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The potential of the Global Person Generated Index for evaluating the perceived impacts of conservation interventions on subjective well-being

Rasolofoson, Ranaivo; Nielsen, Martin Reinhardt ; Jones, J.P.G.

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The potential of the Global Person Generated Index for evaluating the perceived impacts of conservation interventions on subjective well-being

1. Introduction

Debate surrounds how best to conserve biodiversity while avoiding negative impacts of conservation on the well-being of local communities, who are often poor and politically marginalized (Brockington & Wilkie, 2015). Consideration and understanding of the well-being impacts of conservation interventions matters for ethical reasons, as project implementers are morally responsible for ensuring that conservation interventions do not undermine the rights and livelihoods of local communities (Hutton, Adams, & Murombedzi, 2005), and because negative impacts on well-being will erode local support and therefore jeopardize conservation success (Adams & Hulme, 2001; Woodhouse et al., 2015). Increasingly international funding for conservation is explicitly linked with development spending and has both poverty alleviation and biodiversity conservation goals (Milder, Hart, Dobie, Minai, & Zaleski, 2014; Miller, 2014). The majority of studies evaluating the well-being impacts of conservation interventions use a relatively narrow range of externally defined and objective indicators dominated by income or its proxies. While these indicators are valuable for providing credible evidence to external stakeholders, they fail to capture the complex and multidimensional nature of well-being, may miss impacts significant to local communities, and therefore lead to conservation responses unfit for local realities (Dawson, Martin, & Danielsen, 2018; Woodhouse et al., 2015). There have been recent calls for putting local people at the center of evaluation studies and a more holistic approach to studying human well-being in the conservation community (King, Renó, & Novo, 2014; Milner-Gulland et al., 2014; Woodhouse et al., 2015). These calls have been accompanied by methodological guidelines, but empirical studies are rare.

Putting local people at the center of impact evaluation involves letting them define well-being (Woodhouse et al., 2015). Subjective well-being is a multi-dimensional concept reflecting people's own assessment of their lives and the circumstances under which they live (Diener, 2006). Putting local people at the center of impact evaluation involves also letting them define impacts. A crucial issue in evaluating well-being impacts of conservation interventions is how impacts can be attributed to the intervention rather than other confounding factors (Ferraro & Pattanayak, 2006). The participatory approach to impact evaluation involves asking local people directly about their perception of the cause and effect relationship between the intervention and their well-being (Woodhouse et al., 2015). Although subjective well-being and local perceptions can be influenced by the respondents' mood, orientation, cultural norms, and by timing (Camfield & Skevington, 2008), locally perceived well-being impacts are important because they represent people's perspectives on their own circumstances. Such information is valuable because it may predict likely support, or lack of support, for conservation from the local community (Bennett, 2016; Woodhouse et al., 2015).

The Global Person Generated Index (GPGI; Martin, Camfield, & Ruta, 2010) can be used to assess subjective and multidimensional aspects of human well-being. The GPGI collects information about individual's quality of life. Subjective well-being and quality of life are synonymous concepts (Camfield & Skevington, 2008); thus, the GPGI can be used to assess subjective well-being (Britton & Coulthard, 2013). It was developed from the closely related instrument the Patient Generated Index, which has been extensively used to assess health-related quality of life (Camfield & Ruta, 2007). Both instruments define quality of life as the measure of "the difference, or the gap, at a particular period of time, between the hopes and expectations of the individual and that individual's present experiences" (Calman, 1984, p. 124). The GPGI is "global" in that it is not specifically related to any particular

quality of life domain (e.g., health) but captures the multiple dimensions of well-being (Martin, Rodham, Camfield, & Ruta, 2010). It is “person generated” because it permits an individual to select, rate and weigh the relative importance of domains that matter most for his or her quality of life rather than just selecting from a pre-defined list of domains that may miss case-specific domains (Britton & Coulthard, 2013; Camfield & Ruta, 2007). The GPGI has been used and validated in many developing countries including Bangladesh, Thailand, Ethiopia, Sri Lanka and Uganda, and in contexts ranging from the social and cultural construction of well-being to the exploration of the quality of life of HIV patients (Camfield & Ruta, 2007; Jayasinghe, De Silva, & De Silva, 2015; Martin, Rodham, et al., 2010; Mutabazi-Mwesigire, Katamba, Martin, Seeley, & Wu, 2015). The GPGI is among the tools in the framework developed by the Wellbeing in Developing Countries project (McGregor, Camfield, & Woodcock, 2009) and there have been recent calls to extend the use of the framework for evaluating and tracking well-being impacts of conservation interventions (King et al., 2014; Milner-Gulland et al., 2014; Woodhouse et al., 2015). However, despite these recent calls, to our knowledge, there has been no study that uses the GPGI, or any of the Wellbeing in Developing Countries framework tools more generally, in the context of conservation in developing countries. We also know of only one study (Raboanarielina, 2011) that uses explicit measures of quality of life in relation to conservation.

The principle that protected areas should not harm local people was adopted at the World’s Park Congress in 2003 (Pullin et al., 2013), but injustices towards local communities such as eviction, restricted access to sources of livelihoods, and social and cultural disruption due to the establishment of protected areas remain a concern (Brockington & Wilkie, 2015; Poudyal et al., 2016; Snodgrass, Upadhyay, Debnath, & Lacy, 2016). In the last few decades, conservation efforts have increasingly shifted towards community conservation approaches (such as community forest management, CFM)

which are explicitly designed to be more locally inclusive and to have more positive impacts on local well-being (Adams & Hulme, 2001; Hutton et al., 2005). However, the relative well-being impacts of CFM and protected areas (particularly strictly protected areas, which CFM has attempted to replace or complement), and comparison of well-being impacts of different conservation approaches more generally are not well considered in the literature (Brockington & Wilkie, 2015). Such evidence is important to directly determine whether CFM has indeed addressed the potential negative well-being impacts of strictly protected areas.

