areas.

Although mainly focusing on ecosystems and wildlife, monitoring in African national parks also targets the production of data on illegal activities and local communities, involve a variety of organizations such as research institutes, non governmental organizations, private foundations or governmental authorities (Fig. 1). Parks and their partners do not only run programs within the parks' borders but as well in their surrounding areas. Such programs can be conducted on a permanent or a regular basis or for short time periods. In theory, when conducted for management purpose, monitoring in national parks aims at developing

tourism, empowering communities and orienting law enforcement.

In a previous paper (Vimal et al., in press), we proposed a comprehensive analysis of the nature and role of these monitoring programs. Drawing on their limitations to guide management, this manuscript shows how they contribute to promote nature conservation (for instance by deciding what, where and how to protect) and to provide parks with a material dimension (monitoring automatically involves the provision of funds, equipments, human resources, etc.). We therefore conclude on the importance of the socio-political dimension of expertise and stress the need to “review the conditions under which a policy-relevant conservation science can be implemented”.

3. Dealing with social issues

I argue that, by focusing on a linear model of knowledge transfer, conservationists underestimate the social forces and drivers underlying the production and use of monitoring for action and fail to provide policy-relevant knowledge (Game et al., 2015; Mathevet and Mauchamp, 2005). To have an impact on management, expertise for nature conservation should rather be implemented following a model of co-construction of knowledge production and decision making. This suggests that science and action are build simultaneously, influence each-others and thus become more relevant. It requires that environmental practitioners pay more attention to the complex socio-political processes involved in the construction and mobilization of policy-based evidences. In such “reflexive politicization” (Strassheim and Kettunen, 2014), stakeholders surpass the framework of data objectivity as a base for rational public action.

Concretely speaking, national parks should rely more heavily on social engineering in order to build a coherent expertise and make monitoring fully integrated to management strategies. “Measuring is not protecting” (Sheil, 2001). Proactive mediation is needed across services (monitoring, law enforcement, community), partners (NGOs, governmental authorities, research institutes) and hierarchical levels (field agents, officers, heads of service and managers). Parks must improve their capacity to plan knowledge production and actively use it to support, communicate and implement decision.

3.1. Planning a strategy for knowledge production

Overall, monitoring programs should be integrated through a



Fig. 1. The main components of monitoring programs in tropical national parks in Africa.

common strategy for the entire park. Parks managers must make efforts to set clear objectives and define priorities. To which management aim is a given program oriented? Why should it be more important than another one? Will data collected and their interpretation bring concrete gain to support management action?

3.2. Using knowledge to support effective decisions

Parks and their partners must move beyond data collection and analysis. To have an impact on management, monitoring programs must support and lead to clearly identified decisions. In some cases, such decision can even involve some deep changes in the parks' organization and governance (Vimal et al., in press).

3.3. Communicating monitoring towards conservation actions

Monitoring programs must be incorporated in the daily management of parks' territories. An effort should be made to communicate, spread the data, their interpretation and the related decisions to the different stakeholders involved. Monitoring would thus appear as a media towards active implementation of efficient conservation strategies.

4. Three main objectives for monitoring in African tropical national parks

4.1. Less knowledge more action

I argue that, in African tropical national parks, there is an over-emphasis on quantitative knowledge and techniques. Ultimately, there can be a gap between the production of knowledge and the needs of parks with regards to management action. Parks should conduct monitoring following a more pragmatic approach (Danielsen et al., 2003). Priority must be given to programs with high potential impact on management. Hence, monitoring programs should i) have potential for daily and/or rapid action, ii) be objective-oriented, iii) focus more on causes than on consequences of biodiversity loss, iv) and define a targeted scale according to management needs. For instance, the monitoring of encroachments via aircraft photography in the Virunga national park allows direct intervention of the rangers. In contrast, the collection of data on both illegal activities and wildlife presence during rangers patrols or wildlife survey is more oriented towards long-term assessment and does not necessarily attempt to implement a specific action. The first priority of most national parks, or their intended purpose, is to protect the natural resources housed within their limits (Bruner et al., 2001). The most immediate challenge to parks' authorities and their partners is not one of science (Sheil, 2001) but of concrete actions towards biodiversity conservation. In the context of limited resources, both financial and otherwise, as is often the situation for tropical national parks, a better compromise is needed between concrete management and monitoring. Obviously, producing scientifically relevant knowledge might contribute to biodiversity loss reduction in the future, but this should not be performed at the expense of actions which could mitigate such decline now and on a daily basis (Sheil, 2002).

