



POST-PANDEMIC SURVEY OF BUSH MEAT TRADE AND EX-SITU CONSERVATION PRACTICES: A CASE STUDY OF EPE WILDLIFE MARKET AND ZOOS IN LAGOS, NIGERIA.

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ABSTRACT

The post-COVID-19 era has profoundly impacted zoos and wildlife markets, prompting the implementation of new measures to prepare for future pandemics. This study examines the responses of zoos and bushmeat markets in Lagos State, Nigeria, to pandemic challenges and assesses the effectiveness of their post-pandemic strategies. Research was conducted at three sites in Lagos; Shodex Zoo Garden, Omu Resort Zoo, and Epe Wildlife Market, a hub for bushmeat trade. Data were collected using 150 semi-quantitative questionnaires distributed among bushmeat traders and zoo staff: 50 at Epe Wildlife Market and 100 among zoo staff and visitors at the two zoos. The survey evaluated the impact of the pandemic on animal welfare, zoo operations, and the bushmeat trade. Before the pandemic, zoo animals were in excellent condition, but during the pandemic, their condition deteriorated due to reduced food supplies, medical care, and veterinary services. Zoos suspended visitor access, enhanced hygiene protocols, and made dietary adjustments, but veterinary care was insufficient. Seventy-two percent of zoo staff reported increased illness among animals, primarily due to loneliness and depression. Post-pandemic, the effectiveness of these measures varied. Visitor behavior changed little, with 64% of respondents reporting no significant change in visitation frequency. The bushmeat trade faced significant disruptions due to movement restrictions and decreased demand but rebounded post-pandemic, returning to pre-pandemic levels. The study highlights the need for zoos to adopt more robust practices for future pandemics. The Study recommends improving zoo conditions, promoting sustainable ecotourism, enforcing stricter bushmeat trade regulations, increasing public education, and supporting alternative livelihoods to reduce reliance on illegal wildlife trade. Collaborative efforts among conservationists, governments, and local communities are crucial for effective wildlife protection.

Keywords: *Zoos, Bush Meat, Education, Research, Post-Pandemic.*

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INTRODUCTION

People in West and Central Africa have historically used bush meat, or the meat of wild animals, as a natural source of nutrition. But in recent years, hunting for and selling bush meat has expanded as a commercial industry, having detrimental effects on wild animal populations. More and more people are depending on bush meat and the prospects for revenue from trade as human populations and levels of poverty rise (Bowen-Jones *et al.* 2002 and Milner-Gulland *et al.* 2003). Many rural communities in sub-Saharan Africa rely heavily on bushmeat for their livelihoods. In difficult economic times, it can also serve as a vital safety net for the most vulnerable households (Schulte-Herbrüggen, B. *et al.* 2013) as a result, the illegal bush meat trade is growing quickly in cities and is starting to influence consumer demand (Milledge and Barnett 2000). Therefore, bush meat hunting will become a greater threat to wildlife conservation as human populations increase if it is not managed within sustainable boundaries. In the end, this could result in the "empty forest" Redford (1992) warned about, which would harm the livelihood of rural households that depend on these resources. The trade of wildlife, including a range of unusual and endangered species, is well-known at the Epe Wildlife Market in Epe, Lagos State, Nigeria. Illegal wildlife trafficking, which seriously jeopardizes biodiversity and conservation efforts, has drawn attention to this industry (Alalade and Onadeko 2017). According to Alade and Onadeko, 2017 the Epe Wildlife Market is notorious for the trade of endangered and protected species. the activities at the market pose severe challenges to conservation efforts, with many species being at risk of extinction due to overexploitation and habitat destruction. This market is involved in the sale of wildlife that is often captured illegally, violating national and international conservation laws.

