

# Conservation conflict following a management shift in Pendjari National Park (Benin): a Q methodological study



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**Cover picture:** (a) Farmer doing the Q-methodology in his field © Iliana Janssens, (b) APN rangers in training © Stefan Heunis, (c) Elephant (*Loxodonta africana*) in Pendjari National Park © GIZ.

## **List of abbreviations**

AICc: Corrected Akaike's information criterion

APN: African Parks Network NGO

AVIGREF: Village Association for the Management of Wildlife Reserves (l'Union des Associations Villageoises de Gestion des Réserves de Faune)

CENAGREF: National Centre for the Management of Wildlife Reserve (Centre National de Gestion des Réserves de Faune)

CPL: Local Professional Poachers (Chasseurs Professionnels Locaux)

GDP: Gross Domestic Product

IPBES: Intergovernmental Platform on Biodiversity and Ecosystem Services

IUCN: International Union for the Conservation of Nature

MAB: Man and Biosphere program

NGO: Non-governmental organization

NGT: Nominal Group Technique

PA: Protected area

PCA : Principal Component Analysis

PNP: Pendjari National Park

PPP: Public-Private Partnership

Q: Q-methodology

sd: Standard deviation

UNESCO: United Nations Educational, Scientific and Cultural Organization

USD: United States Dollar

WAP: W-Arly-Pendjari Transboundary National Reserve Complex

ZOC: Zone of Controlled Use (Zone d'occupation contrôlée)

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## Abstract

With biodiversity drastically declining on a global scale, the conservation of natural resources is becoming increasingly urgent. A common strategy to counteract biodiversity loss is the sustainable management of protected areas. However, as the protection of nature often conflicts with human livelihoods and involves many stakeholders with different interests, conservation conflict is globally on the rise. These conflicts can hamper sustainable development, social equity and the effective natural resource management. An important first step in resolving conflict is understanding and mapping perceptions of the different stakeholders. In this study, we investigated conservation conflict in the Pendjari National Park in Benin, which was fueled by a shift from participatory management to a Public-Private Partnership. Pendjari is the largest remaining savannah ecosystem in West Africa and home to several threatened megafauna species. Using the Q-methodology, we identified two distinct discourses among stakeholders. The first discourse, supported mainly by formally educated people with non-agricultural jobs, focuses on the limitation of anthropogenic activities in favor of biodiversity conservation. The second discourse is mostly supported by people with a lower education level and a direct dependency on the land. The second discourse agrees there is a need for conservation but even more so for viable alternatives to the people's current livelihoods. We identified the potential underlying factors that may have driven the conflict and suggest possible solutions. The identification of these discourses and their underlying drivers can be included into future decision-making processes and management of the Pendjari National Park.

**Keywords:** Africa, Biosphere Reserves, stakeholder perception, biodiversity conservation, conflict resolution

## 1. Introduction

Global biodiversity has been declining at an increasing rate in recent times, driven by different anthropogenic pressures (Butchart et al., 2010). The loss of biodiversity directly threatens the delivery of ecosystem services and hence threatens human well-being (Cardinale et al., 2012). One way to counteract this trend is through the sustainable management of existing protected areas (PA's) (Geldmann et al., 2013). Conservation focuses on the protection of natural resources and their diversity, however this is not a stand-alone process separated from human society. A more holistic approach to conservation follows the socio-ecological system approach, which includes interactions between natural resources, their users and governance systems (Ostrom, 2009). This approach has been adopted by the United Nations Educational, Scientific and Cultural Organization (UNESCO) in their Man and Biosphere program (MAB). The MAB program is realized through a worldwide network of PA's focusing on the conservation of cultural and biological diversity, sustainable development and outreach activities such as environmental education (Van Cuong, 2017).

The more holistic, socio-economic approach adopts a system of shared governance where multiple stakeholder groups are represented and contribute to the management. Two of the most widely employed shared governance frameworks are participatory management and Public-Private Partnerships (Dudley, 2008). Participatory management theoretically allows local communities to be represented in the management board, which can result in a better attitude towards conservation (Mutanga et al., 2015). In their global assessment, IPBES (2019) found PA's which engage the local communities in the management to be on average less degraded. However, a participatory approach with too many stakeholders has a risk to dilute conservation goals and to increase corruption and conflict (Sterling et al., 2017). Public-Private Partnerships are when a government still determines the policy but mandates a non-governmental organization to execute the day-to-day management. This can provide long-term financial and technical help, something African PA's with the current underfunding and lack of capacity can use dearly (Baghai et al., 2018). However, critics raise questions on the ethics of delegation of law enforcement, the loss of sovereignty of the state and PA's being "sold" to foreigners (Baghai et al., 2018).

The growing pressure to conserve natural resources and the multitude of stakeholders involved, is causing a global increase of conservation conflict (Redpath et al., 2013; Young et al., 2016). This not only limits conservation effectiveness but also inhibits sustainable development and social equity (Redpath et al., 2013). Such conflict arises when (i) conservation is threatened by other interests such as agriculture or fisheries, (ii) conservation is forced on other stakeholders for example through unconsensual relocation, or (iii) when conserved species have an impact of humans (Redpath et al., 2013). To resolve this conflict, we must first understand the stakeholder perceptions regarding conservation goals and PA management (Vodouhe et al., 2010; Redpath et al., 2013). Perception is based on both cultural and individual factors and determines how we internalize situations (Vodouhe et al., 2010). It influences our behavior and consequently our interactions with our environment. By mapping perceptions, we can understand the behavior of different stakeholders towards conservation goals and take the first steps towards improvement.

For research to be more useful to practitioners, we need a more interdisciplinary approach (Laurance et al., 2012). Social sciences can contribute to conservation in many valuable ways (Bennett et al., 2017). We chose to apply the Q methodology (Q), a method with roots in psychology and political sciences, to conservation conflict in the Pendjari National Park in Benin, West Africa (see 2.1.2). Q-methodology is a semi-quantitative method used to map first-person perceptions and group them together into discourses (see 2.3) (Watts & Stenner, 2012). It has been on the rise in conservation since 2015, however, as it has been mostly used in Europe and North-America (Zabala et al., 2018), much remains unknown about its application in African Biosphere Reserves. Africa, with its exceptional biodiversity and indigenous knowledge, remains heavily under-researched and is in urgent need of effective conservation management (IPBES, 2018; Di Marco et al., 2017). This is no different in the Pendjari National Park as it is the largest remaining savannah ecosystem of West Africa, hosting many threatened megafauna species (APN, 2017). However, to ensure its effective and sustainable management, the current conservation conflict needs to be addressed.

In this study, we mapped stakeholder perceptions on the current management in the Pendjari National Park after a shift from participatory management to a Public-Private Partnership in 2017. We looked at the most probable underlying causes through a logistic regression. We also evaluated the applicability of Q in conservation research and in particular in the context of African Biosphere Reserves and made some management suggestions for future.

## 2. Methods

### 2.1 Description of the study site

#### 2.1.1 Ecological and socio-economic environment

This study was conducted in the Pendjari National Park (PNP) in northern Benin (Fig. 1c). In 2017, Benin was the 23<sup>rd</sup> poorest country worldwide with a GDP of 827 USD per capita, of which 23% was generated by agriculture, forestry and fishing (World Bank, 2017). The population of 11.2 million has been growing at a rate of 2.8% ( $\pm 0.05$ ) annually since 2007. Overall, 53% of the population lives in rural areas. Literacy rates are low with only 45% and 33% of men and women being able to read and write (World Bank, 2018).

PNP features a savannah ecosystem with gallery forests along the Pendjari river. It has a tropical climate with a single dry season (October-April) and wet season (May-September). PNP hosts West Africa's biggest populations of large herbivores such as Roan Antelopes (*Hippotragus equinus*), Buffaloes (*Syncerus caffer brachyceros*) and Elephants (*Loxodonta Africana*) (Vodouhe et al., 2010), as well as the critically endangered West African Lion (*Panthera leo leo*) (Henschel et al., 2015).

Currently, the PNP consists of three zones with different functions (Fig. 1c): in the Zone of controlled occupation (ZOC), settlements and all agricultural activities are allowed. In the Hunting Zone, regulated harvesting of non-timber products and religious activities are allowed as well as trophy hunting by tourists. In the core zone of the park, no other activities but research and low-impact tourism such as safaris are allowed.

Over 28,000 people live in and around PNP spread across 24 settlements. They are generally from three ethnicities: Berba (65%), Gourmantche (23%) and Waama (7%) (Vodouhe, 2010). The population's main source of livelihood is agriculture, small-scale animal husbandry and tourism. The main religions are Christianity, Islam and Voodoo. Also syncretism occurs a lot, where people mix in elements from the traditional beliefs with other religions. Benin is the historical cradle of Voodoo, a traditional religion where spirits are represented by natural elements. This is called a 'fetish'. To ask for favors and to keep the spirits benevolent, one has to make regular blood offers to the fetish.