4.2. Highlighting local communities

In tropical national parks, there is a strong bias towards monitoring programs focusing on illegal activities and wildlife within the parks in comparison with those assessing local community activities around the parks. Over the seven parks we surveyed, only eight monitoring programs mainly divided in two parks (Virunga and Bwindi) target local communities while 42 focus on illegal activities and wildlife. It is increasingly recognized, however, that biodiversity conservation success is highly necessitated on direct/visible/realized benefit to local

communities, as well as on their empowerment and willingness to protect said nature (Danielsen et al., 2000; Kaimowitz and Sheil, 2007). Therefore, the assessment of wildlife presence, distribution, ecology should not be considered as more important than, for instance, the evaluation of community livelihood. I argue that, in most of the considered parks, a better balance should be achieved between efforts to monitor wildlife and efforts to monitor communities. Parks' managers should invest more in monitoring community resources, behavior and perception in order to better orient management policies towards local development (see also Stem et al., 2005).

4.3. Improving monitoring impact

The task of using monitoring to implement evidence-based conservation involves different steps including data collection, analysis, results interpretation and communication (Fig. 1). Overall, as mentioned in the following statement, there is a need to increase the performance of parks regarding data analysis and results interpretation with respect to management: "Large quantities of data is collected (...) and is just stored. Little effort is made to analyze and disseminate the results for decision making" (Management plan 2014, Bwindi national park, p37). Monitoring is not a goal in itself; monitoring efficiency is a matter of how far data collected actually impact and drive management actions. Such guidance should not only be limited to one single policy but target complementary uses and impacts according to the different intended services of the parks. Indeed, data collected inside most parks are predominately oriented towards security (law enforcement service) whereas it could also help to direct community development policies. For instance, data focusing on illegal activities inside the parks could not only be used to orient future law enforcement patrols but also to target specific areas around the parks for sensitization and education of local communities.

5. Concrete propositions

5.1. Training and empowering the staff

Although most of the parks' agents are appropriately trained to collect data in the field, only few individuals are proficient in their use of computers and in data management and analysis. Similarly, my interviews revealed that only few people at the top of parks' organization are aware and able to justify the existence of monitoring programs and how they are theoretically integrated into the parks' strategy. Furthermore, parks' rangers rarely have access to the results and analysis of the monitoring programs to which they have contributed and generally have no opportunity to participate in or to comment on interpretation of results. Such a situation obviously limits the development of monitoring strategies and their relevance. Parks' managers must increase the capacity building of the staff and their interest towards monitoring programs.

5.2. Centralizing and disseminating data and analysis

Collected data, analysis and interpretation are often dispersed and rarely shared among programs (i.e. great ape habituation, clearing monitoring, wildlife surveys), services (research and monitoring, law enforcement, community) and partners (NGOs, governmental authorities, foundations, research institutes). They are typically fragmented and stored in the computers of the leaders of the programs, services or organizations. In Salonga, for instance, data collected through monitoring programs and their associated results seem to be rarely shared among the different organizations involved and the park's authority does not centralize them. Such a practice rules out the coherence of monitoring programs, their circulation and use at the park scale. Communication devices should be mobilized to promote complementary uses of monitoring programs and of their outputs. Parks'

authorities should centralize the produced data and related reports within a single common database.

