



Evaluation of the Effectiveness of Environmental Laws in Protecting Natural Resources in Southern Angola (Chimalavera and Bicuar)

Avaliação da Eficácia das Leis Ambientais na Protecção dos Recursos Naturais do Sul de Angola (Chimalavera e Bicuar)

Evaluación de la Eficacia de las Leyes Ambientales en la Protección de los Recursos Naturales del Sur de Angola (Chimalavera y Bicuar)

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Abstract:

This study aimed to assess the effectiveness of environmental laws in protecting natural resources (flora and fauna) within the conservation areas of Chimalavera (Benguela, Angola) and Bicuar (Huíla, Angola). The applicable legal framework governing conservation areas in Angola was identified, followed by an investigation into the institutional, social, and economic factors limiting the enforcement of environmental legislation. Furthermore, the environmental impacts resulting from the ineffective implementation of these laws were examined. To achieve these objectives, the study initially carried out a compilation of the legislation applicable to conservation areas, followed by an interpretation of the legal principles and norms contained in these instruments. For the collection of empirical data, structured surveys were administered to gather information on the variables of interest, specifically the enforcement of environmental laws, inspection and monitoring activities, community participation, and the conservation status of fauna and flora. In addition, field observations were conducted through direct and indirect transects. The findings indicate the existence of legal, economic, institutional, and, above all, social weaknesses that intensify pressure on natural resources within the conservation areas under study.

Keywords:

Effectiveness of environmental protection laws, natural resources, conservation areas.

Resumo:

Este estudo tem como objectivo avaliar a eficácia das leis ambientais na protecção dos recursos naturais (flora e fauna) nas áreas de conservação da Chimalavera (Benguela-Angola) e do Bicuar (Huíla-Angola), foi identificado o quadro legal aplicável as áreas de conservação em Angola, seguido de uma investigação sobre factores institucionais, sociais e económicos que limitam a aplicabilidade da lei, também foram examinados os impactos ambientais resultantes da ineficácia da aplicação das leis, para efeitos efectuou-se inicialmente a catalogação da legislação aplicável as áreas de conservação, seguida de interpretação dos princípios e normas jurídicas destes instrumentos, para obtenção de dados empíricos aplicou-se inquéritos estruturados para colectar dados sobre as variáveis de interesse, especificamente, aplicação das leis ambientais, fiscalização, participação comunitária, e estado de conservação da fauna e flora, outrossim foi utilizada observação de campo, concretizada através de transectos directos e indirectos. Os resultados apontam para fragilidades legais, económicas, institucionais, e sobretudo sociais, que elevam a pressão sobre os recursos naturais nas áreas de conservação em estudo.



Palavras-chave:

Eficácia das leis de proteção ambiental, recursos naturais, áreas de conservação.

Resumen:

Este estudio tuvo como objetivo evaluar la eficacia de las leyes ambientales en la protección de los recursos naturales (flora y fauna) en las áreas de conservación de Chimalavera (Benguela, Angola) y Bicular (Huíla, Angola). Se identificó el marco jurídico aplicable a las áreas de conservación en Angola, seguido de una investigación sobre los factores institucionales, sociales y económicos que limitan la aplicación de la legislación ambiental. Asimismo, se examinaron los impactos ambientales derivados de la aplicación ineficaz de dichas leyes. Para ello, se realizó inicialmente una recopilación de la legislación aplicable a las áreas de conservación, seguida de la interpretación de los principios y normas jurídicas contenidos en estos instrumentos. Para la obtención de datos empíricos, se aplicaron encuestas estructuradas destinadas a recopilar información sobre las variables de interés, específicamente la aplicación de las leyes ambientales, la fiscalización, la participación comunitaria y el estado de conservación de la fauna y la flora. Además, se realizaron observaciones de campo mediante transectos directos e indirectos. Los resultados indican la existencia de debilidades legales, económicas, institucionales y, sobre todo, sociales, que incrementan la presión sobre los recursos naturales en las áreas de conservación estudiadas.