PNP is part of a transboundary network of PA's across Benin, Burkina Faso and Niger which is called the W-Arly-Pendjari-complex or in short "WAP". Several transhumance routes run through the

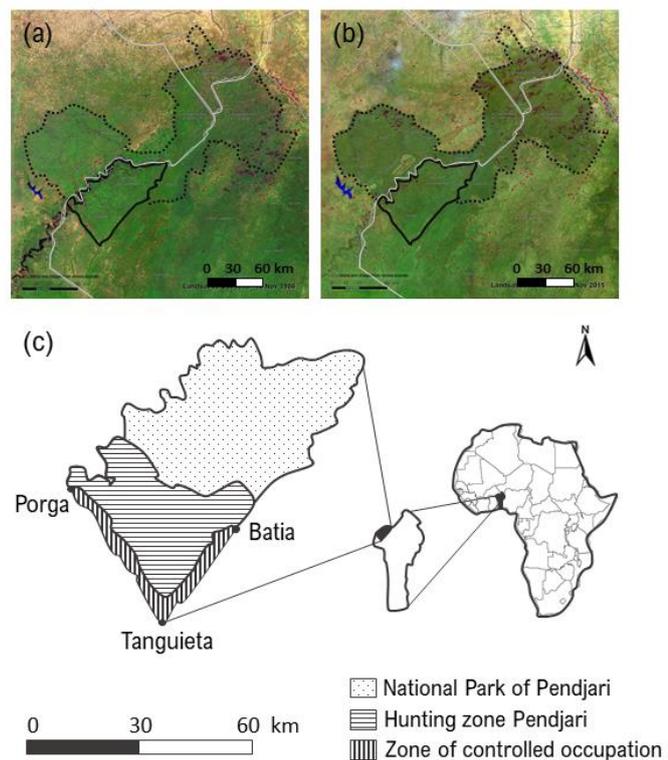


Figure 1: Map of the study site. (a) Satellite picture of the W-Arly-Pendjari (WAP) complex in November 1986. (b) Satellite picture of WAP complex in November 2015, clearly showing the ongoing land degradation and desertification outside of the protected areas. In full black line the Pendjari National Park, in black dotted line the WAP complex, in white line the country borders, with on the left Burkina Faso, top right Niger and on the right Benin. (c) The location of the Pendjari National Park with its three functionally different zones in Benin, West Africa. Satellite pictures adapted from CILSS (2016), map by Iliana Janssens.

park during the dry season, when cattle herders from Mali trek to the south of Benin in the search of water. These herders belong to the Peulh ethnicity.

### 2.1.2 Management history of Pendjari National Park

PNP was first created as a game reserve in 1954 by the French colonial administration, who actively expelled the local people and installed them in surrounding villages (Idrissou et al., 2013) (Fig. 2a, b). After the independence of Benin in 1960, Pendjari received National Park status (Fig. 2c). From then, the governmental Forest Department was in charge and ruled with power and repression to keep locals out of the park. Idrissou et al. (2013) report that gun violence was recurrently used against the locals when in confrontation with the Forest Department. In 1986, PNP joined the UNESCO Man and Biosphere program (MAB), which focuses on integrating sustainable development and outreach within conservation of natural and cultural diversity (Fig. 2d). However, it was not until 1993, after the Rio de Janeiro Earth Summit in 1992, that a participatory management was installed in PNP (Fig. 2e).

From 1996 until 2016, the “Centre National de Gestion des Réserves de Faune” (CENAGREF) managed the park in collaboration with “l'Union des Associations Villageoises de Gestion des Réserves de Faune” (AVIGREF). CENAGREF is a state office with administrative and financial autonomy and AVIGREF is an organization representing the local communities with a board in every village. To gain trust, CENAGREF employed many young locals as “ecoguards” to secure the park against poachers, established the Zone of Controlled Occupation (ZOC) where locals could cultivate crops, and allowed them to enter the park for non-timber forest products (NTFP). CENAGREF also shared 30% of the profit from trophy hunting to AVIGREF, who was in charge of distributing the money amongst the villages who had the best biodiversity conservation results. From 2006 onwards, distrust grew between the CENAGREF directors and the “ecoguards” as poaching rose again and wildlife populations started to plummet. This is when the third player, the “Chasseurs Professionnels Locaux” (CPL), came into place. The CPL are converted poachers who patrolled together with the “ecoguards” and told them if they knew of any activities of still active poachers (Idrissou et al., 2013).

In 2017, another major management shift happened and a Public-Private-Partnership (PPP) was installed (Fig. 2f). The Beninese government signed a 10-year contract with African Parks Network NGO (APN) to take over the management of PNP and provided them with 6 million USD. International organizations such as the La Wyss Foundation and National Geographic granted APN another 17 million USD in total (APN, 2017). APN has so far invested the money in a fence between the ZOC and the Hunting Zone to decrease the human-wildlife conflict. They are creating 35km of new roads, an airstrip and an aerial surveillance program. They provided 20 GPS collars for elephants and lions, have trained new rangers and foresee environmental awareness programs for the local communities (APN, 2017). From 2017-2019, the two Pendjari managers have been James Terjanian (Canada) and Marketa Antoninova (Czech Republic). Since then, CENAGREF and the CPL have been dismantled. AVIGREF is still a partner serving as a link between the local communities and APN, but virtually all of its previous management authority has been taken away. No more conservation money is being shared with AVIGREF or directly with the local communities.

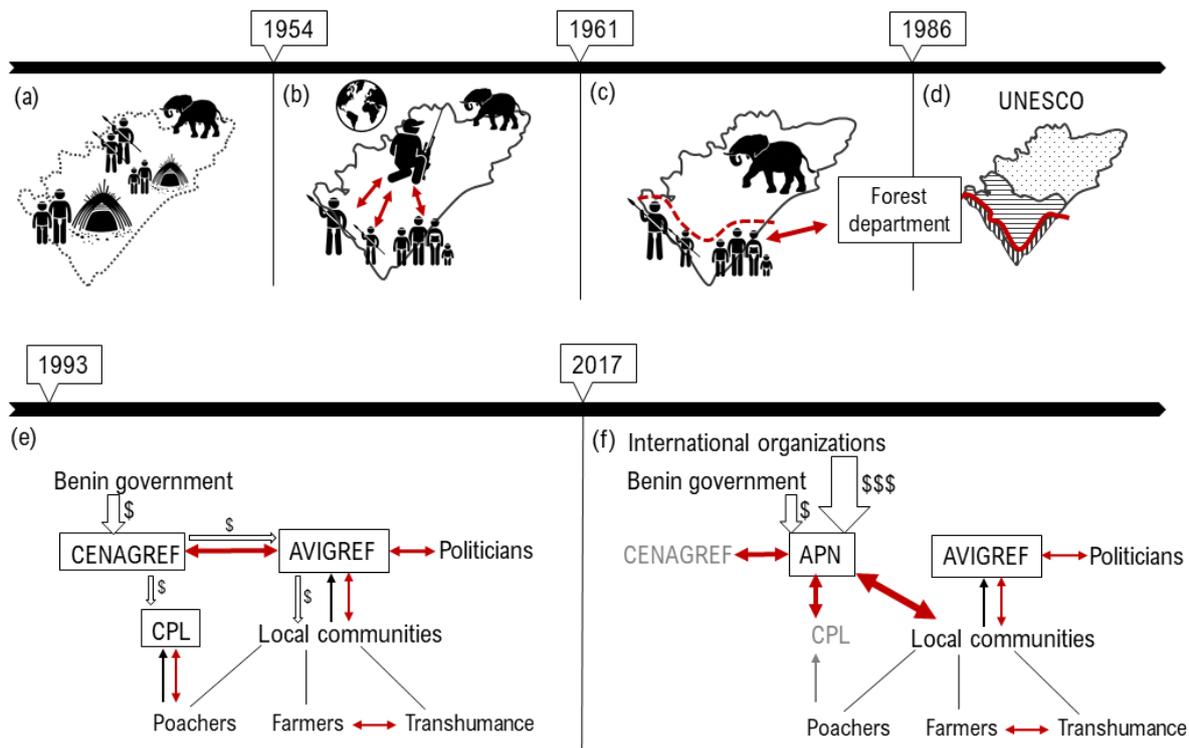


Figure 2: Overview of the management history in Pendjari National park. (a) Before the Pendjari was a protected area, local people lived in the area, where they hunted and cultivated crops. (b) In 1954, French colonists expelled the locals and made Pendjari a Game Reserve. (c) In 1961, Benin gained independence and Pendjari upgraded to a National Park. (d) In 1986, Pendjari joined the Man and Biosphere Reserve network. (e) In 1993, a participatory management scheme was installed. (f) In 2017, a Public-Private Partnership starts and African Parks Network takes over the management. Red arrows indicate conflict, a box around stakeholders with an active management function. Figure by Iliana Janssens

## 2.2 Q methodology

Q methodology (Q), first developed by Stephenson in 1935 (Stephenson, 1935), is a semi-quantitative method which is used to explore subjective viewpoints and identify patterns among them (Watts & Stenner, 2012). Participants are presented with a set of statements to sort from least to most agree. Afterwards, these Q-sorts are statistically analyzed to elicit 'clusters of subjectivity' or Q-factors. Q is conceptually akin to an inverse factor analysis, where the participants (P-set) are the explanatory variables, the statements (Q-set) are the tests and the Q-sorts are the dependent variables (Watts & Stenner, 2012).