On March 11, 2020, the World Health Organization declared a pandemic due to the rapid global spread of the virus. When an infected person coughs, sneezes or speaks, respiratory droplets are the main way that the virus spreads. In addition, it can spread through airborne transmission in confined places with inadequate ventilation and, less frequently, through contact with infected surfaces (WHO, 2020). To stop the COVID-19 virus from spreading, lockdowns were implemented in several nations in 2019. These extreme measures, known as the "great pause" or "anthro-pause," resulted in a decrease in economic activity and human migration. These effects on wildlife were mixed, with some being favorable and some being negative. For many animal species, contact with visitors was abruptly stopped when zoos and aquariums around the world were forced to close due to the COVID-19 pandemic. An important and consistent component of the environment of zoo animals is the visitors, who typically number around 700 million per year (WAZA, 2020) when it comes to zoos and aquariums. Visitors and animals can have enriching and engaging interactions (Sherwen and Hemsworth, 2019). Throughout regular zoo hours, animals behave in a variety of ways to visitors (Sherwen and Hemsworth, 2019); certain animals even within the same species will react differently (Davey, 2007). Anecdotal reports have shown that various species have diverse behavioral reactions during zoo closures. When guests stopped coming, some animals started to hide from the personnel (Steger, 2020), while other animals were more curious in their enclosures (Gandhiok, 2020). To get attention, some animals also started screaming out to their keepers (Mack, 2020). Roy 2020 claims that meerkats at Wellington Zoo (*Suricata suricatta*) were cognizant of the absence of visitors. Zoo keepers at the Adelaide Zoo and the Singapore State Zoo implemented new enrichment techniques in response to declining activity levels to offset the loss of visitor engagement (Eckert, 2020, Fadey, 2020). A considerable amount of study has been done to evaluate the effects of

these closures on different species, mostly through assessing enclosure usage and general health and behavioral changes. Studies have not definitively shown any substantial beneficial or bad effects of the closures or the reopening periods that followed, despite a range of responses (positive, negative, or neutral) having been observed. Researchers have hypothesized that returning visits operate as a positive stimulus, promoting improved human-animal interactions (HAIs), more involvement with enrichment, and closer proximity to visitors.

The COVID-19 pandemic profoundly impacted Nigeria, a developing country with a population exceeding 200 million, across various sectors including economy, education, and socio-economic stability. During the lockdown, businesses in Lagos, particularly traders, experienced a near cessation of revenue generation (Ogundele, 2021). Even after markets partially reopened, traders encountered challenges such as reduced demand, logistical difficulties in restocking, and disruptions in the supply chain, leading to increased prices and a heightened interest in electronic payment systems and e-commerce (Ogundele, 2021). The reduction in human activity during the pandemic period facilitated a resurgence in biodiversity, evidenced by increased sightings of birds and insect pollinators in Nigerian habitats (Okosun *et al.*, 2022). However, conservation efforts encountered setbacks due to suspended fieldwork and financial constraints faced by early-career scientists (Okosun *et al.*, 2022). Many conservation organizations were unable to recruit seasonal staff, impacting their research and educational initiatives. Notably, the pandemic provided poachers with increased opportunities to exploit tranquil nature reserves, resulting in elevated rates of wildlife poaching (Ogundele, 2021). The pandemic severely disrupted research activities, particularly in conservation sciences, as university laboratories and research facilities were shuttered, halting ongoing experiments and field studies (Okosun *et al.*, 2022). Consequently, this disruption impeded progress in conservation research and the development of sustainable resource management strategies. Researchers adapted by engaging citizen scientists in alternative activities, such as backyard wildlife monitoring and web-based research projects (Okosun *et al.*, 2022). The danger of spillover events from animals to humans is thought to have increased significantly as a result of "wet" markets offering live wildlife and wild meat (Jones *et al.*, 2008). Bush-meat distribution trade wasn't left out during this period although it halted temporarily during the lockdown. (Wildaid 2021).

The post-COVID-19 era has required zoos to adopt new lifestyles, implementing techniques and proactive measures to prepare for future pandemics. Zoos have been compelled to adopt a range of strategies to better prepare for future pandemics. Enhanced biosecurity protocols, including rigorous health screenings for animals and staff, have been implemented to prevent zoonotic diseases. Zoos are now focusing more on maintaining biodiversity and monitoring animal health to detect early signs of disease outbreaks, which are crucial for risk mitigation (EAZA, 2020). According to the European Association of Zoos and Aquaria (2021), virtual engagement programs have become prevalent, ensuring continuity in conservation education and providing a platform for global collaboration despite physical access restrictions. The adoption of digital technology for remote animal health monitoring has also increased, reducing physical interventions and disease transmission risks (EAZA, 2020). Financial models have been rethought due to revenue losses during the pandemic, leading to innovative fundraising campaigns and diversified income sources to enhance financial resilience. Online platforms for donation drives and membership renewals have gained popularity, enabling broader audience engagement and necessary fund generation during physical closures (EAZA, 2020). Zoos