With 78% of its population living below the international poverty line of US\$ 1.90 per person per day, Madagascar is one of the poorest countries on earth (World Bank, 2016). Over 70% of the island's population live in rural areas, depending directly on natural resources (e.g., agriculture and pastoral lands, forest resources) for mainly subsistence livelihoods (Scales, 2012). The use of natural resources is also deeply entangled with aspects of Malagasy culture and tradition (Osterhoudt, 2017; Rakotonarivo, Bredahl Jacobsen, Poudyal, Rasoamanana, & Hockley, 2018). For example, most Malagasy people see their lands as possessions endowed to them by their ancestors, who, though dead, stay in contact with their living descendants according to Malagasy belief. Many rural Malagasy believe that following traditional land use practices and taboos helps them maintain positive relations with their ancestors, who in return bless both the land and people (Evers & Seagle, 2012). Swidden agriculture is seen by many as a key part of ethnic identity. Trees and forests are central parts of many rituals connecting the livings and their ancestors (Scales, 2012).

Madagascar is known worldwide for its exceptionally rich and unique forest biodiversity (Brooks et al., 2006). Faced with a high degree of threats to its natural forest habitats, the island country has attempted a range of conservation approaches. Establishing its first protected area in 1927 (Raik, 2007),

Madagascar has over 61,000 km² of its land under some form of protection, covering over 10% of the country's total land area (Alvarado et al., 2015). The last two decades have also seen a rapid expansion of CFM across Madagascar with over 1,000 sites covering more than 30,000 km² of land in 2014 or about 15% of the country's natural forests (Rasolofoson et al., 2017). Given the close relationships between natural resources, livelihoods, culture and tradition, these conservation initiatives could have repercussions on multiple dimensions of local people's well-being (Rakotonarivo et al., 2017). A number of studies have investigated the impacts of protected areas and CFM on human well-being in Madagascar (Ferraro, 2002; Raboanarielina, 2011; Rasolofoson et al., 2017; Sommerville, Jones, Rahajaharison, & Milner-Gulland, 2010). However, very few of these studies explore the multidimensional nature of well-being, and none directly compare strictly protected areas and CFM.

We use the GPGI and participatory impact evaluation to compare the perceived impacts of a strictly protected area and CFM on people's subjective wellbeing in the eastern rain forests of Madagascar. First, we explore the validity of the GPGI for our particular case study. Validation of the GPGI is not the main goal of this study as this has been done elsewhere (Camfield & Ruta, 2007; Martin, Rodham, et al., 2010). However, as this is the first time the GPGI is used in relation to forest conservation in difficult to access rural forest communities, we perform a brief validation of the tool. We then compare the locally perceived impacts of the strictly protected area and CFM on people's quality of life. Finally, we take advantage of the potential of the GPGI as a needs assessment tool (Martin, Rodham, et al., 2010; McGregor et al., 2009) to identify, both in the strictly protected and CFM areas, domains that could be targeted by development projects or conservation compensation schemes aiming to improve human well-being in locally meaningful ways.

2. Methods

2.1. *Study areas*

We compare communities in Zahamena National Park (ZNP), a strictly protected area, and Ambohilero community managed forests located in the Corridor Ankeniheny-Zahamena (CAZ), a new protected area (Figure 1). Habitat type in both, ZNP and the CAZ, is characterized as humid rain forests. Both sites are also among the world's most irreplaceable protected areas in terms of biodiversity conservation due to an immense diversity and endemism of fauna and flora and a high number of threatened species (Le Saout et al., 2013).

Figure 1 here

Figure 1. Location of study sites in eastern Madagascar (CFM: community forest management; sources: Conservation International and Système des Aires Protégées de Madagascar; projection: Laborde Madagascar)

ZNP covers a total of 643.78 km² of land. It is composed of a national park (IUCN category II) in the western part and a strict nature reserve in the eastern part (IUCN category Ia), both managed by Madagascar National Parks. Human consumptive use is prohibited in ZNP, but tourism activities are allowed in the western part. The protected area was created in 1927, and since then its boundaries have been amended multiple times. The eight communes within which ZNP lies are inhabited by around 36,000 people (Raboanarielina, 2012). There is no human occupancy within the boundaries of ZNP, except in the enclave of Antenina covering an area of 3.5 km² (Raboanarielina, 2011). This enclave, located in the northern part of ZNP, encloses three villages with an approximate total population of 300 (authors' own data).

Ambohilero forests in the CAZ are located in the Didy commune and cover 644 km². Most of these forests have been managed under CFM by nineteen community forest management associations since 2004 or 2005. The commune of Didy has a total population of about 23,000. These forests are inhabited by over 2,240 people located in different villages sparsely distributed within the forests (authors' own data).

In both ZNP and Ambohilero forest areas in CAZ, subsistence farming dominated by swidden rice cultivation is the main economic activity. During fallow periods, cultivation of crops such as beans, peanuts, and maize are practiced. During lean periods, collection of forest products such as honey and wild yams provide additional food. Wild-harvested products are also used for construction materials, weaving, cooking energy, and as traditional medicine (Raboanarielina, 2011; Ravelona, 2010).

We selected ZNP and Ambohilero forests because they are relatively close (about 50 km apart), comparable in terms of geography and climate and because the resident communities have similar social and cultural characteristics.