Q has been used for decades in disciplines such as psychology, health care and political science, but only recently gained attention in conservation research (Zabala et al., 2018). Here, it has mostly been used for policy appraisal, conflict resolution and to test for the acceptability of management alternatives (Zabala et al., 2018). As Q is a one-on-one process, it is suitable for situations with high conflict to avoid group-think bias or dominance effect (Mukherjee et al., 2018). There is no need for large sample sizes and it is easier to reach people higher up in the societal hierarchy than with a group-based technique such as focus groups. The systematic and structured way provides semi-quantitative evidence but keeps the in depth quality of an interview (Mukherjee et al., 2018). A typical Q study consists of four main stages: 1) the research design, 2) data collection, 3) analysis and 4) interpretation.

### 2.2.1 Research design

We gathered scientific and grey literature on Pendjari using the search term “Pendjari AND Benin” via ScienceDirect, Web of Science and Google Scholar (last accessed: 10<sup>th</sup> August 2018). We selected 45 documents which were relevant to conservation and management. From these, we isolated 129 fragments expressing a value or untested hypothesis. The fragments were structured per keyword and similar fragments were combined into one overarching statement. This resulted in 44 statements (Table 1), which are equally distributed among the components of the Driver-Pressure-State-Impact-Response (DPSIR) framework. After a pilot test with a local researcher, two outdated statements were replaced by more relevant ones resulting in the final Q-set.

### 2.2.2 Data collection

The fieldwork took place from August to October 2018, 15 months after APN took over the Pendjari management. 53 face-to-face Q-sessions, of which one pilot test, were conducted with participants who were purposefully selected to represent all stakeholder groups. The stakeholder groups are research, AVIGREF, CENAGREF, APN, NGO's, agriculture, transhumance, tourism and politicians. We identified these groups based on the above mentioned literature search and the pilot test. We also made use of snowballing, where participants recommend other potential participants. We were accompanied by two male local translators in their early twenties. Participants were asked to place the statements in seven categories from “+3” to “-3” in a forced normal distribution. They were told to sort respectively from most agree to least agree, with neutral statements in the middle ‘zero’ category.

From each participant we gathered the following information: age, gender, education level, livelihood occupation, birthplace, how long they lived near the park and how long they worked in the park. We also took notes on the quality of the Q-session (see Supplementary A). We noted the amount of time needed, in which language the session was conducted, which translator was present, whether the participants were literate, their understanding of the rules of the Q sorting process and of the content of the statements. We also noted how impatient they were based whether their willingness to reread and change their initial Q-sort and whether they negatively commented on the time passing. After the Q sorting process, we asked to clarify the placement of particular statements in a post-sorting interview and integrated two additional questions: if and why they think biodiversity conservation is necessary, and what they would improve if they were to be in charge of the park themselves.

### 2.2.3 Analysis

Before beginning the analysis, we eliminated the pilot run and 12 other participants based on their performance during the Q-session. The eliminated participants i) did not reread or replace their statements according to the rules of prioritization, or ii) did not match the category on the Q-board with how they verbally expressed their opinion on that specific statement, for at least three statements. This resulted in a selection of 40 candidates, with who we continued all further analyses. Distances from the birthplace to the border of the park were calculated with Google Earth Pro Ink.

We explored the demographic data using Welch's two-sample t-test and Pearson's product-moment correlation (Supplementary A). Before performing an unrotated principal component analysis (PCA) with 20 factors, we tested the assumptions of multivariate normality and homogeneity of variances. To determine how many factors we want to retain, we ran a parallel analysis with 1000 random runs, calculated optimal coordinates and a scree plot. We then ran a PCA with two factors, varimax rotation and Pearson correlation coefficient. What is usually called the “principal component” is

here called the “Q-factor”. We opted for automatic flagging of participants onto a Q-factor. Automatic flagging is based on a significantly high factor loading of the Q-sorts ( $P < 0.05$ ) and on the square loading of a factor not being higher than the sum of square loadings for all other factors (Zabala, 2014). The factor loading is the equivalent of a correlation coefficient, which shows the link between the participants and Q-factors (see 3.1).

To examine what demographic variables explained membership of the participants into Q-factor 1 and Q-factor 2, we used logistic regression. Based on prior literature, we formulated several hypotheses about how different demographic factors should affect membership into Q-factor 1 or Q-factor 2. Based on these hypotheses, we built nine logistic regression models. We then compared the explanatory power of these models using the corrected Akaike’s information criterion (AICc) for small sample sizes. AICc estimates how parsimoniously a model fits data whilst taking into account different numbers of explanatory variables. We used the AICc values to calculate Akaike weights: the probability of a model being the correct model in the set tested. We performed likelihood ratio tests to compare the models to the null model with no explanatory variables. We used the Nagelkerke’s pseudo  $R^2$  to examine model fit. Model assumptions of collinearity, homoscedasticity and residual normality were examined graphically as per (Zuur et al. 2010) (see 3.3).

All analyses were performed in R version 3.6.0 (R Foundation for Statistical Computing, 2019). Additional packages used were MVN version 5.7 (multivariate normality; Korkmaz et al., 2014), psych version 1.7.2 (unrotated PCA; Revelle, 2018), nFactors version 2.3.3 (parallel analysis, optimal coordinates; Raiche, 2010), qmethod version 1.5.4 (rotated PCA; Zabala, 2014), stats version 3.6.0 (logistic regression models; R Foundation for Statistical Computing, 2019) and qpcR version 1.4.1 (AICc; Spiess, 2018).

#### 2.2.4 Interpretation

Based on the z-scores, the ranks, the qualitative data from the post-sorting interviews (Watts & Stenner, 2012) and the quantitative data retrieved from demographic variables, we formulated the discourses of the Q-factors. Discourse 1 is the interpretation of Q-factor 1, discourse 2 is the interpretation of Q-factor 2 (see 3.2).

### 3. Results

#### 3.1 Q methodology

The scree plot (Supplementary B), parallel analysis and optimal coordinates, based on the eigenvalues of an unrotated PCA with 20 factors, all indicate that most of the variance is explained by two factors. Other criteria, such as the less conservative Kaiser-Gutman criterium which keeps factors with an eigenvalue of 1.00 or above or “Brown’s magic number 7” (Watts & Stenner, 2012), would have kept respectively 12 or 7 factors. However, this drastically decreased the interpretability, which is why we chose to go with the more conservative criteria.

The rotated PCA with two factors showed that on Q-factor 1, there are 26 flagged and loading participants and there are 14 on Q-factor 2. While all 40 of our participants got automatically flagged on one or the other Q-factor, there are 15 participants who loaded significantly ( $P < 0.01$ ) on both factors. However, as they are flagged and to avoid a loss of information, we decided to keep these confounding participants in our analysis. Together, Q-factor 1 and 2 explain 51% of the variance in the Q-sorts, which surpasses the threshold of 35-40% (Watts & Stenner, 2012). The two Q-factors are correlated for 70%.

Table 1: The statements with z-scores and rank per Q-factor. Z-scores are a weighted average score showing the relationship between each statement and the Q-factors. The rank is a rounded z-score to match the original Q-board distribution. When z-scores do not differ significantly between Q-factors ( $P < 0.05$ ), they are marked as consensus statements in grey.

Statement	Q-factor 1		Q-factor 2	
	z-score	rank	z-score	rank
1. The participation of local communities is not essential to the effective conservation of wildlife and ecosystems in PNP.	-1.91	-3	-1.76	-3
2. All stakeholders of the PNP trust AVIGREF.	-1.03	-2	-0.47	-1
3. There is no conflict between the stakeholders of the PNP.	-1.74	-3	-1.78	-3
4. The collaboration between APN and the local people should be improved.	1.46	3	1.53	3
5. All stakeholders of the PNP trust African Parks Network.	-1.19	-2	-1.69	-3
6. Local communities should get monetary rewards for protecting nature in PNP.	-1.14	-2	-0.66	-1
7. The distribution of revenues generated by trophy hunting is not sufficient to compensate the loss of access to PNP.	0.20	0	0.66	2
8. Benefit-sharing from tourism activities does provide huge benefits for the local communities around PNP.	0.56	1	-0.97	-2
9. Tourism should be promoted to increase the profit for PNP.	1.48	3	1.63	3
10. Local communities support the existence of the park because of the school trips organized by APN.	-0.42	-1	1.09	2
11. APN staff members have a good job with a high salary.	-0.34	-1	-0.77	-2
12. People working in PNP should be motivated by more than financial gain only.	0.95	2	0.15	0
13. The Park should create more jobs to ensure support from local communities for biodiversity conservation.	1.36	3	1.63	3
14. People who are directly dependent on agriculture benefit less from the park than people with non-agricultural jobs.	0.22	0	0.51	1
15. Tradition should be emphasized in order to ensure local support for conservation in and around PNP.	0.75	1	0.31	1
16. Agroforestry needs to be supported by seedling production in protected plant nurseries by the park staff of Pendjari.	0.09	0	-0.61	-1
17. Agroforestry is a key solution to reduce pressure on the PNP.	0.54	1	-0.93	-2
18. Planting rapidly growing fuelwood species is essential to reduce the pressure on PNP.	0.82	2	0.26	0
19. Education is a key factor in ensuring support for biodiversity conservation in and around PNP.	1.83	3	0.76	2
20. Education and awareness-raising regarding the multiple benefits provided by PNP should be organized by APN.	1.16	2	1.34	2
21. It is important to involve kids and young people in the conservation of wildlife.	1.89	3	1.96	3