5.3. Improving interactions between local management, global assessment and research

Monitoring in tropical national parks does not only target local management but also the production of peer-reviewed research and the assessment of global environmental trends. Parks obviously represent privileged areas to conduct research and compute datasets for global trends' assessment. For instance, Bwindi national park is part of the TEAM network that aims to assess global changes in the tropics (www.teamnetwork.org). The Tai Chimpanzee Project is run since the 70's by a research institute to study the behavior, social structure and ecology of chimps. Similarly, one university monitors since decades presence, abundance and genetics of western gorillas among several clearings at Odzala-Kokoua national park. Although these programs have been useful to promote the conservation of primates in these regions as well as to equip parks with material and human resources, they can also divert them from their main mission. Thus there is a need to clearly identify the aim of a monitoring program at the very beginning of its implementation. Furthermore, whenever possible, an increasing complementarity must be found between these three different goals. How could a global assessment monitoring program or a research-based monitoring program benefit park management? Parks' resources should be proportionally involved according to the potential of such program for local management needs.

5.4. Reforming the funding/reporting system

Management in tropical national parks is easily “sidetracked by initiatives that promise some support” (Sheil, 2001). Donors in such areas have the power to guide parks' activities based on their own goals. They usually support programs politically correct and scientifically sustained which can be easily measurable such as wildlife monitoring. Furthermore funding increasingly involves reporting that can divert stakeholders from practical management and exacerbate bureaucracy (Vimal et al., in press). When not directly targeting management actions, funding should promote monitoring which also focuses on communities around the parks and gives priority to more pragmatic knowledge. Project assessment should clearly separate “performance measurement” (which aims at reporting program's progress) from “impact evaluation” (which assesses the changes induced by a funded program) (Mascia et al., 2014). In the case of monitoring, impact evaluation should clearly mention how collected data was interpreted and which management actions have been identified accordingly.

5.5. Giving voice to human sciences

The organizations historically involved in tropical national parks promoted over time a rationalist approach of the parks management (Adams and Hutton, 2007). Their concept of nature protection is characterized by a strong emphasize on quantitative scientific knowledge and generally mainly focuses on ecological issues (see organizations in charge of monitoring programs and their partners in Appendix

Appendix 1

Law enforcement monitoring									
Park	Mission	Aim	Area	Frequency	Collection method	Features of interest	Analysis	Who	Technical partners
Campo Ma'an	Law enforcement	Management	The whole	Permanent	Patrol	Illegal activities and	Identification and distribution	MINFOF	AWF and WWF

1). I argue that parks would benefit from an increasing diversity of expertise. I particularly stress the need to improve the representativeness of human sciences (Bennett et al., 2016). The presence of economists, sociologists, political scientists, geographers, psychologists or communication experts would allow to build a better compromise between technical data, socio-political issues and decision making.

5.6. Strengthening governance capacity

Parks in Africa can follow various management configurations such as state-centralized management (e.g. Tai, Bwindi), co or multi-partners management (e.g. Campo Ma'an, Salonga) or private management (e.g. Virunga, Odzala-Kokoua). Whatever the configuration, different partners follow different goals and tropical national parks often suffer from a lack of coherence, the absence of leadership and of a common strategy among the different stakeholders involved (Bruyere, 2015; Lindenmayer and Likens, 2010b). Although increasing governance is a complex and long-term issue, a first step towards more integrative knowledge production could be the effective establishment of scientific/management council. Such participatory committee already exists in some of the considered parks (e.g. Salonga, Tai). Nonetheless, they are often used to report and validate existing results rather than to decide and orient future programs. Skills of animation are needed such that various stakeholders could discuss parks' strategies, define priorities, share results and interpretations and direct decisions collectively.