2.2. *Village selection*

We collected information on village characteristics needed for village selection during key informant interviews in Antanandava for ZNP and Didy for the Ambohilero forests in CAZ (the major towns of the communes) in August 2013 (Figure 1). We aimed to select villages from ZNP and Ambohilero forests with comparable characteristics including size, access, and infrastructure. We selected villages located within the forests because they have fewer livelihood alternatives, depend more on forest resources and thus are more affected by conservation interventions than villages located in forest peripheries or farther from forest edges (Poudyal et al., 2016; Ratsimbazafy, Harada, & Yamamura,

2011). Among the CFM sites in the Ambohilero forests in CAZ, we selected four CFM sites and surveyed all the eight villages within the four CFM sites (Figure 1). Within ZNP, we selected all three villages within the Antenina enclave. These villages (across our CFM and ZNP sites) have similar characteristics in that they are small (8 to 27 roofs), difficult to access (2.5 to 6 hours walk from the major town of the commune), and 99% of inhabitants are smallholder farmers (Table 1).

Table 1. Characteristics of the surveyed villages exposed to strict protection (in the Antenina enclave of Zahamena National Park) and Community Forest Management (CFM; in Ambilero forest in the Corridor Ankeniheny-Zahamena new protected area)

Table 1 here

Though the enclave of Antenina in ZNP started to be inhabited during the French colonial area, the enclave was not officially recognized until 1997. The enclave has been designed as a zone of controlled occupation, where people can live but their activities must follow certain rules (Raboanarielina, 2011). The people of the enclave have no official rights to manage the natural resources within and around it and thus live under the rules governing ZNP. In contrast, management of the forests in the CFM sites has been transferred from the state to community management associations in 2004 or 2005. As part of the management transfer, the community associations, assisted by other organizations, defined the rules governing the sites, and then enter into a management contract with the state forest department and possibly the municipality the sites belong to (Rasolofoson, Ferraro, Jenkins, & Jones, 2015). Under the rules governing the CFM sites, each one is divided into multiple zones including zones for conservation, zones where people can use forest resources for subsistence purposes, and in the case of the CFM operating in Betsingita, Ivolobe Felana and Arondramena, zones where it is possible to

practice sustainable commercial use of forest resources. The community management associations also receive support from the organizations that assisted them in the management transfer in the form of direct payments for conservation (e.g., compensation of community forest patrollers, funds to cover the operating costs of the community associations), agriculture assistance or support for the sustainable commercial use of forest resources, where such practice is allowed (Randrianarivelo, Montagne, & Ravelona, 2012; Scales, 2012).

2.3. *Development of the survey instruments*

We used both village and household survey instruments (see supplementary file 1 for the final version of both instruments). The village survey instrument, administered to focus groups, collected village-level information on demography, livelihood activities and infrastructure, and ended with an open-ended question asking how the strictly protected area or CFM has impacted villagers' lives. The household survey instrument collected household level information and had three main sections. The first section gathered information on household composition and demography (gender, age, level of education, and main activity of each household member). The second section quantified household assets (furniture, agricultural equipment, livestock, landholding) and housing characteristics, and asked health-related questions. The last section involved the three stages of the GPGI to collect information about the quality of life of the respondents. In stage 1, respondents were asked to identify up to five domains that were most important to their lives (e.g., family, health, wealth...). In stage 2, they rated their performance in each domain; from 0 (very bad) to 4 (very good). In stage 3, the respondents scored each domain according to its relative importance in their life. This was conducted by providing 10 pebbles and asking to distribute them among the domains, spending more pebbles on domains perceived as more important and fewer pebbles on less important domains.

The quality of life of an individual can be influenced by multiple other factors than conservation interventions in a given area. To establish the perceived cause-effect relationship between quality of life and the intervention (strict protection or CFM), we added another stage to the GPGI instrument. We asked if the respondents perceived that the intervention contributed to their performance [0 (very bad) to 4 (very good)] in each quality of life domain they identified.

The lead author, who is a Malagasy native speaker, translated the survey instruments from the original English version to the Malagasy language. Then, a person that was not involved in the questionnaire design back-translated the Malagasy version to English. The two English versions (original and back-translated) were then compared. Where there were discrepancies, the Malagasy translation was adjusted.

We pre-tested the household survey instrument in three small villages located on the forest edges not far from the town of Didy. Following the pre-test, some changes were made. For example, many of our pre-test respondents struggled to respond to the question for the first stage of the GPGI: “Could you indicate the five most important things in your life?” The term “important things” is ambiguous in the Malagasy language (“*zava-dehibe*”). We exchanged it for a term that literally means “priorities” (“*laharam-pahamehana*”), which consistently elicited sensible responses. Another example of a significant change we made was the scale in the second stage of the GPGI instrument, where respondents are asked to rate their performance in each quality of life domain. The original instrument in Camfield and Ruta (2007) has a seven-point scale, but our respondents had difficulties distinguishing this many points and we reduced it to a five-point scale.

2.4. *Sampling and data collection*

The survey was conducted by the lead author with two research assistants from the University of Antananarivo from July to September 2014. The three interviewers are native Malagasy speakers and comfortable with the local dialect spoken in the study areas. In each survey village, we first established contact with village leaders and representatives of the local forest management association (applicable in CFM villages only) to explain the purpose of our visit. Then, using the village survey instrument, we collected village-level information from a focus group discussion involving a range of people (of both genders).

After the focus group discussion, we developed an exhaustive sampling frame for the village. To do that, we walked from one end of the village land to the other with a knowledgeable local guide to identify every household in the village, taking care to consider isolated households outside the main village. We recorded the GPS coordinates of the location of each household, which was assigned a specific identification number. From this list, we randomly selected households for the surveys, taking first preference sample and replacements in case any of the households in first preference sample could not be interviewed. We aimed to sample at least 40 households in both the CFM and the strictly protected area. Given the much smaller number of villages in the strictly protected area than the CFM sites (3 vs. 8), we were able to sample at a higher rate in the former than the latter. The final sample interviewed represents 80% of those present in the strictly protected area villages, and 67% of those present in CFM villages. Our replacement rate was 6.25%, mainly due to the first preference households being absent. In total, we interviewed 128 households (49 in the strictly protected area and 79 in the CFM sites). Despite the different sampling efforts in the strictly protected area and CFM sites, we believe our samples to be representative of the households of each village. Interviews were

conducted with the household head or, if they were not available, their spouse or other adult household member.