<b>22.</b> Restricting access to the PNP is not a good way to protect wildlife in the long run.	-0.61	-1	0.47	1
<b>23.</b> Strict enforcement of the rules regarding access to the park and its resources is essential for successful management.	0.41	1	0.95	2
<b>24.</b> All agricultural activities should be banned from the PNP and its periphery to ensure wildlife conservation.	-1.58	-3	-2.12	-3
<b>25.</b> Access to the park may not be completely prohibited for cattle.	-1.34	-3	0.85	2
<b>26.</b> Fencing the PNP is necessary to safeguard the wildlife and reduce human-wildlife conflict.	-1.26	-2	-0.27	0
<b>27.</b> Providing financial support for fencing in cattle is an effective strategy to protect them from predators around PNP.	-0.59	-1	-0.28	-1
<b>28.</b> Wild prey density should be increased to reduce predation pressure on livestock.	-0.90	-2	-1.22	-3
<b>29.</b> International financial aid is needed to improve wildlife conservation in PNP.	0.13	0	1.50	3
<b>30.</b> Pesticides used in agriculture have a negative effect on wildlife.	0.94	2	0.34	1
<b>31.</b> Poaching is a serious threat to the Lion and Elephant population in PNP and needs to be addressed.	1.14	2	0.49	1
<b>32.</b> Poaching is a serious threat to non-iconic species, such as smaller herbivores and birds, in PNP and needs to be addressed.	0.54	1	0.47	1
<b>33.</b> Illegal poisoning of carcasses is a threat to the Lion population.	-0.30	-1	-0.79	-2
<b>34.</b> Lion trophy hunting is badly managed around PNP.	0.05	0	-0.71	-1
<b>35.</b> Conflict between humans and predators is increasing due to better protection of predators.	-0.14	0	0.30	0
<b>36.</b> Conflict between humans and wildlife is decreasing.	-0.28	0	-0.27	0
<b>37.</b> It is more important to focus on the socio-economic dimension of conservation than on the ecological dimension.	-0.82	-1	0.28	0
<b>38.</b> Gallery forests should receive extra scientific attention as they are of high economic and ecological value.	0.77	2	0.12	0
<b>39.</b> At PNP, adaptations to climate change are well taken into account in the management strategy.	-0.39	-1	-1.17	-2
<b>40.</b> Scientific research is needed to solve human-wildlife conflicts in and around PNP.	0.44	1	-0.19	0
<b>41.</b> Secure land tenure will be beneficial for PNP's ecosystems and the local people.	-0.02	0	-0.35	-1
<b>42.</b> Transboundary cooperation in the WAP-area is fully functioning and effective.	-1.03	-2	-0.30	-1
<b>43.</b> The management of PNP should focus on iconic species such as Lions, Elephants and Cheetahs.	-1.31	-3	-0.76	-2
<b>44.</b> Zonation into protected and buffer areas with different rules of access and use is the best way to conserve biodiversity at PNP.	0.59	1	0.46	1

## 3.2 Description of discourses

At the base of these discourses are the Q-factors provided by the rotated PCA (see 3.1). We also used the post-sorting interviews to clarify the discourses by using quotes.

### 3.2.1 Consensus statements

All participants rated the statements concerning conflict after the management shift in 2017 as very important and agreed that there is conflict between the different stakeholders (Table 1, s3), there is a need for more collaboration (s4) and that the participation of local communities is essential in an effective conservation strategy (s1). Moreover, everyone agrees that economic activities should be highly prioritized. Specifically, all participants agree tourism should be developed (s9), APN should create more jobs (s13) and agriculture should be allowed within the ZOC (s24). Emphasis was also placed on education: everyone deems it very important to involve the younger generations in conservation (s21) and thinks that APN should organize more education sessions on ecosystem services (s20).

Although the following statements are not rated as highly important, everyone agrees that tradition could be used to stimulate biodiversity conservation (s15), that poaching is a threat to “non-iconic” species (s32) with especially medium to large herbivores being the main target, that people directly depending on the land for agriculture benefit less from the park than others (s14) and the current three-way zonation of PNP serves best to protect nature (s44). In terms of human-wildlife conflict, they do not think that increasing the wild prey density would alleviate pressure on livestock (s28) or that fencing in livestock is a good solution (s27). Neither do they estimate that human-wildlife conflict has decreased recently (s36).

### 3.2.2 Discourse 1 : Conservation for nature’s sake

Discourse 1 (D1) strongly believes education is the key solution to effective conservation (s19). They do not think you should work in conservation with money as motivation (s12) or that locals should receive cash to protect natural resources (s6).

*“It is important for everyone to understand why conservation is necessary.” (p23)*

*“If you are only motivated by money, you will not do a good job.” (p40)*

D1 strongly believes livestock should be completely banned from PNP (s25).

*“Domestic animals do not belong with wildlife. They destroy habitat and spread diseases.” (p11)*

However, D1 is milder on restricting people’s access to PNP.

*“Restricting access is not a battle you can win. The locals still have a strong tradition linked to the park and are dependent for food and medicinal plants. Only by using the park’s resources, one can understand its value.” (p6)*

*“You cannot just take advantages away from local communities, without replacing them by others.” (p26)*

*“You need flexible rules, otherwise you create aversion.” (p45)*

D1 emphasizes the protection of trees by prioritizing scientific research on gallery forests (s38). They think planting fast-growing fuelwood would be an effective solution to provide for local needs (s18). They also think science could help alleviate human-wildlife conflict (s10).

*“The gallery forest is a refuge for many species in West Africa. Especially with increasing desertification and the multiple uses of gallery forests, it needs protection.” (p46)*

D1 does not think management should be entirely focused on iconic species (s43), but they do think that poaching on Elephants is a serious threat (s31) as well as the use of pesticides in agriculture (s30).

*“Poaching on Lions rarely happens, however, poaching on Elephants is a major threat which should be addressed.” (p21)*

*“The biggest threat to PNP at the moment are pesticides.” (p6)*

In terms of the management conflict, D1 finds APN (s5) and AVIGREF (s2) to be equally distrusted by other stakeholders. They emphasize that the management coordination across the WAP-complex is not effective (s42). However, they do not think Pendjari should be fenced off from the other protected areas in the WAP (s26).

*“There is a lot of intoxication going on with rumors circulating about APN which is sabotaging them.” (p25)*

*“The WAP cooperation does not work. From Burkina Faso, poachers enter Pendjari and escape easily again over the border where we cannot follow them. Burkina can fish, Benin cannot. We need to coordinate better.” (p22)*

While D1 does not prioritize the bad salary by APN as much as D2, they express themselves stronger about it in interviews:

*“There are many complaints about the APN salary and tough work circumstances of the rangers. We do not have shelter from the rain, nor medicine, nor good food. A lot of rangers get sick.” (p40)*

A good summary for D1 is how they rate the ecological dimension of conservation to be more important than the socio-economic side (s37).

### 3.2.3 Discourse 2: Conservation for human's use

Discourse 2 (D2) prioritizes financial issues, by saying that there is a strong need for international aid (s29) and that the locals are not equally sharing in the benefits of tourism or trophy hunting (s8, s7). They do not think passion is more important than money as a motivation (s12) and they emphasize that the park staff are badly paid (s11).

*"International aid money has been disappearing higher up before it even reaches us." (p7)*

*"Why can white people have trophy hunts, but we locals cannot enter for food?" (p13)*

*"We cannot work without money, we have to feed our families." (p38)*

D2 strongly expresses how other stakeholders distrust APN, while they say AVIGREF is better trusted (s5, s2).

*"The moment APN took our grounds and access away, they also took our trust in them." (p32)*

*"The worst AVIGREF can do is take money away from us. But APN is dangerous, they do not listen and can kill us." (p31)*

D2 strongly disagrees to ban all livestock from the park (s25), making this the subject where both discourses differ the most. They also are not agreeing to limit the general access for locals, but with less urgency (s22). D2 says that the school trips into the park with children is one of the reasons they support the existence of PNP (s10).

*"We have not yet seen any alternatives for watering our cattle, despite all the promises. But we have been thrown out of the park already." (p44)*

*"We need medicinal plants and we need to feed the fetish, otherwise the park will die." (p13)*

Poaching is not seen as a major problem (s31, s32, s33) and D2 does not agree with the security measures APN has taken to protect wildlife:

*"Over 16 local poachers have been wounded by APN rangers. Before APN, we imprisoned and re-educated the poachers. Now, they are hunted down like wildlife." (p32)*

Education is deemed important but not in touch with reality (s19). In terms of management solutions, D2 strongly disagrees that agroforestry is a viable solution (s17, s16). However, they think climate change is not integrated into the current management (s39) and voice their concerns about desertification during the interviews.