Palabras clave:

Eficacia de las leyes de protección ambiental, recursos naturales, áreas de conservación.

INTRODUCTION

The concern for the protection and management of the environment, specifically conservation areas, is a global project that dates back more than 50 years, beginning with the *Man and Environment Programme*. Following the 1971 UNESCO Convention, the 1972 Convention on the Protection of the Natural and Cultural Heritage was approved in the same year. Continuing with the same concern for environmental protection, the 1974 Paris Convention emerged, and others followed, notably the 1979 Bonn Convention, as well as the Convention on Biological Diversity. All these agreements or conventions aimed at and contributed to the preservation of areas whose ecological, environmental, landscape, or even cultural significance and value were considered to be of enormous international importance. (Basílleo, 2018).

The issue of the effectiveness of environmental laws in protecting natural resources (fauna and flora) is currently at the heart of the contemporary debate on environmental management, particularly in African contexts where pressure on ecosystems coexists with significant institutional limitations. Conservation areas emerge as privileged spaces to empirically assess the effectiveness of environmental policies. Given its ecological importance



and the increasing anthropogenic pressure on its natural resources, the Chimalavera Regional Natural Park 's protection is crucial because it plays a fundamental role in biodiversity conservation and in providing essential ecosystem services to local populations (Silva & Santos, 2020).

analyzing the effectiveness of environmental protection laws is a central focus for understanding and improving legal frameworks.

This shows that, despite the relevance of the topic, there is a scarcity of studies on this subject in the Angolan context. On the other hand, the specialized literature has highlighted the existence of an implementation gap, characterized by the discrepancy between formally established laws and the observed environmental results. This knowledge gap limits the adoption of effective measures for the conservation of natural resources (fauna and flora), versus their useful exploitation by the populations. Thus, it becomes necessary to develop research in order to improve the institutional performance of the administrations of conservation areas. (Abreu, 2021).

THEORETICAL FRAMEWORK

Definition and History of Conservation Areas in Africa

The issue of environmental protection is one of the central problems of our time, being a priority concern for various governments and international institutions. Aspects related to the scarcity of natural resources, the increase in the world's population, and the growing needs for goods and services require rational management of these resources at both the international and national levels. (Cysne & Amador, 2020).

History of Conservation Areas in Africa

Environmental conservation in Africa has a rich and diverse history, influenced by historical, political, and socioeconomic factors . Different management models have been implemented over the centuries, reflecting everything from traditional conservation systems practiced by local communities to modern models based on national environmental legislation and international agreements. (Domingos, 2017).

Human presence in Africa dates back hundreds of thousands of years, and indigenous populations have always played a crucial role in maintaining ecosystems. The formalization of conservation areas began in the late 19th and early 20th centuries with the creation of the first



national parks. *Kruger* National Park in South Africa, established in 1898, was one of the first examples of official conservation, followed by Virunga National Park in the Democratic Republic of Congo, created in 1925. (Andrade & Shelton, 2004).

Expansion of protected areas

During the 20th century, several African countries began investing in the creation of national parks and nature reserves. The 1960s were a crucial period for conservation in Africa, as many countries gained their independence and began formulating their own environmental policies. (International Union for Conservation) Nature , 2021).

The conservation of natural resources is enshrined in the Constitution of the Republic of Angola and in ordinary laws.

Among the various norms present in the “CRA”, the following stand out: in Article 21, under the heading, Fundamental Tasks of the State, in its paragraph m), it prescribes the following: “ *To promote harmonious and sustainable development throughout the national territory, protecting the environment and natural resources*” (...), here it can be clearly seen that the defense of the environment is a fundamental task of the Angolan State, and simultaneously a fundamental right under Article 39, in point no. 2 of the same article, where there is a clear intention of the Angolan State to protect the environment, it becomes clearer, with the following prescription: “*The State adopts the necessary measures for the protection of the environment and of the species of flora and fauna throughout the national territory, (...)*”.