have increased their research emphasis, particularly on zoonotic disease transmission and wildlife health, through partnerships with academic institutions and investments in scientific studies. These efforts contribute significantly to global health strategies (EAZA, 2020). Infrastructure improvements to enhance isolation and quarantine capacities for animals showing illness symptoms are being prioritized, ensuring better management of current and future health concerns (EAZA, 2020). Additionally, zoos are focusing on mental health and well-being programs for their staff, recognizing the stresses of managing a zoo during a pandemic and the necessity of robust support systems (EAZA, 2020). The post-COVID-19 era significantly impacted the Epe Wildlife Market, commonly known as the Olowu Market, in various ways. The initial lockdown measures resulted in a temporary halt to the trade of bush meat and fish, which are the primary commodities of the market. As restrictions eased, the market faced several challenges, including reduced customer footfall and stringent health regulations (Adebayo, 2022). One of the notable effects was the change in consumer behavior. Many consumers became wary of the potential health risks associated with wildlife products, leading to a decline in demand (Okeke, 2021). This shift forced many traders to diversify their offerings or reduce their operations.

This study seeks to provide up-to-date insights into the bush meat trade and ex-situ conservation practices in Lagos, Nigeria, particularly in the context of post-pandemic changes. This study aims to support the development of informed strategies to manage wildlife trade sustainably and enhance conservation efforts in the post-pandemic era. The study will provide a comprehensive understanding of the current state of the bush meat trade and conservation practices in Lagos, offering actionable insights for policymakers, conservationists, and other stakeholders.

MATERIALS AND METHODS

Description of the study area

Three study sites were identified for this study (Fig. 1). The study sites were Shodex Zoo Garden, Omu Resort Zoo, and Epe Wildlife Market all in Lagos State. The selected zoos within Lagos were chosen based on their accessibility and relevance to ex-situ conservation practices. The rationale for the choice of the sites was based on information in the literature. Shodex Garden, Omu Resort, and Epe Wildlife Market were designated as sites one, two, and three, respectively.

Site 1 - Shodex Zoo Garden

Located at 6°33'32.58"N, 3°21'59.74"E, Shodex Garden is a leisure center offering a range of amenities. It includes zoological gardens, event staging and lighting, educational tours, and picturesque landscapes, providing a relaxing environment for visitors.

Site 2 - Omu Resort Zoo

Situated at 6°29'23.78"N, 3°45'10.55"E, the Omu Resort is a diverse recreational and educational facility. It features a zoo, a wax museum, SeaWorld, go-karting, quad biking, and various other attractions, making it a comprehensive destination for entertainment and learning.

Site 3 - Epe Wildlife Market

Also known as Olowu Market, this bustling riverbank marketplace is renowned for its vibrant trade in bushmeat and fish. The market, situated at 6°34'56.07"N, 3°59'24.38"E, features a variety of wildlife displayed in wooden booths. Visitors can find porcupines, monkeys, snakes, antelopes, hedgehogs, monitor lizards, crocodiles, pangolins, and giant cane rats.

Research design and methodology

Two sets of semi-quantitative structured questionnaires were designed and validated by an expert. A total of 150 questionnaires were distributed and collected within a week during the study conducted in April 2024. Of these, 50 questionnaires were given to bush meat traders and hunters in the Epe area of Lagos State, while 100 questionnaires were distributed among two zoos located in Lagos Mainland, with 50 each at the two locations. This method was suitable as it provided data from both hunting and market sites at Epe Wildlife Market and zoos in Lagos. All the questionnaires administered were recovered as respondents cooperated massively. The traders surveyed were either present at the market site or identified through the Traders' Associations in Epe. Interviews were conducted during daytime market hours. The questions addressed the types of bush meat sold, the effects of the pandemic and its aftermath on hunting and trading, the average monthly income from bush meat, whether the trade has returned to pre-pandemic levels and the quantities of bush meat purchased and sold.

Initial visits with letters of introduction were conducted at the selected zoos. Both zoo visitors and staff who were on-site during the study were interviewed. The questionnaires collected data on respondents' demographics, the types of animals present in the zoos, visitor frequency, the impact of the pandemic on zoo animals, the behaviour observed by the zoo staff during the pandemic, and the effects of the pandemic and its aftermath on the zoos according to the sampled respondents. During the interviews, respondents were assured of confidentiality to build trust with the traders and zoo participants. Additional visits were made to distribute and collect the questionnaires from the traders. Once the questionnaires were administered, the collected data was compiled for analysis.