The research approach followed the research ethics framework of the lead author's institution. All informants were informed of the aims of the research, and our independence from local conservation or state actors was emphasized. We explained that participation in the research was voluntary, that they could leave the interview at any time and that they did not have to answer any question they were not comfortable with. They were also informed that they would remain anonymous.

2.5. Data analyses

2.5.1. Validity of the GPGI

We investigated both content and construct validity. Content validity is the extent to which the domains within the GPGI are relevant to the concept of quality of life (adapted from the definition of content validity in Haynes, Richard, and Kubany (1995)). Here, the purpose was to see if our GPGI can capture domains that other studies found relevant to the quality of life of people in Madagascar or other developing countries. To do that, we grouped closely related domains mentioned by respondents in the GPGI stage 1 into the same categories. For example, “agricultural yield” and “insecticide to protect agriculture” were categorized under agriculture. Respondents generally understood the task and responded in brief phrases, and thus little categorization was required. Then, we compared the categories of domains derived from our use of the GPGI to those of other quality of life studies using the GPGI or other instruments. In particular, we compared with Farnworth (2004), which is the only quality of life study in Madagascar that, to our knowledge, has used an instrument collecting data on domains of people's life to infer conclusion about their quality of life. Raboanarielina (2011) does not

disaggregate component domains but uses overall measurements such as happiness and basic need satisfaction and therefore cannot be used to evaluate content validity in this study. We also explored how our quality of life domains compare with those of Camfield and Ruta (2007) and Martin, Rodham, et al. (2010), which used the GPGI in Thailand, Bangladesh, and Ethiopia.

Construct validity is “the extent to which a measure is related to specified variables in accordance with an established theory or hypothetical construct” (Camfield & Ruta, 2007, p. 1043). Here, we tested the general theory that materially well-off individuals have higher quality of life than those materially worse-off, and healthier individuals have higher quality of life than those with ill-health (Camfield & Ruta, 2007). We used an asset index as a material well-being indicator. We developed the asset index by aggregating the assets and household characteristics collected during the household survey. We applied principal components to estimate the weights given to each asset and household characteristic in the aggregation process (Filmer & Pritchett, 2001; supplementary file 2 Table S2.1). We compared the final GPGI scores of individuals in the poorest quintile to those in the richest quintile (see Martin, Rodham, et al. (2010) for the creation of the final GPGI score based on information collected with the GPGI survey instrument). We also compared the final GPGI scores of individuals reporting poor health to those reporting good health. In both comparisons, we used the Mann-Whitney U non-parametric test.

2.5.2. Relative impacts of strictly protected area and CFM

To investigate the relative impacts of strictly protected area and CFM on people’s quality of life, we considered a quality of life domain to be negatively impacted when the intervention was perceived as having contributed to a very bad (0) or bad (1) performance of an individual in that domain. Similarly, a quality of life domain was defined to be positively impacted when the intervention has contributed to

a good (3) or very good (4) performance of an individual in that specific quality of life domain. To examine the magnitude of the relative impacts of strict protection and CFM, we compared the two interventions in terms of the distributions of the frequency of individuals across different numbers (i.e., zero to five) of impacted quality of life domains. We conducted this comparison separately for negative and positive impacts, using Fisher's exact test. Second, because quality of life is determined by both the performance in quality of life domains (score in GPGI stage 2) and the relative importance or weight (score in GPGI stage 3) of these domains (Bowling, 1995; Tovbin, Gidron, Jean, Granovsky, & Schnieder, 2003), we also compared the weighted performance (GPGI stage 2 score multiplied by GPGI stage 3 score) in domains that have been perceived to be impacted in the two intervention areas. We used Mann-Whitney U non-parametric test for the comparison.

Restricting the analysis just to the domains perceived by respondents to be impacted by the strict protection or CFM, we compared the characteristics of these impacted domains in the two interventions in terms of their type, direction of impact (negative or positive) for each domain, importance of each domain, and the frequency with which each domain is impacted. We applied an adapted version of the Importance Performance Analysis (IPA) framework (Azzopardi & Nash, 2013; Martilla & James, 1977; Figure 3A and B); where domains in quadrant I and III have been negatively impacted by the strict protection or CFM and domains in quadrant II and IV have been positively impacted. Quadrants I and II contain domains with high importance, and thus have a heavier weight on quality of life than domains in quadrants III and IV that have low importance. We also included the frequency with which a domain was perceived to be impacted as a third dimension. A frequently and negatively impacted domain with heavy weight on quality of life is of concern.

Finally, we used content analysis of the transcribed focus group responses to the open-ended question on perceptions of how the intervention (CFM or strict protection) had impacted villagers' lives to provide quotes to support results from the IPA. We identified three major themes: the domains of villagers' lives impacted by the strict protection or CFM, the direction of the impact (positive or negative) for each domain, and the mechanisms through which the strictly protected area or CFM impacted each domain. Information on the number of participants in each focus groups and the labelling used in quotes (to protect anonymity) is given in supplementary file 2 Table S2.2.

2.5.3. Needs assessment

The IPA framework is a diagnostic tool used to identify priorities where deployment of scarce resources would make the most difference. To identify domains where investment could enhance quality of life, we used the original version of IPA framework shown in Figures 4A and B, where domains that fall in quadrant I are of high importance but low performance (suggesting increased resources should be allocated to these domains). Domains in quadrant II are highly important with high performance (suggesting resources should be sustained). Those in quadrant III are of low importance and low performance (suggesting no change in the allocation of resources is needed). Domains in quadrant IV are of low importance but high performance (indicating perhaps that resources invested here may be better spent elsewhere). In this analysis, we included all domains mentioned by the respondents (i.e., the entire dataset). We included the frequency with which a domain was mentioned by respondents as a third dimension as more frequently mentioned domains are more significant to the quality of life of the communities than less frequently mentioned domains.