*"Education only speaks of human impact on the environment, but it does not bring concrete solutions for the locals." (p38)*

*"Agroforestry would not work here due to our nutrient-poor soil. Shade means no harvest." (p32)*

*"The desert is knocking on our door, we need to protect the trees even before we protect the animals." (p13)*

At the same time, D2 illustrates a knowing-doing gap with the use of pesticides:

*"It is true that pesticides are bad for the environment, but we cannot go without. There are no viable alternatives." (p31)*

### 3.3 Drivers of the discourses

Participants from the two discourses differed in several demographic and socio-economic factors. D1 has no people without education and the majority (73%) of people with secondary and tertiary education (Fig. 3a). Moreover, almost all people working for APN (86%), all people who work for other NGO's (Fig. 3e, f) and the majority of politicians (75%) are in D1. D2 has all people without education, half of the people with primary education and the majority of illiterate participants (62%) (Fig 3a, b). It contains the majority of people who practice agriculture (54%) (Fig. 3c) and the all of people who have a top function in AVIGREF (n=3). 51% of D1 was born around the park, versus 71% of D2 (Fig 3d). The P-set is further explored in Supplementary A.

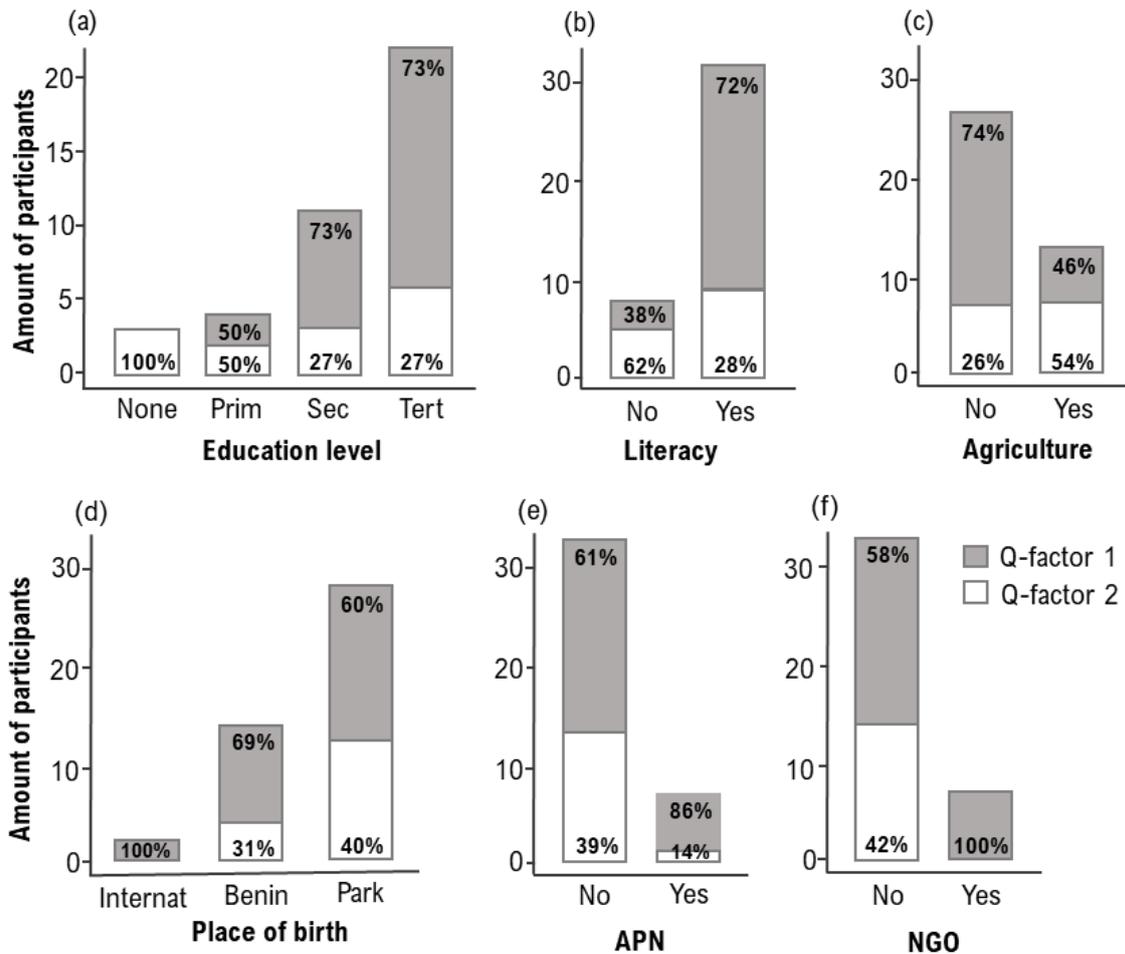


Figure 3: Distribution of our participants along demographic variables. (a) Highest completed education level being no education (None), primary education (Prim), secondary education (Sec) or tertiary level which includes bachelor, master or PhD level (Tert), (b) Literacy records whether our participants were able to read the statements, (c) Agriculture indicates whether people were active in cultivating crops or livestock, (d) Place of birth shows whether people were born outside of Benin (Internat), in Benin (Benin), or in the villages around the park (Park), (e) APN shows which participants worked for African Parks Network, (f) NGO indicates participants working for other NGO's than APN. Q-factor 1 in grey and Q-factor 2 in white. The percentages in the bar are the percentage of Q-factor per demographic variable.

The importance of education and agriculture in differentiating the two discourses is supported by our logistic regression analysis. Membership to discourses was best described by a model that only included education (AICc weight: 0.50, Table 2). In this model, decreased education significantly increased the chance of belonging to Q-factor 2 (GLZ education effect: Est. =  $-0.81 \pm 0.39$ , Wald's  $t = -2.06$ ,  $p = 0.04$ ). Moreover, the second-best model of Q-factor group was based on whether the participants were active in agriculture or not (AICc weight: 0.19). However, this model was not significantly better than the null model at  $P < 0.05$ .

Table 2: Summary of the logistic regression models. (a) The best model (in bold) is significantly better than the null model where the variable is 1. The pseudo  $R^2$  indicates the percentage of variance explained by the model. The AICc weights indicate the probability that a model is the correct model out of all tested models. Significant models are shown in bold ( $P < 0.05^*$ ) or with a dot ( $P < 0.1^.$ ).

Logistic regression model	pse. $R^2$	$\chi^2$	df	$P$	AICc	AICcWt
<b>Education level</b>	0.16	4.85	1	<b>0.03*</b>	51.3	<b>0.50</b>
Agriculture	0.10	2.95	1	0.09.	53.2	0.19
Amount of time worked in PNP	0.03	0.86	1	0.36	55.3	0.07
APN + NGO + research	0.03	0.80	1	0.37	55.3	0.07
Member of AVIGREF	0.02	0.44	1	0.50	55.7	0.05
APN+ top function AVIGREF + politician	0.01	0.15	1	0.70	56.0	0.05
Member of CENAGREF	0.01	0.14	1	0.70	56.0	0.05
Tourism + Teacher	0.02	0.73	2	0.69	57.7	0.02
Age + Gender + Birthplace	0.07	2.13	3	0.55	58.8	0.01

#### 4. Discussion

We found two distinct discourses in the PNP after the 2017 management shift. The biggest disagreements are about access to natural and financial resources and about protection of trees. Discourse 1 agrees with restricting access, planting and protecting more trees, while discourse 2 wants more access to natural and monetary resources and does not want trees integrated into the agricultural practices. At the base of this divide, we found education level as the most probable driver. Vodouhe et al. (2010) investigated perceptions of the previous participatory management of PNP and found the assessment of the management, education level and birthplace of the participants to be the main underlying drivers. The higher the education level, the more positive the perception towards the PNP, which is consistent with our results. However, birthplace was not significant for us. In supplementary A, we found education level to be significantly positively and negatively correlated with respectively conservation and agricultural activities. We also found education level to be significantly negatively correlated with age, which could indicate a generational gap (Supplementary A). This generation gap risks to be magnified by focusing environmental education only on younger generations. We did not measure income, household size or religion which are brought up by Mutanga et al. (2015) as drivers determining attitudes towards PA's.

All stakeholders agree there is conflict in Pendjari and a need for better collaboration between management and locals. Mutanga et al. (2015) found attitudes towards conservation to be determined by the creation history of parks, with a negative connotation linked to forced relocation, fences and fines. With its violent, non-consensual past, the feeling of historical injustice definitely plays a role in the Pendjari conflict. The initial management by the Forest Department was characterized by gun violence (Idrissou et al., 2013), which has returned according to several locals with APN's para-militarization. Although APN are recognized by many as knowledgeable professionals, many people expressed that APN pushes decisions too fast and without consent from the local communities.