Sampling Technique

A simple random sampling method was used to select 50 hunters from a total population of 150. Additionally, 100 zoo respondents were sampled, with 50 each chosen from the two selected zoos using a convenience sampling approach.

Method of Data Collection

The questionnaire was administered personally by the researcher and included a series of structured questions relevant to the research. Designed to elicit firsthand information, the questionnaire comprised closed-ended questions.

Data Analysis

Data obtained was analyzed using descriptive statistics where results were expressed in tables, frequency, and percentage.

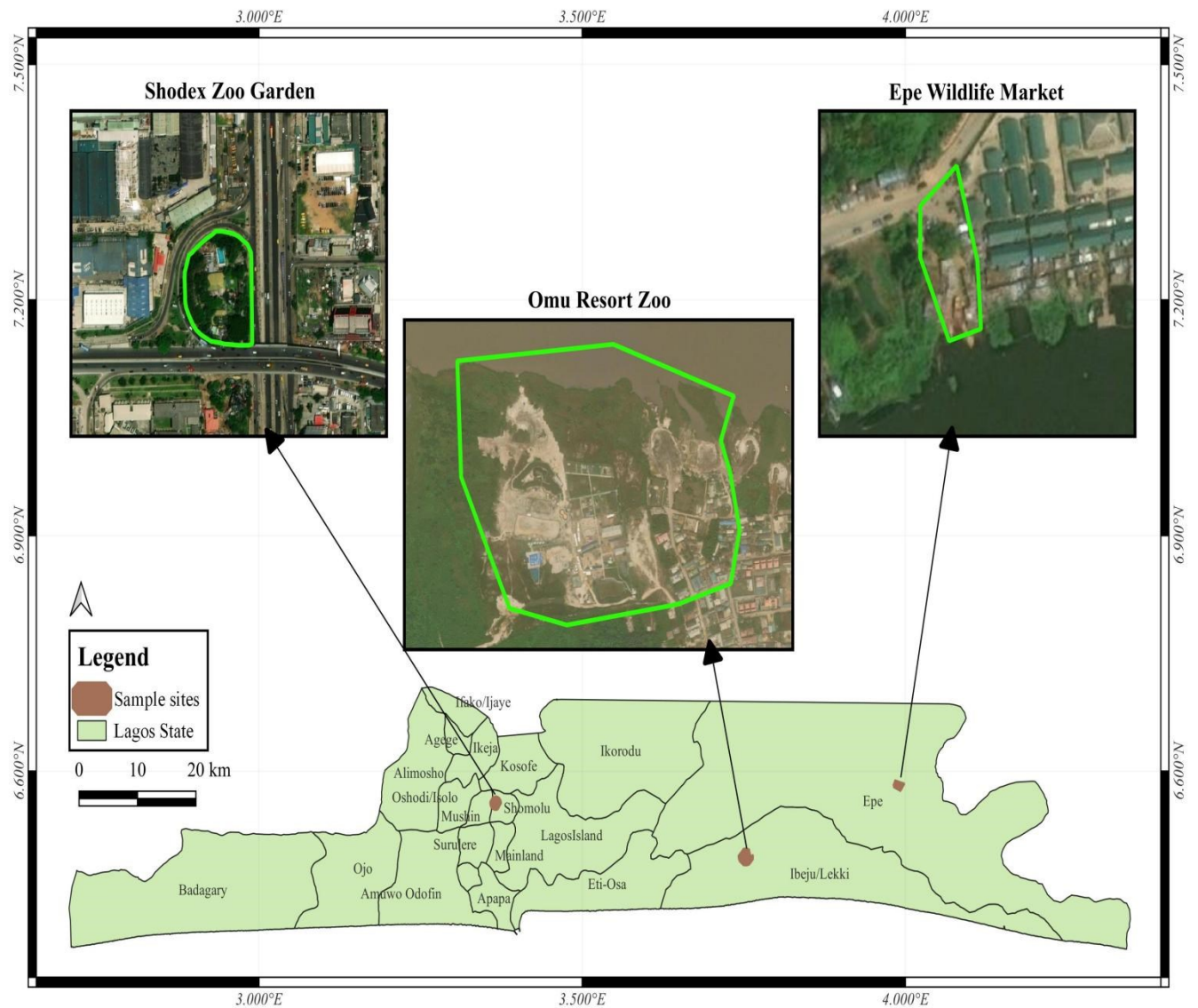


Figure 1: Map showing the Study Locations

RESULTS AND DISCUSSION

DEMOGRAPHY OF THE SAMPLED RESPONDENTS

Table 1: Demography of the sampled respondents ($n=150$)