6. Conclusion

The framework proposed in this manuscript is directed towards a more policy-relevant approach of conservation science (Game et al., 2015). I argue that parks' managers/directorships should focus more on the social context in which knowledge production can lead to decision-making. This involves a more reflective approach of data collection, interpretation, and communication, and calls for a new perception of the relationship between knowledge and action towards the implementation of evidence-based policies.

This manuscript highlights the central position of monitoring as a tool for conservation in tropical national parks. Reforming monitoring does not only assume a new perception of science but simultaneously relies on deep changes in parks' administration, organization and governance. Monitoring programs can therefore be considered as intermediary objects (Vimal and Mathevet, 2011; Vinck, 1999). By improving the social dimension of their implementation, stakeholders involved in parks' management can make “common cause” (Stengers, 2002) towards efficient conservation strategies.

Acknowledgment

This project was funded by the Robert Bosch Foundation and hosted by the German Centre for Integrative Biodiversity (iDiv) and the Max Planck Institute for Evolutionary Anthropology. I am particularly grateful to all the staff of national parks and their partners for their contribution and willingness to participate to the project. Thanks to Erin Wessling for her advise on a previous version of the manuscript.

Tai	patrol Law enforcement	Management	park The whole	Permanent	Patrol	large mammals Illegal activities and large mammals	Identification and distribution	OIPR	
Odzala- Koko- ua	Law enforcement patrol	Management	The whole park	Permanent	Patrol	Illegal activities and large mammals	Identification and distribution	AP	WCS
Odzala- Koko- ua	Elephant tracking	Management	The whole park	Permanent	Patrol	7 elephants	Daily track and position, home range, ecology	AP	
Odzala- Koko- ua	Elephant killing	Management	The whole park	Permanent	Patrol	Ivory stock and carcasses	Quantity	AP	MIKE- CITES
Salonga	Law enforcement patrol	Management	The whole park	Permanent	Patrol	Illegal activities and large mammals	Identification and distribution	ICCN	WCS, WWF, ZSM, MPI
Salonga	Elephant killing	Management	The whole park	Permanent	Patrol	Ivory stock and carcasses	Quantity	ICCN	MIKE- CITES
Virunga	Law enforcement patrol	Management	The whole park	Permanent	Patrol	Illegal activities and large mammals	Identification and distribution	ICCN	WCS
Virunga	Elephant tracking	Management	The whole park	Permanent	GPS necklace tracking	15 elephants	Daily track and position, home range, ecology	Virunga foundation	
Virunga	Invasion of the park (agriculture and rebels)	Management	The whole park	Permanent	Aircraft survey photography	Illegal logging, encroachment and rebels	Identification and distribution	Virunga foundation	
Bwindi	Law enforcement patrol	Management	The whole park	Permanent	Patrol	Illegal activities and large mammals	Identification and distribution	UWA	
Gunung Leus- er	Law enforcement patrol	Management	The whole park	Permanent	Patrol	Illegal activities and large mammals	Identification and distribution	UWA	OIC, WCS, FKL, LIC
Gunung Leus- er	Invasion of the park (agriculture)	Management	The whole park	Permanent	Satellite image analysis, drones survey photography	Illegal logging, encroachment	Identification and distribution	SOCP, FKL	

Ecological monitoring

Park	Mission	Aim	Area	Frequency	Collection method	Features of interest	Analysis	Who	Technical partners
Bwindi	Mountain gorilla census	Management/research	The whole park	Every 5 years	Transect	Gorillas, large mammals	Parasitology, genetic identification, density, distribution and family structure of gorillas; large mammals and illegal activities relative density and distribution	IGCP	DFGFI, Gorilla doctors, MPI, MGVP, ITFC
Bwindi	Habituated mountain gorillas monitoring	Management	14 Groups	Permanent	Tracking	Gorillas	Vital domain, number and health checking	UWA	MGVP, Gorilla doctors
Bwindi	Global change monitoring	Management/research	The whole park	Permanent	Camera trap, vegetation plots, climate	Vegetation, wildlife, climate	Distribution, growth rate, temporal evolution	ITFC	TEAM