However, to better protect the environment, Angolan lawmakers have created a set of legal, civil, and even criminal measures. This is the scope of Article 39, paragraph 3 of the Angolan Constitution, which states: “ *The law punishes acts that endanger or harm the preservation of the environment .*” More recently, with the approval of Law No. 38/20 of November 11, 2020, which approved the Angolan Penal Code, Title VI introduces the concept of crimes of common danger, and Article 283 innovates with the crime of environmental aggression. For example, according to paragraph 1 of this law, anyone who harms the environment by hunting, setting fires, or cutting down forests can be punished with an abstract penalty ranging from 1 to 5 years.

Mechanisms for evaluating the effectiveness of environmental laws for the protection of resources.



natural features of conservation areas.

The increasing degradation of the environment, especially in conservation areas, has affected directly impacts natural resources. The effectiveness of environmental laws is closely linked to their ability to produce concrete results in practice. (Diegues, 2000).

According to Milaré (2015), **the evaluation of the effectiveness of environmental laws** can occur from different perspectives: legal effectiveness: relates to the degree of compliance with environmental laws by individuals, companies and public bodies; social effectiveness: analyzes the impacts of legislation on social and community behavior; ecological effectiveness: assesses whether the law effectively contributes to the conservation of natural resources; institutional effectiveness: verifies the capacity of environmental bodies to apply and monitor the application of existing laws.

According to Holkings (2003), the effectiveness of conservation area management depends on the existence of mechanisms for monitoring, evaluating, and adapting public environmental policies.

Mechanisms for evaluating the effectiveness of environmental laws through the use of methodological instruments and multi-dimensional indicators in light of (Prestes, et al. 2018):

Environmental indicators; these indicators allow measuring ecological changes in conservation areas, among the main ones are: deforestation rates, biodiversity conservation, water quality, recovery of degraded areas, control of forest fires, and reduction of illegal hunting.

According to Holkings (2019), ecological indicators are fundamental for measuring the effectiveness of conservation policies. Legal indicators: The effectiveness of laws can also be measured by legal and institutional indicators, analyzing the following variables: number of environmental infractions; a reduction in environmental infractions demonstrates greater effectiveness of legislation; application of sanctions: effectiveness depends on the effective punishment of environmental infractions; existence of public policies: effective environmental laws require consistent, continuous public policies, and above all, economic alternatives for local communities that customarily depend on the park's natural resources.

Models for evaluating the effectiveness of environmental management.



Several methodological models have been created to evaluate the effectiveness of protected area management, the most notable being the following:

a) RAPPAM (*Rapid Assessment and Prioritization of Protected Area Management*)

This methodology, developed by the World Wide Fund for Nature, allows for a credible assessment of the management of protected areas. This method considers the following aspects: planning, financial resources, oversight, community participation, and environmental monitoring. METT (*Management Effectiveness The Tracking Tool*) was created by the World Bank and the *World Wide Fund for Nature* to monitor the effectiveness of environmental management.

