IMPACT EVALUATION ON BIODIVERSITY IN GABON

Project summary

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Title:	Impact Evaluation on Biodiversity in Gabon
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SUMMARY

FSC is committed to understanding and demonstrating the effectiveness of its standards through its Monitoring and Evaluation system which includes field-based evaluations. This report summarizes the scope, methods, and some initial findings from an impact evaluation commissioned by FSC in Gabon to explore the impact of FSC forest management certification on biodiversity. The results showcase the conservation value of FSC-certified forests for biodiversity, with many species found and some in greater abundance compared to uncertified forests. It also identifies the presence of threatened and cryptic species in FSC-certified forests. The project also aimed at testing the effectiveness of an innovative state-of-the-art technology called environmental DNA (eDNA) as a cost-effective and efficient tool for monitoring biodiversity in FSC-certified forests globally.

BACKGROUND

To better understand the effectiveness of FSC standards and demonstrate the benefits of responsible forest stewardship, FSC is implementing a robust Monitoring and Evaluation system. One part of the broader scope of this system is to test precise hypotheses about the effects and the specific added value, of FSC forest management certification on a range of social, environmental, and economic topics. To this end, FSC conducts field-based impact evaluations led by researchers and involving local experts and stakeholders.

A particular focus of these impact evaluations is biodiversity conservation, including the presence of rare and threatened species and their habitats. This topic is a priority for FSC and plays a central role in two of the main FSC standards: the FSC Principles and Criteria for Forest Stewardship (FSC-STD-01-001 V5-3) and the International Generic Indicators (FSC-STD-60-004 V2-1). However, conducting field studies and collecting data in forests for biodiversity monitoring can be very demanding and costly. They often require technical experts to be on-site to identify species through direct observations which is typically very time-consuming. However, there is now a technology called **environmental DNA (eDNA)** that allows sampling biodiversity with unprecedented cost-effectiveness and efficiency. This method consists of sampling the ecosystem, usually water, to capture DNA traces left by living organisms to confirm their presence easily without requiring any biological expertise.

To better understand how FSC-certified forest stewardship contributes to preserving biodiversity in Central African tropical forests and to evaluate the use of eDNA as a cost-effective, robust, and replicable technology for field data collection, FSC has commissioned an impact evaluation project in Gabon. This country is a prime candidate for piloting the use of eDNA for forest biodiversity monitoring given that FSC requirements for forest management ensure the good management of watercourses, which should prevent soil erosion and water sedimentation. This, in turn, is thought to influence water quality and its associated biodiversity.

To guide the whole project, the following overarching questions were considered to ensure conformity with the ISEAL Impact Code of Good Practice by FSC:

- *Is FSC certification producing the intended social outcomes and impacts?*
- *What unintended social effects (positive and /or negative) have resulted from FSC certification?*
- *What factors could have influenced the results (factors within the control of FSC and other external factors)?*
- *What are the limitations?*

Scope and objectives of the project

The project was conducted in Gabon in 2022, and it was designed to compare FSC-certified and uncertified forest concessions evaluating the specific contribution of FSC certification.

This project had two objectives:

1. To evaluate the added value of FSC certification for biodiversity conservation in Gabon
2. To pilot the eDNA technology and evaluate its potential as a cost-efficient and replicable methodology to monitor forest biodiversity in the FSC system.

Methods

Environmental DNA

A modern tool that makes it possible to detect and analyze the DNA traces left in the environment of living organisms regardless of their size. These traces, known as **eDNA** can be extracted from sampling water, soil, or feces and offer a great opportunity to characterize the biodiversity of an ecosystem and identify very rare and threatened species, which are usually quite difficult to find using traditional scientific inventory techniques, can be confirmed with less effort and resources. In addition, since it is not an invasive tool, species can be identified without direct observation which is typically very time-consuming and requires technical experts to come to the field.

Sampling plan

For this project, the field work was carried out in three phases:

Development of the sampling strategy: This included the selection of forest concessions and the development of the sampling strategy and specific sites. This led to the choosing of two FSC-certified and two neighboring uncertified concessions.