3. Results

3.1. Validity of the GPGI

3.1.1. Content validity

The most significant domains mentioned as important to respondents' quality of life in the GPGI were agriculture (74%), health (60%), livestock (55%), education (48%), work and agriculture equipment (39%), livelihood activities or jobs (37%) and family, spouse or relatives (22%). Ten additional domains were mentioned by less than 20% of respondents and further 15 domains mentioned by less than 5% (see Table S2.3). The study by Farnworth (2004) also looked at farmers in Madagascar, and there is strong overlap between the most frequently cited domains in our study and important domains of Farnworth (2004) (e.g., health, education, money, and food). While other important domains in Farnworth (2004), such as social relation, immediate environment and aspiration were not explicitly mentioned in our study, components associated with these domains such as wealth, furniture, livestock, land, community and family relation, forests (forests products), rice, and infrastructure were nominated. Time management and market, which are important domains in Farnworth (2004), were missing in our study (though market was mentioned by one respondent).

The domains in our study are comparable to other GPGI produced domains in studies in other developing countries (Camfield & Ruta, 2007; Martin, Rodham, et al., 2010). Particularly, frequently cited domains in these other studies also include health, education, income activities or job, family or children. However, the frequencies of agriculturally related domains (agriculture, livestock, equipment, land) are higher in our study than in Camfield and Ruta (2007) and Martin, Rodham, et al. (2010). Supplementary file 2 Table S2.3 compares domains nominated in this study with these other studies.

3.1.2. Construct validity

The richest respondents had higher GPGI score than the poorest, but the difference is not statistically significant (Table 2). Respondents reporting good health had higher GPGI score than those reporting poor health, and the difference is statistically significant at the 5% significance level (Table 2).

Table 2. Difference in GPGI score between poorest and richest quintile of asset index and between respondents reporting poor and good health

Table 2 here

3.2. *Relative impacts of strictly protected area and CFM*

A high proportion of respondents reported no perceived negative (over 60%) or positive (over 50%) impacts of the strictly protected or CFM interventions. We did not detect a statistically significant difference between the strictly protected area and CFM sites in terms of the distributions of the frequency of individuals across different numbers (i.e., zero to five) of negatively ($P = 0.57$, Figure 2A) or positively ($P = 0.39$, Figure 2B) impacted domains.

Figure 2 here

Figure 2. Distributions of the frequency of individuals reporting different numbers (zero to five) of negatively (A) and positively (B) impacted domains

The weighted performance in domains perceived to be impacted is lower in the strictly protected areas than in CFM sites (0.37 and 0.45 respectively), but the differences are not statistically significant ($P = 0.23$).

Among people living in the strictly protected area, land and agriculture are two domains of high concern (they are relatively frequently and negatively perceived as impacted and have a heavier weight

on quality of life of impacted individuals (quadrant I; Figure 3A)). The focus groups in the strictly protected area revealed two locally perceived mechanisms through which the strict protection negatively impacted the land and agriculture domains. First, the strict protection restricts access to agricultural lands. Participants in village ZNP1 explained: “Lands that used to belong to us or to our parents have been locked in the protected area. We cannot use these lands anymore.” (FG-ZNP1; supplementary file 3 Quote S3.1). Participants in village ZNP3 echoed this concern: “Because the population keeps growing, there may not be enough land in the future.” (FG-ZNP3; supplementary file 3 Quote S3.2). The lack of agricultural lands has caused conflicts between the three villages in the strictly protected area. People in village ZNP2 stated that: “Agricultural lands are scarce. Villagers of village ZNP1 and village ZNP3 grab our lands. We are left without lands.” (FG-ZNP2; supplementary file 3 Quote S3.3). Second, the strict protection negatively impacted the land and agriculture domains through creation of expectations that have not been fulfilled. For example, residents of village ZNP1 strongly believe that the construction of a dam reportedly promised by Madagascar National Parks would improve their agricultural yield. However, focus group participants reported that: “Madagascar National Parks has not provided any assistance to us. Development projects like the construction of a dam were promised, but never came.” (FG-ZNP 1; supplementary file 3 Quote S3.4).

Figure 3 here

Figure 3. Comparison of the characteristics of impacted domains in (A) the strictly protected area and (B) community managed forest sites [X-axis: mean performance score of impacted domains, Y-axis: mean importance score of impacted domains; I: Negatively impacted domain with heavier weight on quality of life, II: Positively impacted domain with heavier weight on quality of life, III: Negatively impacted domain with lighter weight on quality of life, IV: Positively impacted domain with lighter

weight on quality of life; size of symbol indicates the frequency with which respondents perceived a particular domain to be impacted; 2: education, 3: agriculture, 4: rice, 5: work equipment, 6: land, 7: livestock, 8: house, 9: furniture, 10: money or wealth, 11: livelihood activities, 12: health, 13: community relation, 14: forest or water products, 15: food, 16: poverty or development, 17: infrastructure, 19: external support, 22: peace, 25: fence, 26: hospitality, 29: local forest management association, 30: environment, 31: market, missing numbers are not impacted domains]

We note that though the participants' perception of the impacts of the strict protection on land and agriculture was overwhelmingly negative, participants in villages ZNP2 and ZNP3 mentioned that by protecting the forests the strictly protected area ensures that: "We have enough rain for agriculture." (FG-ZNP2; supplementary file 3 Quote S3.5) and that: "Our agricultural lands are not destroyed by sands from soil erosion." (FG-ZNP3; supplementary file 3 Quote S3.6).