Our participants identified a need for true dialogue and more communication to first build trust. Trust can increase by fair participation and makes conflict resolution more likely (Young et al., 2016). To initially install trust, CENAGREF granted many advantages to the locals such as access to the park to water cattle and 30% of the trophy hunt profits (Idrissou et al., 2013). Many of these advantages have been taken back by APN, as they cut all access to livestock, they decreased the limits from the ZOC and are not distributing money to AVIGREF anymore. Also the harvest of natural resources has been cut back. However, the locals have an elaborate traditional knowledge on medicinal plants and depend directly on the parks natural resources for their health care. The town of Tanguieta (Fig. 1) has one pharmacy and hospital, but for most village people these are out of economic and geographical reach.

*“APN took our land. We do not have enough for agriculture anymore.” (p18, D1)*

*“My parents lived in the center of the park. Our fetish are still there. We need medicinal plants. We need more access.” (p44, D2)*

However, APN themselves point out:

*“This has been a UNESCO park for over 40 years. The ground belongs to the government, not to the people.” (p53, D1)*

In conservation conflict situations where there is illegal resource use, researchers often make enforcement-based recommendations (Baynham-Herd et al., 2018). This is what APN has been applying, by increasing the security of the park through the training and para-militarization of rangers. However, in a context of agricultural expansion or active protest against conservation, stakeholder-

based interventions are recommended (Baynham-Herd et al., 2018). In PNP, where poachers set fire to vehicles of APN (source: several participants brought this up independently), first engaging with the stakeholders seems the necessary next step. There needs to be a balance between the threat of punishment and the promise of reward to ensure effective collaboration (Idrissou et al., 2013). To generate attitudinal change, it is important to include stakeholders' values into decision-making, to increase trust and to make decision-making transparent (Sterling et al., 2017). This last factor is something APN has effectively done by going into all the villages to explain their mandate and conservation strategy (APN, 2017). However, the first two factors is where APN seems to be lagging behind.

Stakeholders can be engaged to different degrees, going from passively receiving information to a full collaboration (Sterling et al., 2017). APN seems to choose for the former, which clashes with the locals as they got used to the latter over the past 20 years. A sustainable management however requires involvement from all stakeholders from the beginning, with clear negotiations and communication such that everyone has realistic expectations, with the same goals and rules (Idrissou et al., 2013; Redpath et al., 2013). Redpath et al. (2013) find conservation outcomes to be less sustainable when they are to the detriment of others, which seems to be the case in PNP. A standardized assessment procedure as proposed by Zafra-Calvo et al. (2017) can be a first step towards addressing social equity in Pendjari.

PA's with a management which focuses on participation with the locals and maintains cultural and livelihood benefits are more likely to have both positive socio-economic and conservation outcomes (Oldekop et al., 2015). Stricter managements which try to eliminate anthropogenic influences from the PA might also be effective in their biodiversity conservation but are missing an opportunity to contribute to local sustainable development (Oldekop et al., 2015). The effectiveness of shared governance depends on (i) the risk of stakeholders only joining the collaboration to advocate for their own interest, (ii) knowledge gaps between stakeholders with different backgrounds and (iii) whether the environmental problems are permanent or not (Bodin, 2017).

Sterling et al. (2017) say stakeholder engagement is more successful when it is based on their local context and value system. This is where the sensitive subject of foreign experts comes to the table. Many participants from both discourses raised following perceived problems: they think that 1) it takes foreigners several years to familiarize with the local situation, 2) foreigners are paid on a European scale and thus thrice as much as locals and 3) there is a discontinuation of the project once they go home, which is detrimental for wildlife conservation. There is a sentiment that APN is pushing decisions too fast. They do not do it the habitual way which is through meetings with the village chiefs, which has been mentioned as a cause for the current conflict. Another factor to successful engagement identified by Sterling et al. (2017) is having a strong leader figure to the project. Cultural differences in the concept of leadership should be taken into account to achieve an effective conservation management (Straka et al., 2018). Benin still has a very male-dominated culture. In 2009, 70% of Beninese women have experienced some form of gender-based violence, be it genital mutilation, domestic violence or rape (OECD, 2014). Due to a high rates of illiteracy (48.2% of adult women never attended school, compared to 18.3% of adult men), women are poorly represented in politics with only 10% of the elected being female (OECD, 2014). Several participants expressed their dismay over having a woman in charge and made it clear they did not take APN as serious as when a man would have been the main leader figure. All of this does not excuse sexism nor racism, but they might be root causes that fuel the current conflict and misunderstanding between stakeholders.

However, as the two discourses overlap for 70%, they agree on many issues. The 15 participants who significantly loaded on both discourses, could serve as brokers to increase understanding and communication between the two discourses. During the interviews almost all participants express they think conservation of biodiversity is necessary for the following reasons (in order of importance): for the next generations, for sustainable development of the region, for exploitation of the natural resources, against climate change, for spirituality and for the ecosystem balance. This shows the effect of previous environmental education. It also indicates a knowing-doing gap with the people of discourse 2, who know what is necessary but are more pragmatic and in need of viable solutions. One of the main strategies of APN is to generate income and to promote the sustainable development of the surrounding communities through tourism. However, recent events where two French tourists on a safari in PNP were kidnapped by Islamist extremists (Euronews, 2019), are hurting the opportunities of the PNP to draw international crowds (Fig. 4). It seems more feasible to focus on national than on international tourism.

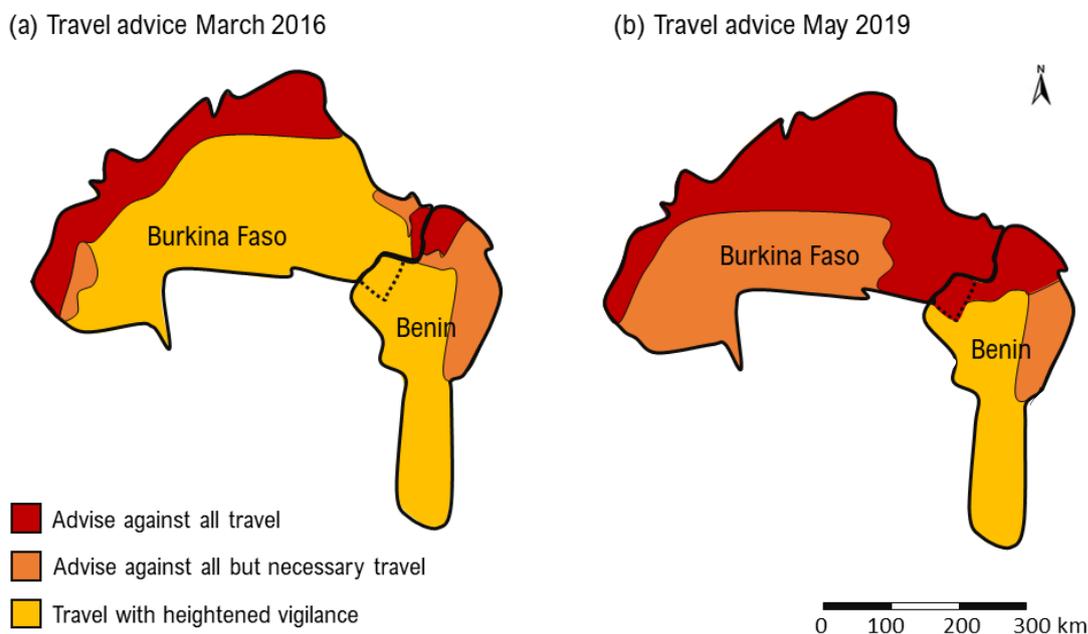


Figure 4: Changing travel advice from the French government for neighboring countries Burkina Faso and Benin. Country borders in thick full black line, Pendjari National Park in dotted black line. a) Travel advice in March 2016. The Pendjari National Park is still code “yellow”, meaning one can travel but with heightened vigilance. b) Travel advice in May 2019 after the kidnapping of two French tourists in Pendjari. All travels to the park are strongly discouraged. Figure by Iliana Janssens

Whilst Q methodology has several beneficial features for understanding perceptions in a conservation context (Mukherjee et al., 2018), we found a number of issues with the method. Q is a cognitively challenging and lengthy process which requires a lot of patience from both interviewer and interviewee. For the illiterate participants (n=14), this majorly reduced the accuracy of their Q-sort and 6 had to be eliminated from the final analysis. Allowing an unforced distribution of the Q-sort might help. As for Q in the context of African Biosphere Reserves, we suggest it would be better combined with a survey or NGT to reach a wider public of lesser educated stakeholders and to consume less time. This way, new information which might have been overlooked while making the Q-set, can still be uncovered. Doing fieldwork during the wet season as we did is not ideal as a lot of people want to cultivate their lands. Our statements were based solely on online available literature which limited our

scope. However, Thomas and Baas (1992) did comparative studies with different Q-sets on the same subject and found the conclusions to be the same. We also suspect an interviewer bias happened as interactions might have been altered due to linguistic, cultural and gender differences between interviewer and respondent (MacKenzie, 2016). Sorting into three piles of statements first, as suggested by Watts & Stenner (2012), was not feasible in the context of illiterate stakeholders and translators. We also want to emphasize that these results merely represent one moment in time. Much might have changed already in the APN management strategy, which is why we suggest it would be interesting for further research to repeat a Q every 1-2 years. Finally, Q analyses do not compare results to any null expectation, while this is common in other disciplines (Gotelli & Graves, 1996). We provide a suggestion in supplementary C.