Monitoring of conservation areas

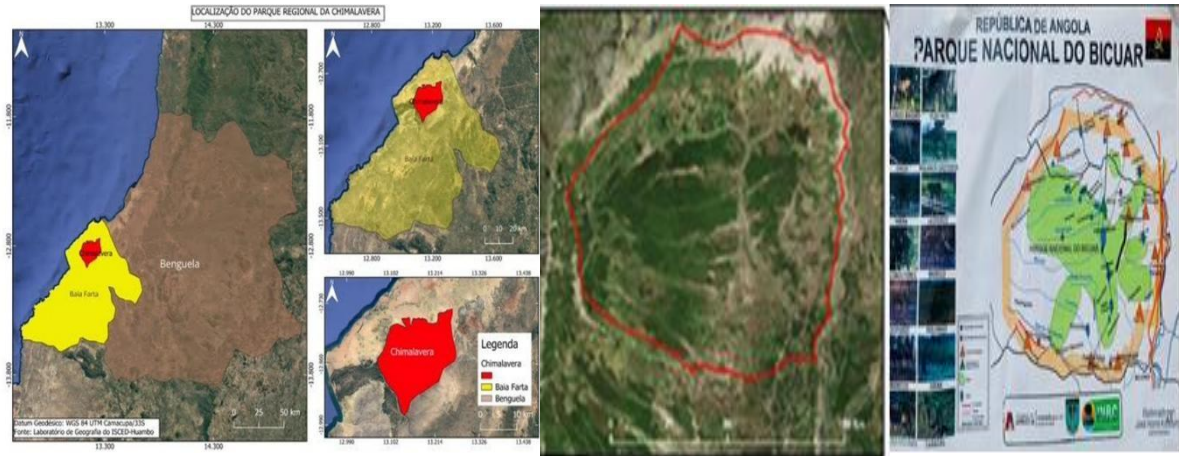
Enforcement is one of the most important mechanisms for ensuring the effectiveness of environmental protection laws. The actions of enforcement agencies include: applying fines, halting activities such as construction within conservation areas, seizing equipment (firearms, fishing gear, deforestation equipment, etc.), civil and criminal liability, and continuous monitoring. According to Machado (2018), the absence of adequate enforcement profoundly compromises the effectiveness of environmental legislation. Efficient enforcement depends on: financial resources, qualified technical personnel, monitoring technologies, institutional independence, and international cooperation.

Challenges to the effectiveness of environmental laws in the conservation of natural resources:

The effectiveness of environmental laws is hampered by numerous challenges, such as: lack of financial resources, budgetary limitations that compromise their effective monitoring and management; corruption and institutional weaknesses, socioeconomic conflicts, economic activities that frequently conflict with environmental conservation, lack of reliable data, the absence of a wildlife monitoring system, a control map of occurrences, and a lack of records of environmental infractions in parks, hindering accurate assessments of the effectiveness of environmental laws in these areas. (Abreu, 2021).

MATERIALS AND METHODS

This study was conducted in two national parks, specifically, the Chimalavera Regional Natural Park, located in the province of Benguela, southwest Angola, and the Bicuar National Park, located in the province of Huíla.



Chimalavera Park - Benguela Figure 2 - Bicuar National Park - Huíla

This study is exploratory in nature, as it seeks to expand knowledge regarding the effectiveness of environmental laws in protecting the natural resources of conservation areas in southern Angola (Chimalavera and Bicuar). To identify the main legal instruments applicable to conservation areas, documentary research was used, through a survey of Angolan legislation applicable to terrestrial conservation areas.

Social diagnoses were conducted to verify the dependence on natural resources and vulnerabilities of communities regarding their main subsistence activities (agriculture, firewood, water, and especially hunting), inquiring about the tangible benefits that communities obtain from the parks. The economic diagnosis allowed the identification of the main sources of funding for the parks, and with this, to assess the management capacity, at the level of inspection, monitoring, relating to costs, and institutional management capacity, monitoring, and qualified human resources.

The perceptions regarding the knowledge of environmental protection laws applicable to conservation areas by the conservation area managers were obtained through content analysis of interviews and measurement of the opinions, attitudes, preferences, and behaviors of the managers, as well as the abundance of species observed through direct or indirect transects. The data were then processed in Excel and SPSS to obtain descriptive statistics.

Through direct observation or field research, empirical data relating to the understanding of institutional and environmental indicators were obtained through the completion of the observation form. Also within the scope of field research, direct transects



(animal sightings) and indirect transects (signs of animal presence) were carried out for nocturnal animals and those more evasive to human contact, thus allowing for an environmental diagnosis, looking at the main biodiversity indices . It is important to emphasize that this method was applied primarily in the Bicuar National Park .