PARAMETER		Site 1	%	Site 2	%	Site 3	%
SEX	Male	24	48	27	54	7	14
	Female	26	52	23	46	43	86
	Total	50	100	50	100	50	100
AGE	20 and below	4	8	2	4	0	0
	21 – 30	10	20	15	30	9	18
	31 – 50	21	42	23	46	15	30
	50 above	15	30	10	20	26	52
	Total	50	100	50	100	50	100
MARITAL STATUS	Single	13	26	19	38	5	10
	Separated	0	0	0	0	5	10
	Divorced	0	0	0	0	5	10
	Widowed	0	0	0	0	1	1
	Married	38	76	31	62	34	68
	Total	50	100	50	100	50	100
HIGHEST LEVEL OF EDUCATION	Elementary/ primary	0	0	1	1	18	36
	High school/	8	16	7	13	5	10
	Secondary education	5	10	10	20	3	6
	Tertiary	36	72	33	66	1	2
	No education	1	2	0	0	22	44
	Total	50	100	50	100	50	100
OCCUPATION	Zoo Manager	2	4	1	2	0	0
	Zoo Staff	27	54	23	46	0	0
	Bush Meat Trader	0	0	0	0	50	100
	Zoo Visitors	21	42	26	52	0	0
	Total	50	100	50	100	50	100

The demography of the respondents ensures that the sample is representative of the sampled population, enhancing the validity and reliability of the study findings. It provides a comprehensive understanding of the responses based on age, gender, occupation, and other socio-economic factors. The sample from various sites showed a higher number of females than males. The majority of respondents were aged between 31 and 50, while a minority were 20 years old or younger. At Site 1, 26% were single, and 75% were married, with none reported as divorced, separated, or widowed. Site 2 had similar demographics, with 38% single and 62% married, and no respondents reported as divorced, separated, or widowed. In Site 3, most respondents were married (68%), with 10% single, 10% divorced, 10% separated, and 1% widowed. Regarding education, respondents from the sampled zoos generally showed higher educational attainment. At Site 1 72% attended tertiary university, 16% high school, and 10% secondary school, with 2% reporting no education. Site 2 reported 66% attending tertiary university, 20% secondary school, 13% high school, and 1% with no education. A total of 100 responses were obtained from the two sampled zoos, and 50 responses were

collected from Site 3, bringing the total to 150 responses. However, among bush meat traders, educational attainment was lower, with 44% having no education, 36% attending elementary school, and the remaining 20% having secondary or tertiary education. Staff demographics varied across the sampled zoos.

Site 1 had 4% managerial staff, with 54% staff respondents and 42% visitors during the survey. Site 2 2% managerial staff, with 46% staff respondents and 52% zoo visitors. Site 3 was exclusively occupied by bush traders as shown in **Table 1.0**.

Table 2: Scientific Classification and IUCN Status of Animals Found in the Zoo's

S/N	COMMON NAME	SCIENTIFIC NAME	ZOO	IUCN STATUS
1	Lion	<i>Panthera leo</i>	Site 2	Vulnerable
2	Ostrich	<i>Struthio camelus</i>	Site 2	Least Concern
3	Baboon	<i>Simia hamadryas</i>	Site 2	Least Concern
4	Porcupine	<i>Erethizon dorsatum</i>	Site 2	Least Concern
5	Snake	<i>Python sebae</i>	Site 2	Vulnerable
6	Turtle	<i>Pelomedusa subrufa</i>	Site 2	Least Concern
7	Crocodile	<i>Crocodylus niloticus</i>	Site 2	Vulnerable
8	African grey parrot	<i>Psittacus erithacus</i>	Site 2	Endangered
9	Civet Cat	<i>Paradoxurus hermaphroditus</i>	Site 2	Least Concern
10	Jaguar (exotic species)	<i>Herpailurus yagouaroundi</i>	Site 2	Least Concern
11	Hyena	<i>Hyaenidae</i>	Site 2	Least Concern
12	Caracal	<i>Caracal caracal</i>	Site 2	Least Concern
13	Ostrich	<i>Struthio camelus</i>	Site 1	Least Concern
14	Geese	<i>Anser anser</i>	Site 1	Least Concern
15	Baboon	<i>Papio anubis</i>	Site 1	Least Concern
16	Crocodile	<i>Mecistops cataphractus</i>	Site 1	Least Concern
17	Porcupine	<i>Erethizon dorsatum</i>	Site 1	Least Concern
18	Rabbit	<i>Oryctolagus cuniculus</i>	Site 1	Least Concern
19	African grey parrot	<i>Psittacus erithacus</i>	Site 1	Endangered