## **5. Conclusion**

In this study, we found two discourses of perception on the current management in the Pendjari National Park after the shift in 2017. Education level and direct land use are the most probable underlying causes for this division. In the Pendjari National Park the decreased benefits, local stewardship and limited livelihood opportunities have caused conflict. Although everyone agrees conservation is necessary and could benefit the region in its sustainable development, there is a need for concrete, viable alternative livelihood opportunities. Conservation effectiveness is heavily influenced by local support and collaboration, which first requires trust to be installed. This trust can be gained through culturally adapted communication and by giving back stewardship to the locals. Many aspects of conservation conflict are still badly understood, while the urgency to find solutions become more clear with the declining biodiversity. This study shows the importance of working transdisciplinary and indicates how social sciences could contribute to conservation research. Q is a useful method to map stakeholder perceptions, however should be adapted for a less educated public. It allowed us to adequately identify consensus and dissensus and allowed us to formulate management recommendations. An English and a French summary for policy-makers are provided respectively in Supplementary D and E.

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## Supplementary A: Exploration of the Q-sessions and P-set

### A.1 The Q-sessions

Before the selection, we explored all 53 conducted Q-sessions. The Q-sessions lasted between 20 to 180 minutes with an average of 65 minutes. The average time of the Q-session seems to go down the higher the education level is (mean time  $\pm$  standard deviation (sd) in minutes for i) no education: 72 ( $\pm$ 16), ii) primary education: 74 ( $\pm$ 18), iii) secondary education: 63 ( $\pm$ 22), iv) tertiary education: 64 ( $\pm$ 36)). However, when tested with a Pearson's correlation, this is not significant ( $r = -0.59$ ,  $df = 50$ ,  $P = 0.55$ ).

We looked at the understanding of the participants of i) the rules of the game (how to sort and prioritize the statements with only a limited amount of spaces per category) and ii) the content of the statements. When we had to explain the rules or statements more than twice, the participant was ranked as bad. 30% ( $n=16$ ) of the participants understood both the rules and the content badly. Their mean interview time  $\pm$ sd in minutes was 73 ( $\pm$ 18). 53% ( $n=28$ ) of the participants understood both the rules and the content good. Their mean interview time ( $\pm$ sd) in minutes was 64 ( $\pm$ 33). However, with Welch's two-sample t-test this is not significant ( $t = 1.1$ ,  $df = 42$ ,  $P = 0.26$ ).

We explored the link between the understanding and literacy. Literacy changes the Q-session experience for the participant, as the statements have to be read-aloud to them. We saw that of those who understood both the rules and content well, the majority can read (literate:  $n=27$ , illiterate:  $n=1$ ), while the majority of those who did not understand rules and content, was not able to read (literate:  $n=6$ , illiterate:  $n=10$ ). This indicates that the Q methodology is quite a difficult process for people who cannot read.

During the Q-sessions, we took note of the level of impatience of the participants, based on whether they negatively commented on the time the Q-session took and their unwillingness to reread and change their initial Q-sort. Those who were not impatient at all ( $n=31$ ) have a mean interview time  $\pm$ sd in minutes of 70 ( $\pm$ 32), while those with a lot of impatience ( $n=8$ ) have a mean of 43 ( $\pm$ 13) minutes. Welch's two-sample t-test shows impatience and amount of minutes are significantly correlated ( $t = 2.4$ ,  $df = 33$ ,  $P = \mathbf{0.023}$ ).

### A.2 The P-set

We selected 40 well-performing participants for our analysis (see 2.3). The participants are between 21 and 58 years old, with a mean age  $\pm$ sd of 42 ( $\pm$ 10). 93% is male ( $n=37$ ) and 7% is female ( $n=3$ ). 20% ( $n=8$ ) is illiterate, their interviews were conducted with a translator.

Education level varies among the participants: 8% ( $n=3$ ) does not have any education, 10% ( $n=4$ ) finished primary education, 27% ( $n=11$ ) finished secondary education and 55% ( $n=22$ ) finished tertiary education which includes a bachelor, master or doctoral study. There is a significant, negative Pearson correlation between education level and age ( $r = -3.3$ ,  $df = 50$ ,  $P = \mathbf{0.0018}$ ). Those with tertiary education are on average 10 years younger (mean age  $\pm$ sd: 36  $\pm$ 9) than those who do not have tertiary education (mean age  $\pm$ sd: 46  $\pm$ 9).

Participants with tertiary seem to be born further away from the park (median distance  $\pm$ sd in km: 171  $\pm$ 1832) than the ones without an education (mean age  $\pm$ sd: 47  $\pm$ 8, median distance  $\pm$ sd in km: 21  $\pm$ 120). 62% ( $n=25$ ). However, this is only marginally significantly correlated with Welch's t-test ( $t = 2.0$ ,  $df = 25$ ,  $P = \mathbf{0.055}$ ). With the Pearson correlation test, we found a significant correlation between education level, agricultural livelihood and conservation livelihood (participants active in APN, other

NGO's or research). Education level and conservation are positively correlated ( $r = 4.9$ ,  $df = 50$ ,  $P = 9.5 e^{-6}$ ), while education level and agriculture are negatively correlated ( $r = -6.3$ ,  $df = 50$ ,  $P = 6.7 e^{-8}$ ). This indicates those active in conservation have a higher education level, while those active in agriculture have a lower education level.

### Supplementary B: Scree plot

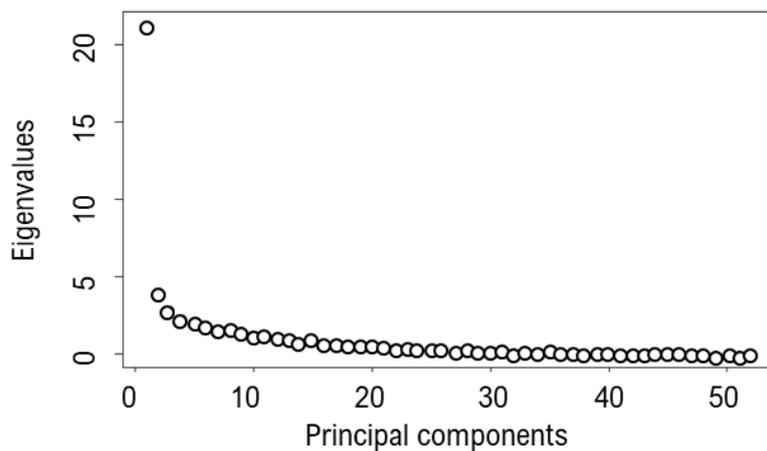


Figure b: Scree plot with principal components on the x-axis and eigenvalues on the y-axis. Looking at the slope, it is clear two principal components capture the most variability of the data, as the angle of the slope changes after the first two components.

### Supplementary C: Potential null model for future Q-methodology development

In the context of a forced distribution, there are a limited set of possible outcomes. Thus, randomly placing statements onto the Q-board will yield some perception result. Given that we expect some perception if we randomized the Q-sort, Q-methodology should have methods to examine the deviation from the random expectation. In the context of the placement or importance of individual statements, this could be done using a simple null model (sensu Gotelli and Graves 1996). Consider that we have  $X$  participants in the P-set. Each of these participants conducts a Q-sort. Thus, following this, for each statement in the Q-set, we can generate a summary statistic based on the  $X$  participants. This may be the proportion that agree with statement  $j$  (i.e.  $X_j > 0$  for statement  $j/X$ ) or the mean importance score (-3, -2, -1, 0, 1, 2, 3) for each statement. To generate a random expectation, one would randomly place statements onto the Q-board  $X$  number of times. From this randomized dataset, we could calculate the summary statistics as previously (e.g. proportion that agree with statement  $j$ ). We would then repeat this procedure 1000 times, each time recording the summary statistics for each statement. This procedure then generates a null distribution of summary statistics for a given statement. We would then compare the actual summary statistic to the null distribution to examine how it deviates from this expectation. For example, in a forced distribution with 50 participants, it may be very likely for a mean importance score of -1 to occur for a given statement just by a random sample draw. Conceptually similar null models are used broadly in ecological sciences (Myers et al. 2013) and could potentially complement other approaches in Q-methodology.

## Supplementary D: English summary for policy makers

Recently, biodiversity is drastically declining on a global scale. As biodiversity directly effects the provision of ecosystem services and thus human well-being, it is important to counteract this trend of biodiversity loss. A common strategy is the sustainable management of protected areas. However, as the protection of nature often conflicts with human livelihoods and involves many stakeholders with different interests, conservation conflict is globally on the rise. These conflicts can hamper sustainable development, social equity and the effective natural resource management.