To identify the environmental perception of public actors , knowledge of environmental laws applicable to conservation areas, institutional management, as well as the involvement of local communities in terms of tangible benefits, a questionnaire survey was applied to the main actors in the management of the parks under study (administrators, section heads of the parks, as well as inspectors of the conservation areas under study). The questionnaire was structured with short-answer questions, multiple-choice questions, and, in some cases, justification was requested for the answers provided.

The sample elements were carefully selected , including only individuals with employment ties to the conservation areas under study. The questionnaires were administered in two phases; the first took place in the Chimalavera Regional Natural Park in May 2025, and the second phase in December 2025. Of the 103 employees from the two parks, 35 participated in the study , including administrative inspectors, section heads, and environmental inspectors.

RESULTS AND DISCUSSION

With the cataloging of the legal instruments applicable to conservation areas in Angola, the main laws applicable to terrestrial conservation areas were selected , highlighting the following: Constitution of the Republic of Angola, Law 5/98 of June 19 - Basic Law on the Environment, Presidential Decree No. 10/11 of January 7, which approves the Organic Statute of INBAC (National Institute of Biodiversity and Conservation Areas), Presidential Decree No. 278/22 of December 7, which approves the Organic Statute of MINAMB (Ministry of the Environment), Law No. 8/20 of April 16 - Law on Conservation Areas, Presidential Decree 50/24 - Regulation on environmental conservation areas, and finally Presidential Decree 261/18, which approves the Organic Statute of the Management Service of the Bicuar National Park .

From this cataloging, fundamental principles were recorded that guide the protection of natural resources in the conservation areas under study, with emphasis on the constitutional principle of the right to a healthy environment , provided for in the Constitution of the Republic of Angola, which in its paragraph 2, adopts the following prescription: “ *The State adopts measures necessary for the protection of the environment and of species of fauna and flora, throughout the national territory . (...)*. This shows that the protection of natural resources is a fundamental guarantee of the Angolan State under Chapter II of the CRA.



In summary, Law 5/98 of June 19, the basic environmental law, establishes four types of environmental protection instruments in Angola: formative (environmental education); preventive (environmental protection areas, which include conservation areas; environmental legislation, environmental impact assessment; environmental licensing), repressive (audits; environmental offenses and crimes); and reparative (civil liability and environmental insurance). (Angola, 2018).

From the analysis and interpretation of infra-constitutional, or ordinary, environmental legislation, specific principles were highlighted, as foreseen in the Basic Law on the Environment, specifically in the norms of articles 4 and 5, in which the principles of environmental training and education stood out, which grants everyone the right and duty to receive environmental education. This principle implies that the communities surrounding the Chimalavera and Bicuar parks have the right and duty to receive environmental education.

The principle of participation, foreseen in the basic environmental law, prescribes that all Angolan citizens have the right and the duty to participate in monitoring the implementation of environmental policy; this transfers a direct responsibility to local communities to participate actively and responsibly in monitoring the implementation of environmental policy.

Another principle that deserved reflection was the principle of accountability, which confers responsibility on all agents who, as a result of their actions or omissions, cause damage to the environment, assigning them the obligation to repair or compensate for the damage caused. This represents a firm stance regarding civil liability for damage caused in conservation areas. This aspect, with the approval of Law 38/20 of November 11th, the Angolan Penal Code, introduced the concept of environmental crimes under Article 282 of the Angolan Penal Code, providing for an abstract penal framework ranging from 2 to 12 years of imprisonment. However, the effectiveness of this law continues to be a major challenge.

There are specific principles present in the Law on Conservation Areas, which are of great relevance for the protection of natural resources in conservation areas, as stated in Article 5.

The principle of sustainable development – which essentially implies that natural resources should be evaluated, inventoried, and used rationally – seeks a balance between the environment, the economy, and society, combined with the principle of the fair and equitable sharing of benefits. This law also introduces the principle of scientific research and technological development: it consists of promoting and creating knowledge about the management of environmental conservation areas and associated resources through research institutions.