Among the people living in the CFM sites, the education domain is relatively frequently and negatively perceived as impacted and has heavier weight on quality of life of impacted individuals (quadrant I, Figure 3B). The focus group discussions explain the reason for this dissatisfaction: the local forest management associations have raised expectations that they would be able to provide primary schools but only village CFM1 among the eight surveyed CFM villages has a school and that one is in poor condition and has been closed for some years. Participants in the focus group discussion in village CFM1 revealed: "The forest management association built the school and we were responsible for paying the teacher' salary. But we are so poor that we could not keep paying the teacher enough, and he left the village." (FG-CFM1; supplementary file 3 Quote S3.7).

The land domain is relatively frequently and negatively impacted, but its weight on quality of life of impacted individuals is medium (it is on the middle horizontal line; Figure 3B). The negative impacts on the land domain were due to restrictions enforced by CFM. The focus group participants in village CFM2 mentioned: “We do not have enough land to grow food.” (FG-CFM2; supplementary file 3 Quote S3.8); and participants in village CFM3 stated: “Population has grown rapidly and we are not allowed to enlarge our agricultural lands. Thus, available lands are not enough to provide for the people.” (FG-CFM3; supplementary file 3 Quote S3.9).

Agriculture and health are among the domains perceived to experience positive impacts of CFM. They are also among the most frequently impacted domains and have a heavier weight on quality of life of impacted individuals (quadrant II; Figure 3B). The positive impacts of CFM on the agriculture domain are due to the increased sense of land tenure security the communities perceived from CFM. Before CFM, communities did not have any legal claim to their lands within forests. However, under CFM, though forest land ownership still belongs to the state, local people have defined rights to make some management decisions concerning their lands and forests and, crucially, to exclude outsiders. This sense of security provided by CFM was expressed during focus group discussions in five CFM villages through statements such as: “CFM has allowed and legalized our stay and agricultural activities here in the forests.” (FG-CFM4; supplementary file 3 Quote S3.10) and “we have been granted the rights to practice our agricultural activities without fearing eviction.” (FG-CFM1; supplementary file 3 Quote S3.11). However, a participant in village CFM5 revealed that: “We have received threat of eviction and imprisonment from the local forest management association because they accuse us of clearing the forests. We are not satisfied with the lands available to us at all.” (FG-CFM5; supplementary file 3 Quote S3.12). CFM villagers also recognized that: “By protecting forests, CFM brings enough rain for

our agriculture.” (FG-CFM3, supplementary file 3 Quote S3.13). The perceived positive impacts of CFM on health come from forest ecosystem services such as pure air and medicinal plants as mirrored in the statement of participants in village CFM1: “The forests protected by CFM provide pure air and medicinal plants for us.” (FG-CFM1, supplementary file 3 Quote S3.14).

3.3. *Needs assessment*

In the strictly protected area, land is a priority domain (quadrant I; Figure 4A) because it is relatively frequently nominated by respondents, has low performance and high importance. Agriculture and money or wealth are relatively important because they are relatively frequently nominated and have low performance, though their importance is medium (on the middle horizontal line; Figure 4A).

Education, health and food are domains, in which a high frequency of individuals are performing well and which have high importance in the strictly protected area (quadrant II; Figure 4A).

In CFM sites, priority domains that need to be improved to enhance the quality of life are education, agriculture, land and money or wealth. They are relatively frequently mentioned, have low performance and high importance (quadrant I; Figure 4B). In CFM sites, family and health are the domains having high frequency, performance, and importance (quadrant II; Figure 4B).

Figure 4 here

Figure 4. Needs assessment in (A) the strictly protected area and (B) community managed forest sites (B) [X-axis: mean performance score of domains, Y-axis: mean importance score of domains; I: Concentrate here (increase resources), II: Keep up the good work (sustain resources), III: Low priority (no change in resources), IV: Potential overkill (curtail resources); Size of symbol indicates the frequency with which respondents mentioned a particular domain; 1: family, 2: education, 3:

agriculture, 4: rice, 5: work equipment, 6: land, 7: livestock, 8: house, 9: furniture, 10: money or wealth, 11: livelihood activities, 12: health, 13: community relation, 14: forest or water products, 15: food, 16: poverty or development, 17: infrastructure, 18: religion, 19: external support, 20: clothing, 21: electricity or light, 22: peace, 23: cigarette, 24: motivation, 25: fence, 26: hospitality, 27: fire, 28: coffee, 29: local forest management association, 30: environment, 31: market, 32: mining; Source: (Martilla and James 1977)]

It is important to note that although all these villages are located in the middle of the forest, the domain forest products was not mentioned in the strictly protected area (Figure 4A) and it is in the non-priority domain in the CFM sites (quadrant IV; Figure 4B).

4. Discussion

4.1. *Validity of the GPGI for measuring subjective well-being*

Overall, the GPGI appeared to work well at capturing life domains important to the respondents' quality of life. The domains identified as important in our study are similar to those identified in other quality of life studies in Madagascar (Farnworth, 2004) and other developing countries (Camfield & Ruta, 2007; Martin, Rodham, et al., 2010). The small discrepancies between domains in our GPGI and these other studies may result from differences in study settings. For example, the remoteness of our study sites and the absence of market economy may explain why the market domain was not mentioned in contrast to Farnworth (2004), who worked in an area where cash crops are important. The higher frequencies of agricultural related domains (agriculture, livestock, equipment, land) in our study than in Camfield and Ruta (2007) and Martin, Rodham, et al. (2010) may be because virtually all our

respondents are smallholder farmers, whereas respondents in these other studies range from rural farmers to wealthy urban businessmen.