Bwindi	Habituated mountain gorilla monitoring	Management/research	3 Groups	Permanent	station Tracking	Gorillas	Vital domain, nutrition, behavior, genetic, parasitology, social structure, ecology	MPI	ITFC
Campo Ma'an	Wildlife survey	Management	The whole park	Every 3 years	Transect	Large mammals and illegal activities	Great apes, elephants, duikers (3sp) density and distribution; other large mammals and illegal activities relative density and distribution	WWF	
Campo Ma'an	Gorilla habituation	Management	< 5%	Permanent	Tracking	Gorillas	Vital domain, food	WWF	
Gunung Leuser	Restoration sites monitoring	Management/research	< 5%	Permanent	Transect, camera traps, plots	Planted tree species, birds, orangutans, mammals	Vegetation growth and phenology; number of birds species; species recolonization; orangutan behavior	OIC	University of Nagoya, University of Liverpool
Gunung Leuser	Mammals survey	Management	< 10%	Permanent	Camera traps	Rhinoceros and other mammals	Species presence; rhinoceros reproduction	FKL	
Gunung Leuser	Tigers survey	Management	< 10%	Every 2 years	Transect	Tigers and other mammals	Density, distribution	WCS	
Gunung Leuser	Orangutans survey	Management/research	The whole park	2004 and 2013	Transect	Orangutans	Density, distribution	SOCP	Liverpool John Moores University
Gunung Leuser	Orangutan monitoring	Research	< 10%	Permanent	Tracking	Orangutans	Vital domain, nutrition, behavior, social structure, ecology	SOCP, FKL	University of Aceh, University of Zurik, Liverpool John Moores University
Odzala Koko-ua	Clearing monitoring	Tourism	1 clearing	Permanent	Observation of the clearing	Gorillas, birds, large mammals	Frequencies of mammals and birds; individual identification of gorillas, ungulates, elephants	AP	University of Rennes 1
Odzala Koko-ua	Gorilla habituation	Tourism	< 5%	Permanent	Tracking	Gorillas	Vital domain, food	AP	University of Barcelona
Odzala-Koko-ua	Wildlife survey	Management	The whole park	Every 4 years	Transect	Large mammals and illegal activities	Great apes, elephants density and distribution; ungulates,	WCS	

Odzala-Koko-ua	Gorillas/clearing monitoring	Management/research	3 Clearings permanently, 4 others	Permanent	Observation of the clearing	Gorillas (+ birds, large mammals)	illegal activities relative density and distribution Group composition, behavior, ecology, epidemiology, social and genetic structure, sympatric species	University of Rennes 1	
Salonga	Wildlife survey	Management	The whole park	2004 and 2015	Transect	Large mammals and illegal activities	Great apes, elephants density and distribution; ungulates, illegal activities relative density and distribution	WCS, MPI, ZSM	
Salonga	Elephant monitoring around a clearing	Management	1 Clearing	Permanent	Camera traps	Elephants	Presence	WCS	
Salonga	Carbon monitoring	Research	3 Parcels	Permanent	Vegetation plots	3 Forest types	Biomass and botanical composition	WCS	CTFS, University of Leeds
Salonga	Bonobo monitoring	Research	1 Site; < 5%	Permanent	Tracking, camera trap, transect	Bonobos	Vital domain, nutrition, behavior, genetic, parasitology, social structure, ecology	MPI	
Salonga	Ecological and law enforcement monitoring	Management/research	< 10%	2 times a year	Transect (+ patrol)	Bonobos, elephants, large mammals, vegetation, IA	Distribution and temporal evolution of bonobos and elephants; impact of law enforcement, data quality of patrols; relation between wildlife and vegetation; genetic structure of bonobos; ivory trade tracking	ZSM	Kyoto University, Michigan State University
Tai	Wildlife survey	Management	The whole park	Every year	Transect	Large mammals, birds and illegal activities	Great apes, elephants, bovidae, tale apes density and distribution; birds, other large mammals, illegal activities relative density	OIPR	WCF