Organization and execution of the sampling missions: Field work for sampling at all sites was carried out for just over two weeks, starting on March 21, 2022, and ending on April 5, 2022. Samples were sent to SPYGEN also in April.

Sample analysis: Conducted by SPYGEN, a French biotechnology company specializing in molecular ecology and an expert and leading company in eDNA.

The project aimed to compare the biodiversity of FSC-certified forests with that of non-FSC-certified forests and to focus on detecting **rare**, **threatened**, and **charismatic** species, along with **bio-indicator** species. Thus, to test the technology, various taxa (e.g., Eukaryots, insects, vertebrates, fish, mammals, etc.) were analyzed in this pilot project to determine their relevance.

Figure 1. Forest bridge downstream of the sampling site. Source: Terea

Field work

The sampling was conducted in two concessions in the north of the country, and two concessions in the south (Fig. 2). Sampling was done in forest compartments that were logged approximately at the time (ca. two years) to avoid biases related to wildlife response to logging disturbance. Specifically, the field work consisted of collecting water samples in watercourses in different watersheds in the selected forest concessions. These streams are expected to capture DNA information from various upstream watercourses and be representative of the entire associated watershed. In other words, the sampling sites acted as sentinels for larger forest areas.

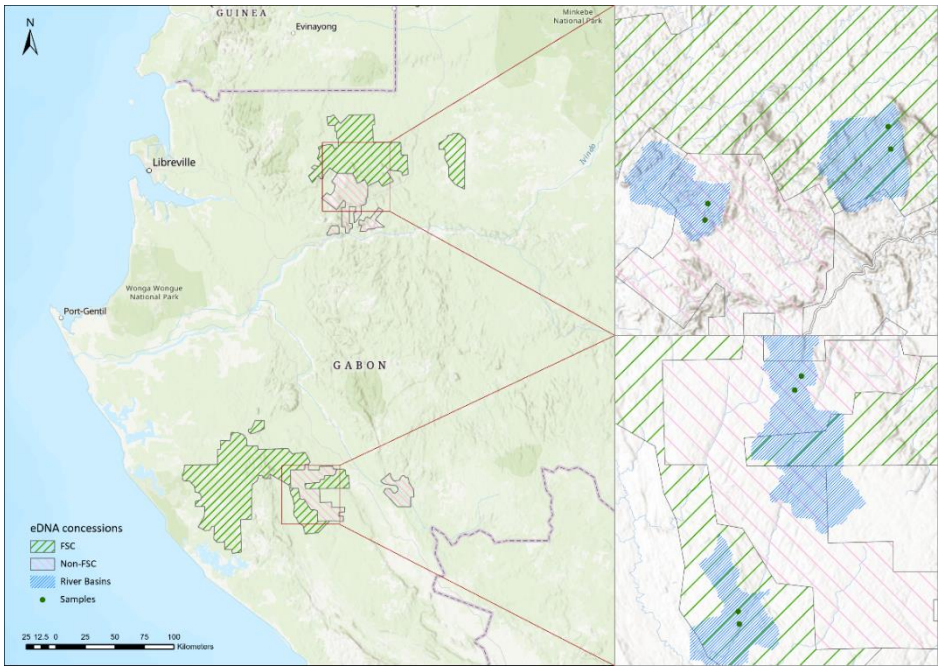

Figure 2. Sampling sites. Source: Terea

The field work was conducted by local consultant company Terea following SPYGEN's sampling protocol to ensure the quality of the results. So that large quantities of water could be sampled, at each site 30 liters of water were sampled twice by pumping with a peristaltic pump (Fig. 3) and filtering the water in the stream for 30 minutes.

Each sampling kit was provided directly by SPYGEN, specifically developed to increase species detection and avoid contamination of sample DNA. Each kit is single-use, and it is composed of a filtration capsule (supplied in a sterile bag to avoid contamination) with a large surface area filter for the filtration of very large amounts of water (Fig. 4). In addition, a preservation buffer, a sterile pumping tube with a trainer and gloves for sample collection was also supplied by SPYGEN.