Source: IUCN 2024

Respondents were asked about the animals present in the zoo. For site one, many of them mentioned ostriches, geese, baboons, crocodiles, porcupines, rabbits, and African grey parrots. In Site Two, a significant number listed lions, ostriches, baboons, porcupines, snakes, turtles, crocodiles, African grey parrots, civet cats, jaguars (exotic species), hyenas, and caracals. The researcher also confirmed these findings through direct observations as shown in Table 2.

Pandemic's Impact on Zoo Animals by Sampled Respondents

In Figure 4 below, data from respondents at sampled zoos indicated that before the pandemic, the condition of zoo animals was predominantly excellent (74%), with 14% rated as good, and 12% as fair. None of the zoos reported poor animal conditions before the pandemic. However, during the pandemic, the supply of food, medical care, and veterinary checks for zoo animals deteriorated significantly. A majority (74%) reported a poor state, while 26% described it as fair, and achievable with quick proactive measures to mitigate the pandemic's impact. None of the zoos reported excellent or good conditions for these aspects during the pandemic. When asked about the overall welfare of zoo animals during the pandemic, 92% of respondents agreed that it was fair. This perception is seen as an attempt to protect their image and reputation during challenging circumstances.

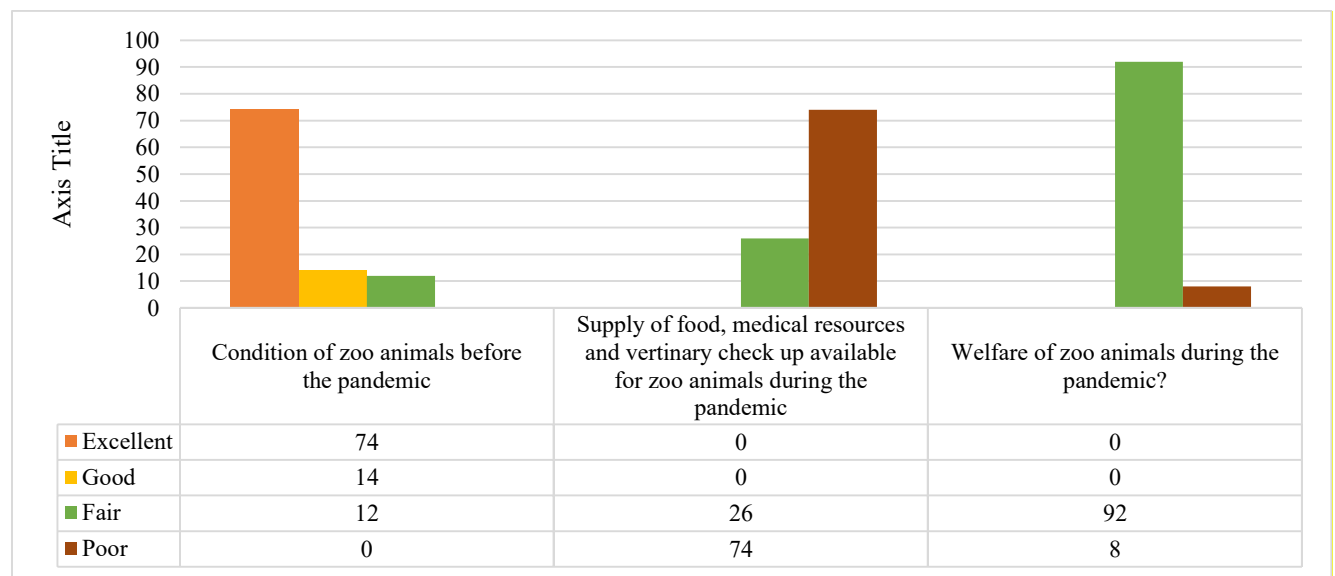


Figure 4: Pandemic Impact on Zoo Animals in Sampled Zoos ($n=100$)