The GPGI furthermore appears to meaningfully reflect respondents' quality of life. In accordance with general theory (Camfield & Ruta, 2007), we found that healthier individuals had a higher quality of life, as measured by our GPGI, than those with poor health. We also found that the richest respondents had higher quality of life than the poorest, but this difference was not statistically significant. This may be due to the small economic variability in our samples (respondents are nearly all asset poor, smallholder farmers living in remote areas). Camfield and Ruta (2007) and Martin, Rodham, et al. (2010)'s samples had large economic variability (from rural farmers to wealthy urban businessmen), and they found moderate correlations between material well-being and quality of life. Another explanation for lack of statistical difference in quality of life between the rich and the poor is that despite the general theory (Camfield & Ruta, 2007), the relationship between material well-being and quality of life is complex, and many factors including adaptation, positive cognitive bias, homeostasis, unrealistic optimism and illusions of control can all weaken the relationship (Camfield & Skevington, 2008).

4.2. *Impacts of conservation interventions in eastern Madagascar on subjective well-being*

Despite the hope that CFM would have more positive impacts on local well-being than strict protection (Scales, 2012), we cannot detect any difference between the two interventions. We used three measures to examine the magnitude of their relative impacts: the distributions of the frequency of individuals across different numbers of negatively or positively impacted quality of life domains, and the weighted performance in domains perceived to be impacted by respondents. There were no statistically

significant differences in any measure. However, there are clear differences in the characteristics of domains perceived to be impacted which suggests that there are differences between the strictly protected area and CFM in terms of their local impacts. For example, different types of domains were impacted by the two interventions, the interventions impacted the same domain in different directions (positive and negative), the same impacted domain had different importance in the two interventions, and the frequency with which a domain was impacted differed.

The fact that we did not detect strong evidence for better impacts on local wellbeing of CFM when compared to strict protection is interesting given that CFM was explicitly designed to have a more positive impact than strict protection on local well-being (Adams & Hulme, 2001; Hutton et al., 2005). Nevertheless, our result supports a body of work suggesting that CFM has had disappointing results in terms of delivering expected positive well-being impacts (Dressler et al., 2010; Nielsen & Treue, 2012). There have been suggestions that one reason for the lack of positive impacts is that CFM is often not implemented as the theory suggests it should be. CFM could serve as a shallow cover to a strict protection agenda, in which the coercive power of the state is transferred to non-governmental organizations or local elites (Blaikie, 2006; Brown & Lassoie, 2010; Corson, 2012; Dressler et al., 2010), who can be incompetent, corrupt, and driven by self-interest (Agrawal & Gibson, 1999; Alexander & McGregor, 2000).

Our findings that the characteristics of the impacted domains under strict protection and CFM are different indicate the two interventions have had different impacts on well-being. However, impacted individuals may have adapted their internal standards, values, or conceptualization of quality of life in response to the interventions, a phenomenon known as response shift (Schwartz et al., 2006; Schwartz & Sprangers, 1999), so that the different impacts of both interventions have not been seen in the

measures used to investigate the magnitude of their relative impacts. For example, impacted individuals in the CFM sites perceived that CFM improved their agriculture domain through increasing their sense of land tenure security. However, by promising schools to the community, the local forest management associations have created expectations that have not been met and caused the impacted individuals to perceive negative impacts of CFM on the education domain. In contrast, in the strictly protected area, agriculture was a major concern due to the strictly enforced conservation restrictions, but because of the presence of a functioning primary school education was not a major concern.

Direct comparison of the GPGI final scores between strict protection and CFM would not give a credible estimate of the relative impact of the two interventions. Some of the five life domains nominated by a respondent have not been impacted by the intervention. Thus, the GPGI final score, which measures overall subjective well-being, can include components that are not related to the intervention. Such factors confound the estimate of the relative impact of strict protection and CFM obtained by comparing GPGI final scores in the two interventions. Instead, we sought to attribute outcomes (in terms of subjective-wellbeing as measured by GPGI) to conservation interventions (strict protection or CFM) using a participatory approach where we asked respondents whether the interventions contributed to their performance in each of their valued quality of life domains. This participatory approach to attribution permits identifying the specific quality of life domains impacted by the interventions, examining the characteristics of these impacted domains, and thus exploring the response shift phenomenon that might have occurred.

Our results indicate the importance of expectations as mechanisms through which conservation interventions affect well-being. It is therefore important that practitioners and managers are careful in promises they make to local communities and are held accountable for these promises. Previous studies

have shown that unfulfilled livelihood support promises relate to dissatisfaction, loss of local support for conservation, and reduced compliance to regulations (Dawson et al., 2018). The perceived positive impacts of CFM on the agriculture domain due to an increased sense of land tenure security point to the attention that should be given to the recognition of land tenure rights of local communities by conservation and development stakeholders (Rakotonarivo et al., 2018). Such recognition is mandated by CFM legislation in Madagascar, but its implementation is largely missing (Pollini & Lassoie, 2011). The perceived negative impacts of strict protection on land and agriculture domains in Zahamena National Park suggest that further efforts to integrate local community perceptions in future amendments of the park boundaries are needed to limit adverse impacts of restriction of access to agricultural lands on local well-being. Lack of local consultation has been reported concerning the recent efforts to extend protected areas across Madagascar despite such consultation being crucial to ensuring conservation does not harm local communities and ultimately conservation success (Corson, 2012).

In this study, we did not examine how impacts on well-being vary across different groups with different characteristics within the surveyed communities. Larger sample sizes would be needed to appropriately carry out heterogeneity of impacts analyses (Ferraro & Pressey, 2015). However, such analyses would be valuable as evidence shows that impacts are not felt equally by all members of a society (Rasolofoson et al., 2017), and marginalized groups may be less able to access any benefits from conservation than others (Poudyal et al., 2016). Future studies could use the same approach but target larger populations or select larger samples to investigate heterogeneity of impacts. For example, one could extend the sampling strategy to explore how impacts of conservation interventions differ between men and women, as genders conceptualize well-being differently (Britton & Coulthard, 2013).