This is also the case in the Pendjari National Park in Benin. From 1996-2016, the Centre National de Gestion des Réserves de Faune (CENAGREF) managed the park in participation with the local communities, who were directly represented through l'Union des Associations Villageoises de Gestion des Réserves de Faune (AVIGREF). Due to a lack of funding and hidden conflict between the stakeholders, this management ceased to be effective in protecting biodiversity after 5 years. However, to gain their trust, local communities were granted advantages such as cultivating crops in the Zone of Controlled Occupation, permits to water their cattle in the park and CENAGREF shared 30% of the trophy hunting incomes with AVIGREF. In 2017, the Beninese government signed a 10-year mandate with African Parks Network NGO (APN), to whom they handed over the day-to-day management. APN took back a lot of the previously mentioned advantages by forbidding cattle to enter the park, decreasing the size of the Zone of Controlled Occupation and not sharing income anymore. However, they did provide environmental education and promised to provide aid by improving infrastructure and drawing tourism to the park. Nevertheless, the withdrawal of advantages without an immediate tangible replacement, caused stakeholder conflict.

An important first step in resolving conflict is understanding and mapping the perceptions of the different stakeholders. In this study, we applied the Q methodology in the Pendjari National Park, Benin. The Q methodology is a social science technique which allows us to elicit perceptions from stakeholders and group them together. We conducted fieldwork from August until October 2018, which is 15 months after APN first got installed. We selected 40 participants from the following stakeholder groups: research, AVIGREF, CENAGREF, APN, NGO's, agriculture, transhumance, tourism and politicians.

Although there is a lot of overlap, we found people split into two groups, which we call discourses. The first discourse consists of 26 participants, including the majority of people with a university education, people working for APN or other NGO's and the majority of politicians. Discourse 1 strongly believes all access should be prohibited for cattle, that education is a key solution, that scientific research should be intensified, and that both pesticides and poaching on Elephants are a serious threat to biodiversity. The second discourse consists of 14 participants, including the majority of people with primary or no education, people directly dependent on the land through agriculture and of those who are born in the villages around the park. They emphasize a strong need for more access to natural and monetary resources, they don't see poaching as a major problem, they don't think agroforestry is a solution and express their need for viable livelihood alternatives. We found education level to be the most probable driver behind the divide between the two discourses. The higher the education level, the more positive the perception of conservation. Between the two discourses, there is consensus that stakeholder conflict is present in the Pendjari National Park and that this could be solved through more participation and trust. They agree tourism should be developed and APN should create more jobs. Everyone agrees biodiversity conservation is necessary, but disagrees on how strict this should be.

To increase trust and attitudinal changes in the stakeholders in order to resolve the current conflict, there is a need for a more participatory approach. When stakeholders are involved in the decision-making process, they are given back stewardship, which generates more sustainable biodiversity conservation results. It is important to not only include stakeholders' values into the decision-making process, but also to adapt the management and communication style to the local cultural setting. This is especially important in Pendjari, as it was first created by French colonists without consent of the local communities. Although a stricter management which eliminates all human activities from the park can also yield good conservation results, when this same conservation is to the detriment of others it has not proven to be sustainable on the long-term. Environmental education is helpful, but should focus on all generations of all stakeholders groups and should be combined with concrete, immediately applicable solutions and alternative livelihoods. As there is a lot of overlap between the two discourses we identified, there is a lot of consensus despite the current conflict. The areas of disagreement could be breached by assigning good brokers who can improve communication and understanding between the members of the two discourses.

#### Supplementary E: Résumé français pour les gestionnaires.

Récemment, la biodiversité est en déclin drastique mondialement. Étant donné que la biodiversité influe directement sur la fourniture de services écosystémiques et donc sur le bien-être humain, il est important de contrecarrer cette tendance à la perte de biodiversité. Une stratégie commune est la gestion durable des aires protégées. Cependant, comme la protection de la nature entre souvent en conflit avec autres moyens d'existence humains et implique de nombreuses parties prenantes ayant des intérêts différents, les conflits de conservation sont en augmentation mondialement. Ces conflits peuvent entraver le développement durable, l'équité sociale et la gestion efficace des ressources naturelles.

C'est également le cas dans le parc national de la Pendjari au Bénin. De 1996 à 2016, le Centre National de Gestion des Réserves de Faune (CENAGREF) a géré le parc en collaboration avec les communautés locales, qui étaient directement représentées par l'Union des Associations Villageoises de Gestion des Réserves de Faune (AVIGREF). En raison d'un manque de financement et de conflits cachés entre les parties prenantes, cette gestion a cessé d'être efficace pour protéger la biodiversité après 5 ans de succès. Cependant, pour gagner leur confiance, les communautés locales ont bénéficié d'avantages tels que l'agriculture dans la zone d'occupation contrôlée, des permis d'abreuvement du bétail dans le parc et le CENAGREF partageait 30% des revenus de la chasse au trophée avec AVIGREF. En 2017, le gouvernement béninois a signé un mandat de 10 ans avec l'ONG African Parks Network (APN), à qui il a confié la gestion quotidienne. APN a repris beaucoup des avantages mentionnés précédemment en interdisant l'accès au parc au bétail, en diminuant la taille de la zone d'occupation contrôlée et en ne partageant plus les revenus. Cependant, ils ont fourni de l'éducation environnementale et promis de fournir de l'aide en améliorant l'infrastructure et en attirant le tourisme dans le parc. Néanmoins, le retrait des avantages sans remplacement immédiat a provoqué des conflits entre les parties prenantes.

Une première étape importante dans la résolution des conflits consiste à comprendre les perceptions des différentes parties prenantes. Dans cette étude, nous avons appliqué la méthodologie

Q dans le parc national de la Pendjari, au Bénin. La méthodologie Q est une technique des sciences sociales qui nous permet d'obtenir les perceptions des parties prenantes et de les grouper ensemble. Notre travail de terrain était d'août à octobre 2018, soit 15 mois après l'installation d'APN. Nous avons sélectionné 40 participants parmi les groupes d'acteurs suivants : recherche, AVIGREF, CENAGREF, APN, autres ONG, agriculture, transhumance, tourisme et politiques.

Bien qu'il y ait beaucoup de chevauchement, nous avons constaté que les gens se divisaient en deux groupes, que nous appelons les discours. Le premier discours est composé de 26 participants, dont la majorité des personnes ayant une formation universitaire, des personnes travaillant pour APN ou d'autres ONG et la majorité des politiciens. Discours 1 croit fermement que tout accès devrait être interdit au bétail, que l'éducation est une solution clé, que la recherche scientifique devrait être intensifiée, et que les pesticides et le braconnage des éléphants sont une menace sérieuse pour la biodiversité. Le deuxième discours est composé de 14 participants, dont la majorité des personnes sans instruction formelle, des personnes directement dépendantes de la terre par l'agriculture et de celles qui sont nées dans les villages autour du parc. Ils insistent sur la nécessité d'un accès accru aux ressources naturelles et monétaires, ils ne voient pas le braconnage comme un problème majeur, ils ne pensent pas que l'agroforesterie soit une solution et ils expriment leur besoin d'alternatives de subsistance viables. Nous avons constaté que le niveau d'instruction était le facteur le plus probable à l'origine du fossé entre les deux discours. Plus le niveau d'éducation est élevé, plus la perception de la conservation est positive. Entre les deux discours, il y a un consensus sur le fait que il y a conflit entre les parties prenantes dans le Parc national de la Pendjari et que cela pourrait être résolu par une participation et une confiance accrues. Ils conviennent que le tourisme devrait être développé et que l'APN devrait créer plus d'emplois. Tout le monde s'accorde à dire que la conservation de la biodiversité est nécessaire, mais n'est pas d'accord sur la manière dont elle doit être stricte.

Pour accroître la confiance et les changements d'attitude chez les parties prenantes afin de résoudre le conflit actuel, il est nécessaire d'adopter une approche plus participative. Lorsque les communautés locales sont impliquées dans le processus décisionnel, elles sont réintroduites dans l'intendance, ce qui génère des résultats plus durables dans la conservation de la biodiversité. Il est important non seulement d'inclure les valeurs des parties prenantes dans le processus décisionnel, mais aussi d'adapter le style de gestion et de communication au contexte culturel local. C'est particulièrement important en Pendjari, car il a été créé originalement par des colons français sans le consentement des communautés locales. Bien qu'une gestion plus stricte qui élimine toutes les activités humaines du parc puisse également donner de bons résultats de conservation, lorsque cette même conservation se fait au détriment des autres, elle ne s'est pas avérée durable à long terme. L'éducation environnementale est utile, mais elle devrait se concentrer sur toutes les générations de tous les groupes de parties prenantes et devrait être combinée à des solutions concrètes et à des moyens de subsistance alternatifs. Comme il y a beaucoup de chevauchement entre les deux discours que nous avons identifiés, il y a beaucoup de consensus malgré le conflit actuel. Les points de désaccord pourraient être écartés en désignant de bons courtiers qui peuvent améliorer la communication et la compréhension entre les membres des deux groupes de discussion.

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