Figure 3. Example of sampling with a Vampire peristaltic pump provided by SPYGEN. Source: Terea

Figure 4. Illustration of the filtration capsule, with a total surface of 500 cm2 allowing the filtration of 30 liters of water. Source: SPYGEN

RESULTS

Biodiversity in Gabon

Statistical analyses show differences in the composition of the fauna of FSC versus non-FSC forest management. These differences are heightened by the quantitative analysis that revealed that the diversity of taxa such as vertebrates is more important in FSC forests than in non-FSC forests for all classes. However, the number of sites studied is too small for robust statistical analysis.

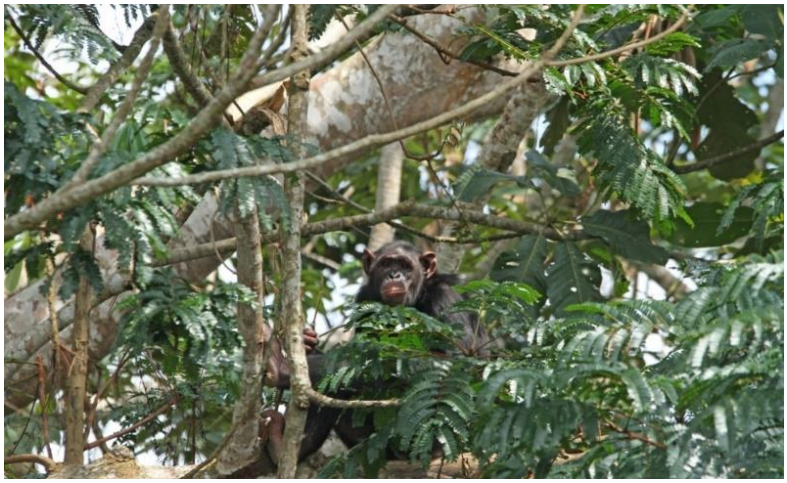

Figure 5. Chimpanzee (Pan troglodytes) Source: V. Prié

Regarding mammals, the eDNA from hunted species (for this project only antelopes, monkeys, and pangolins were considered) were found to be three times more abundant in FSC forests than in non-FSC forests. Notably, Pangolins were detected only in FSC forests (results confirmed by both mammal and vertebrate analyses). This may be linked to FSC requirements aimed at preventing unauthorized and illegal hunting in FSC concessions (FSC 2020).

Figure 6. White-bellied Pangolin (Manis tricuspis) Source: Bart Wursten

Overall, the eDNA analysis revealed the presence of charismatic species such as the African forest elephant, *Loxodonta cyclotis*, the Western Gorilla, *Gorilla gorilla*, both classified as Critical endangered in the IUCN Red List, as well as the Chimpanzee, *Pan troglodytes*, and the Leopard, *Panthera pardus*.

In addition, more cryptic mammal species of conservation concern were also detected in FSC-certified forests, such as the Giant Ground Pangoli, *Manis gigantea*, the White-bellied Pangolin, *Manis tricuspis*, the elusive Giant Otter Shrew, *Potamogale velox*, the African Palm Civet, *Nandinia binotata*, and the Cameroon Scaly-tail, *Zenkerella insignis,* a rare and almost unknown species of rodent. Notably, some interesting patterns were seen, giving new insights into what could be good bioindicators of well-preserved watercourses.

CONCLUSIONS

We found positive outcomes of FSC-certified forest management biodiversity. eDNA analyses show some differences between certified and uncertified forests, both for very large taxonomic groups such as the Eukaryots, and for more specific taxa such as birds and mammals.

The results of this project, tend to show a higher biodiversity in FSC-certified forests but also a higher abundance, measured as the number of eDNA traces from most of the taxonomy groups studied.

The project has proven that eDNA can be an effective tool to measure biodiversity within forest concessions. Additionally, since collecting eDNA samples is relatively easy, its use could empower forest managers to monitor their forests more effectively.

Limitations

The sampling was too small for a robust statistical interpretation of the results. For example, the great apes were only detected in uncertified FSC forests, which is probably not related to forest management, but rather to the small number of sampled sites and the stochasticity of their occurrence. These could also be inadequate bio-indicators.

NEXT STEPS

A manuscript is being written and will be submitted for publication in an international peer-reviewed scientific journal.

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