An interpretation of environmental protection laws, principles, and regulations reveals legal gaps, a lack of practical mechanisms for monitoring and enforcement, a lack of civil and criminal liability, as well as a failure to utilize and promote ecotourism, even though it is legally prescribed under Article 19 of the Law on Conservation Areas in conjunction with Article 47 of the Regulations on Conservation Areas.

The data obtained from respondents regarding their contact with environmental laws reveals a critical situation for the normative effectiveness of the environmental legal regime. The fact that 85.7% of respondents stated that they had never had contact with environmental laws, contrasting with only 5.7% who reported direct contact **and** 8.57% who indicated occasional contact, highlights a structural rupture between the normative system and its social recipients . This situation compromises the principle of the effectiveness of environmental protection laws , according to which the material validity of the law depends not only on its formal existence, but also on its social appropriation and capacity to guide concrete behaviors (Bobbio, 1995).

The graph demonstrates that for 83.71% there is no forest management plan; for 14.2 % there may be a forest management plan, while for 2% of the sample there was a forest management plan. These data unequivocally reveal the practical or functional absence of a forest management plan in the conservation areas analyzed (Chimalavera and Bicular). The forest management plan is an essential instrument for operationalizing environmental protection standards , as foreseen in article 20, paragraph o) of the INBAC Statute. The practical or functional absence of a forest management plan restricts the populations surrounding the park from benefiting from tangible park benefits, translated into PFM and PFNM, inhibiting the balance between conservation and sustainable use of natural resources.

Based on the analysis conducted through the social diagnosis, it was determined that the parks under study are dependent on natural resources. This diagnosis also considered the participation of communities in park management, as well as the existence of tangible benefits from living near the park.

Regarding the main economic activities of the communities surrounding the park, the results show that 37.85% of respondents indicated that the main economic activities for survival in their communities are agriculture, followed by livestock farming at 17.14%, then hunting at 10%, the next 15.1% are self-employed, followed by 5% who are public employees, and finally 15% who are dedicated to collecting firewood and non-timber forest products within the parks. The data indicate that the risks of park encroachment persist, especially since both the perimeter of the Chimalavera National Park in Benguela and the Bicular National Park in Huíla province have been altered by encroachment from farmers and communities.

According to Pretty (2003), environmental policies that do not integrate the socioeconomic needs of populations tend to fail, even when legally well-structured. The laws exist, but they are not accompanied by viable economic alternatives. The effectiveness of environmental laws depends on the integration of conservation, local development, and community participation.

The economic diagnosis allowed for the identification of the park's main sources of funding. In general terms, the law, under Article 29 of the Angolan Conservation Areas Law, permits funding through: budgetary allocations, fines applied for infractions in conservation areas, fees and charges, revenue from ecotourism exploitation, donations, as well as funds from international assistance for the conservation of biological diversity. However, the most ironic aspect is that, up to the date of the research, there was no applicable legislation for the collection of these fees and charges, leading to a collection...

Fig. 6 - Funding sources for the parks.

Arbitrary, and without entry into the Treasury's Single Account, ecotourism is not promoted, and international assistance for species conservation is practically non-existent, both in Chimalavera and Bicular.

Furthermore, it should be emphasized that, according to data from the Angolan State General Budget, dated 31/10/2023, there was a nominal reduction compared to the previous year, amounting to approximately 11.89 billion AKZ this year. However, financial execution remains below the total authorized amount, with reported execution of approximately 56%. This figure represents approximately 6 billion AKZ to cover the entire ministry, including autonomous institutes, such as the National Institute for Biodiversity Conservation and Conservation Areas (INBAC), responsible for managing all conservation areas in Angola. It is important to note that since then, the budget of this ministry represents one of the smallest quotas at the executive branch level, falling below 0.1% of the State General Budget in the 2025 fiscal year.