Larger populations or sample sizes could also be amenable to analyzing how impacts vary with levels of education, which could moderate impacts of conservation on well-being (Rasolofoson et al., 2017).

4.3. *Identifying areas for future investment to improve local well-being*

Perceived positive well-being impacts of conservation have been associated with conservation success (de Koning, Parr, Sengchanthavong, & Phommasane, 2016; Oldekop, Holmes, Harris, & Evans, 2016). Combined with arguments based on environmental justice, this suggests that conservationists should work to maximize positive and minimize negative impacts of conservation on local well-being.

The needs assessment findings indicate some differences in the strict protected and CFM areas in the priority domains that could be targeted by increased resource allocation to improve quality of life in locally meaningful ways. We undertook a needs assessment using the Importance Performance Analysis, which has been used in other sectors such as tourism, food services, education, business, healthcare, banking and public administration as a diagnostic tool to identify priorities (Azzopardi & Nash, 2013). However, to our knowledge, Importance Performance Analysis has not been previously used in a biodiversity conservation context, although it was used in tourism visitation of protected areas for improving the competitiveness of protected areas as tourism destinations (Haahti & Yavas, 2004; Tonge & Moore, 2007; Wade & Eagles, 2003).

Needs assessment was possible because we used the GPGI. An overall subjective well-being measure does not provide any information on well-being component domains from which to prioritize and a focus on narrow objective indicators may misguide resource allocation. For example, a study objectively measuring income from different sources could find that forest products are important sources of income and conclude that they should be the target of increased resources in order to

improve well-being. However, the forest product domain was not mentioned among the valued domains in the strictly protected area and was a non-priority in CFM sites. Respondents may have included forest products in the domains of livelihood activities and food, but these domains are not high priority domains where increasing resources could primarily be allocated to improve quality of life. This highlights the importance of considering subjective indicators that capture the multidimensional nature of well-being like the GPGI, which suggests that increasing resources allocated to forest products may do little to improve well-being in locally meaningful ways.

4.4. Lessons for the evaluation of the impact of conservation on human well-being: locally relevant information versus robust measures of the magnitude of impacts

Following concern about the quality of impact evaluation in conservation (Ferraro & Pattanayak, 2006), there has been a recent increase in the publication of rigorous empirical evaluations. For example, there are a growing number of robustly designed quantitative studies aiming to estimate the magnitude of the impacts of conservation interventions on human well-being. Sims (2010) demonstrated a positive impact of protected areas on household consumption expenditure in Thailand using an instrumental variable design. Andam et al. (2010) used statistical matching to show that protected areas reduced poverty in Costa Rica. Using similar matching design, Rasolofoson et al. (2017) concluded that CFM did not have substantial negative impacts on household consumption expenditure in Madagascar. Such credible estimates of the magnitude of impacts are crucial for external stakeholders (e.g., government and non-government agencies and donors) who need tangible, comparable and quantitative estimates to inform their decisions on identification of cost-effective interventions (Woodhouse et al., 2015). However, objective indicators and rigorous quantitative empirical designs may not cover dimensions of well-being locally perceived to be important or

impacted by the interventions. Thus, they may be of limited use if the purpose is to understand and respond to local concern about conservation impacts (Bennett, 2016).

Where understanding impacts as experienced by local people is important, subjective well-being measures such as GPGI combined with participatory impact evaluation has been promoted (Milner-Gulland et al., 2014; Woodhouse et al., 2015). Like all methodological approaches, this of course also has limitations. Firstly, it cannot provide the quantitative estimates of the magnitude of impacts so often wanted by policy makers (Woodhouse et al., 2015). Secondly, interventions may have impacts but people's adaptation, through which they re-conceptualize the definition of well-being (response shift), may make the magnitude of these impacts undetected by measures of subjective well-being. Finally, subjective well-being measures and perceptions of impacts are commonly affected by mood, cultural norms, and by timing (Camfield & Skevington, 2008); although it is worth noting that by constructing subjective well-being from its component domains, the GPGI may be less affected than overall judgment of subjective well-being (Schwarz & Strack, 1999). Quantitative impact evaluation using objective measures of well-being, and subjective well-being evaluation using participatory approaches therefore play different but complementary roles in the impact evaluator's toolkit.

5. Conclusions

It is increasingly recognized that conservation interventions can impact local well-being and there is interest in understanding the ways in which different conservation interventions may have different impacts. Our study highlights differences in the characteristics of the domains of well-being impacted under strict protection and CFM and suggests how those involved in implementing these conservation interventions may allocate resources to improve well-being in locally meaningful ways. Based on our

experience, we argue that the Global Person Generated Index (GPGI) holds promise for the recent push to consider the subjective and multi-dimensional nature of human well-being in conservation impact evaluation. Its strength lies not so much in its final score, which measures individual's overall quality of life, but on the wealth of information it provides on what life domains people value and their performance in these valued domains (Camfield & Ruta, 2007). The challenges of robust impact evaluation, especially for large conservation interventions such as protected areas or community forest management, are increasingly well understood (Baylis et al., 2016). Participatory approaches, while they cannot provide robust quantitative estimates of the magnitude of an impact on a given outcome of interest, provide extremely valuable insights and reveal local perceptions of the impacts of an intervention. Local perceptions may be more valuable than studies measuring quantitative impacts when it comes to understanding local support, or lack thereof, for an intervention. We suggest that conservation practitioners interested in improving the well-being impact of their interventions on local people would benefit from applying such approaches in impact evaluations and using the results to change practice on the ground.

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