Tai	Chimpanzee habituation	Tourism	< 5%	Permanent	Chimpanzee tracking	Chimpanzee	and distribution Vital domain, food	OIPR	WCF, MPI
Tai	Mangabey and Red Colobus habituation	Tourism	< 5%	Permanent	Tracking	Mangabey, Red Colobus	Vital domain, food, behavior	WCF	MPI
Tai	Ecological and law enforcement monitoring	Research	< 5%	Permanent	Transect	Large mammals, vegetation change, illegal activities	Distribution and temporal evolution of wildlife; Impact of law enforcement	WCF	MPI
Tai	Tai chimpanzee and monkey projects	Research	5 Sites; < 5%	Permanent	Tracking, camera trap, transect	Chimpanzees and other primates	Vital domain, nutrition, behavior, genetic, parasitology, social structure, ecology	MPI, University of Neuchatel	CSRS
Virunga	Mountain gorilla census	Management/ research	< 10%	Every 5 years	Transect	Gorillas, large mammals	Parasitology, genetic identification, density, distribution and family structure of gorillas; large mammals and illegal activities relative density and distribution	IGCP	DFGFI, Gorilla doctors, MPI, MGVP, ITFC
Virunga	Hippopotamus survey	Management	< 40%	2011, 2015	Transect (aerial and pedestrian)	Hipopotamus	Density, distribution, relation with law enforcement effort	WCS	
Virunga	Savannas wildlife survey	Management	< 70%	Every 5 years	Aircraft transect	Large mammals (7 sp)	Density, distribution	WCS	
Virunga	Habituated mountain gorillas monitoring	Management/ tourism	8 Groups	Permanent	Tracking	Gorillas	Vital domain, number and health checking	ICCN	MGVP, Gorilla doctors

Community monitoring

Park	Mission	Aim	Area	Frequency	Collection method	Features of interest	Analysis	Who	Technical partners
Campo Ma'an	Human/wildlife conflict	Management	All around the park	Permanent	Villagers report	Damages of wildlife on human activities	Number, distribution, wildlife involved, and type of damage	WWF	CIRAD, OFAC, FAO
Virunga	Edouard Lake fishing activity	Management	Edouard Lake	Permanent	Interviews and field prospection	Fishes stock	Fisheries statistics, delimitation of spawning areas	WCS	WWF
Virunga	Monitoring community forests	Management	< 10%	Permanent	Field prospection, focus group	Land use	Delimitation of area for cropping, conservation and resource use	WWF	Local communities
Virunga	Delimitation of community	Management	< 10%	Permanent	Field prospection	Cropping area	Delimitation of cropping area; Monitoring conflict with park boundaries	WWF	

Bwindi	plantations Multiple resources use monitoring	Management	2km buffer zone inside the park	Permanent	Resources users report	Honey, medicinal and handicraft materials	Amount harvested, revenue generated per parish	UWA	Local communities, ITFC
Bwindi	Local community monitoring	Research/ management	All around the park	Permanent	Interviews, focus group, household surveys, participatory 3D modeling	Women, Batwa culture, resources users, local communities	Profiling resources users; mapping local cultures; impact of ICDs and multiple use on livelihood; role of women in conservation	ITFC	IIED, JGI, ACOS
Bwindi	Revenue sharing assessments	Management	All around the park	Permanent	Analysis of UWA data	Community projects	Location, nature and amount spent	UWA	ITFC
Bwindi	Human/ wildlife conflict	Management	All around the park	Permanent	UWA and HuGo (human and the gorilla people) records	Damages of wildlife on human activities	Number, distribution, wildlife involved, and type of damage	UWA	ITFC

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