With these meager quotas, environmental laws will certainly not be effective in protecting natural resources (fauna and flora) in the conservation areas under study, since it inhibits the hiring of more inspectors, the acquisition of vehicles and other means for effective monitoring, as well as the hiring of technical personnel, such as veterinarians, environmental engineers, and others who would be responsible for monitoring wildlife.

Therefore, Bruner et al. (2004) demonstrate that areas with adequate funding show better conservation indicators.

When addressing the environmental diagnosis, pressure on biodiversity was observed; this analysis began with monitoring, followed by an analysis of other environmental indicators.

The data indicates that the main constraint in monitoring environmental conservation areas is due to the reduced number of inspectors. Respondents showed that 43% stated that the



main constraint to monitoring is related to the reduced number of inspectors. For example, at the time the research was conducted, the 150 km² of the Chimalavera Regional Natural Park were monitored by approximately 15 inspectors, giving a ratio of 10 km per inspector, and monitoring was carried out only once a day, or only when an incident occurred. There are no adequate conditions. Regarding the objectives for inspectors to effectively deter offenders, and also concerning the constraints, 29% cited a lack of food. Respondents commented that they do not receive this allowance during the average 15 days they remain inside the park, and therefore make small contributions among their colleagues on duty. Given that salaries are still not the best, this opens the door to acts of corruption, in some cases leaving offenses against natural resources (fauna and flora) unpunished. 14% responded that the insufficiency of resources (vehicles, motorcycles, drones) is the main obstacle. The same percentage was for the group that responded about the absence or constant non-attendance of inspectors in environmental conservation areas due to illness.

According to Watson et al (2014), Many conservation areas in Africa face operational difficulties due to a lack of equipment and transportation, which fosters illegal practices. The absence of inspectors at the service locations demonstrates that monitoring is not continuous and systematic; the sustainable management of natural resources depends on the permanent presence of monitoring and control mechanisms.

As stated by Barbier et al. (2010), the existence of environmental legislation, by itself, does not guarantee the conservation of natural resources; it is necessary to invest in monitoring, financing, technical training, and community participation.

Through the implementation of double transects during the six days of fieldwork within the framework of the FAO Monitoring Project Wildlife observations in the Bicuar conservation area revealed the following: during the six days of transects, the maximum number of observations occurred on the 1st day, with 65 records, while the day with the fewest observations was the 3rd day, with only 30 records, giving a daily average of 45.5 records/day. Considering the average distance traveled, which was 150 km² per day, totaling 900 km over the six days, corresponding to 11.3% of the total area with an approximate geographical extension of 7900 km²; the data unequivocally show significant variation in observations, both through sightings and indirect signs of the presence of certain species of fauna and flora.

According to Fragoso (2026), the high variation in species richness may result from: habitat heterogeneity, ecological fragmentation, or external pressures, in the case of Bicuar: the observed variability suggests a non-homogeneous system subject to local disturbances.



Direct sightings Table 2- Indirect transects

Species	Total
Monkeys	70
Epumumu	23
Oluile	10
Wild boars	21
Bambi	7
Holongo	14
Hoods	17
Partridge	6

The results from the tables, show differences between the averages of 8 different groups of fauna observed, as well as the signs observed during the Indirect tree marks (elephant) transects; $F = 42.22$; $p < 0.05$. Sable antelope feces 22 This value; $F = 42.22$, measures the Bambi feces 14 ratio between; variability between Hyena footprints 31 groups by days of observation, and Variability within groups, African wild dog brands 10

For this purpose, 42.22 is considered a high value, and it indicates that the differences between the groups are much stronger than the internal variations, strong evidence of a real difference. The p-value (significance level) indicates the probability that the results are random; $p = 0.05$ indicates that there is less than a 5% probability that the results occurred by chance, therefore the result is statistically significant, although with a maximum of 65 and a minimum observation of 30 species.

$$D \approx 0.18$$

According to Charles (2023) : Statistical differences in ecological data indicate changes in the structure and functioning of ecosystems. Biodiversity structure (ecological indices)

Estimated Shannon index :

The Shannon index measures diversity by considering wealth plus equity .

$$H' = - \sum (p_i \ln p_i) \quad \text{Where:} \quad \bullet \quad p_i = \frac{n_i}{N}$$

The most abundant species in the study were: Monkeys (~70); Epumumu (~27), Oluile (~11); Capotas (~17); Wild boars (~21).

The least abundant were: Partridge, Bambi, Holongo .

Approximate result: $H' \approx 2.3 - 2.6$, specifically, $H' \approx 2$, this result, according to Shannon , (1948), indicates that there is moderate diversity, since the mean is greater than one (1), but less than three (3), represented as follows: $1 < H' < 3$.

dominance , Simpson's Index : measures dominance.

$$D = \sum p_i^2$$

There is good diversity, but with dominance of some species (monkeys and epumumu) . The most predominant species was the monkey, with a strong dominance of nearly 30%. This may signify trophic imbalance, indicating a possible reduction in large herbivores and predators. According to Odum (1971), disturbed ecosystems tend to exhibit the dominance of opportunistic species, and this indicates moderate ecological pressure and a possible reduction in more sensitive species.

The data show a high frequency of indirect signals and low direct visibility of large mammals. According to Robinson (1996), the predominance of indirect signals indicates the presence of fauna under human disturbance. This indicates a glaring ineffectiveness of Angolan environmental protection laws , including the Basic Law on the Environment, the Law and Regulations of Conservation Areas , as well as the Magna Carta of the Republic of Angola in Article 39, paragraph 2.

The following indicators of human pressure were also detected during the transect: indirect recordings ; large animals avoid contact; even a simple sound from the drone would cause them to immediately flee; dispersed distribution.

Likely pressures: Poaching, human/motorized vehicle traffic, triangulation of data obtained in surveys, and through remote sensing after processing in *Quantum GIS* , the northeast and east areas appear as major hotspots for forest fires.



Therefore, regarding the evaluation of the effectiveness of environmental laws, the results indicate that, for the biodiversity indicator, the effectiveness is moderate. This suggests that the laws have some effect on the park, but it is still insufficient given the scarcity or absence of other indicators, particularly concerning sightings. Direct violations are low, indicating limited oversight due to the limited number of operational human resources. The high level of evasive behavior points to persistent pressure.

FINAL CONSIDERATIONS

The analysis and interpretation of the legal-environmental framework allowed for monitoring legal innovation through the various laws approved in the Angolan context. Significant normative advances, consistent legal principles, and specific regulations governing environmental sectors and conservation areas were observed. However, gaps were also noted, both in the Constitution of the Republic of Angola and in ordinary legislation, with inconsistencies between the legally foreseen protection and the practical realities of conservation areas, due to the weak applicability of legal instruments, resulting in low effectiveness.

The results of the investigation into the main factors limiting the effectiveness of environmental laws in protecting the natural resources of the Chimalavera and Bicular conservation areas revealed that both are bordered by neighboring villages, many of which are dependent on the park's natural resources. Furthermore, the reduced number of inspectors, weak contact between respondents and the environmental laws applicable to conservation areas, lack of technical personnel for natural resource management, weak community involvement in management, and the absence of tangible benefits for the communities significantly reduce the applicability of the law in these areas.

The environmental diagnosis revealed pressures on biodiversity, where the reduced number of inspectors on duty daily, and considering the large geographical areas to be monitored, negatively contributes to the weak effectiveness of environmental laws in protecting natural resources. The lack of qualified technical personnel trained in natural or environmental sciences constitutes another significant obstacle, since wildlife monitoring becomes completely vulnerable. With all these elements recorded, the risks of environmental infractions increase, translated, for example, into deforestation in the Bicular National Park. The reduced presence of species susceptible to direct sightings, both in Bicular and Chimalavera, demonstrated pressure on these ecosystems. The biodiversity indices analyzed pointed to moderate diversity and low abundance, due to the massive presence of opportunistic species, especially monkeys.



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