A total of 50 zoo staff respondents from Site 1 (27) and Site 2 (23) were surveyed about the measures taken during the pandemic. Among them, 35 confirmed that closing visitation was the primary step taken during that period. Additionally, 11 respondents mentioned enhancing hygiene and cleaning protocols, while 3 reported changing the animals' diet. Two respondents stated that veterinary care was increased, as depicted in Figure 5.0

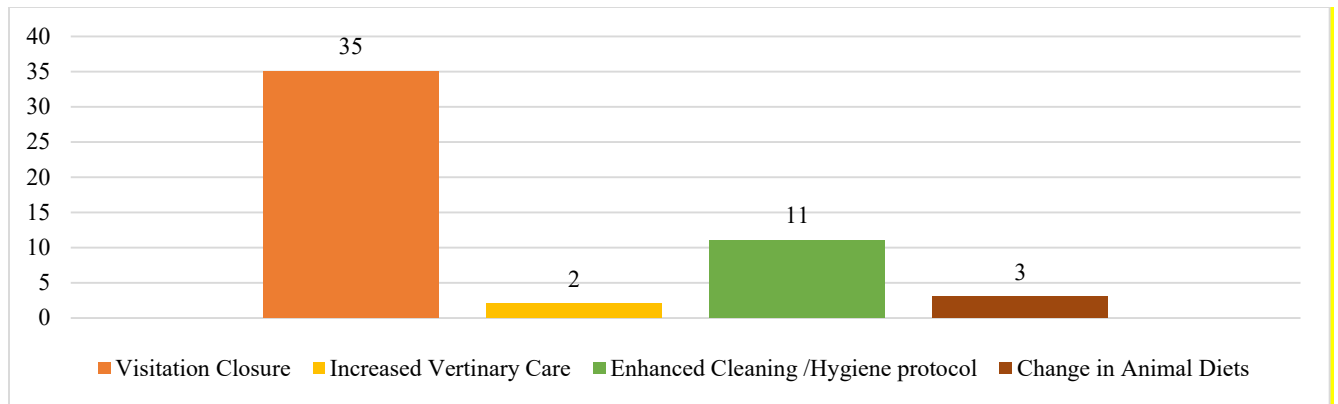


Figure 5: Measures taken by sampled Zoos during the Pandemic

Illness cases among animals, as confirmed by zoo staff, have been attributed to the pandemic, with a significant proportion relating to loneliness and depression. Specifically, 72% of staff reported that such cases were present, whereas 28% indicated they were not. These findings are illustrated in Figure 6 and Table 3. Zoo staff from sites 1 and two were interviewed to assess the behavior of animals during the COVID-19 pandemic and the reasons behind these behaviors. This assessment aimed to understand the impact of the pandemic on the animals as detailed in Table 3.

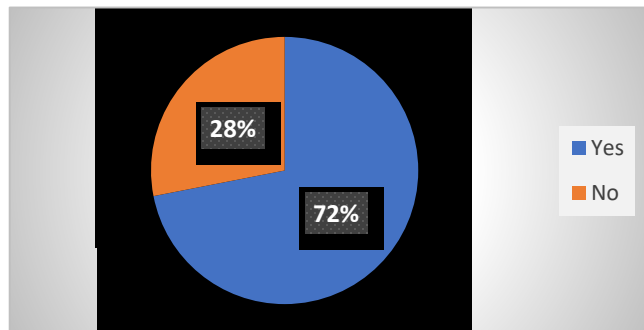


Figure 6: Cases of Illness Attributed to the pandemic by sampled Zoo respondents

Table 3: Behavioral changes observed by sampled zoo staffs during the COVID19 pandemic.

ANIMAL OBSERVED	BEHAVIORS OBSERVED	REASON FOR BEHAVIOUR	ZOOS
Female Ostrich	Loneliness and depression	Female Ostrich lost her mate as a result of malnutrition.	Site 1
Female Geese		Female Geese lost her mate as a result of malnutrition.	
Baboons		Baboons began to notice a lack of human attention.	
Crocodiles	Increased Behavior	Mating Crocodiles' newfound seclusion due to the lack of human activity has resulted in some unexpected benefits after years of natural mating efforts.	Site 1
<hr/>			
Ebelechukwu <i>et al.</i>, 2024			OJER 5(1) 31
Baboons	Aggressiveness	privacy. Due to a scarcity of food, male baboons began attacking female baboons.	Site 1
Female Geese		Due to a lack of a mate, female geese become extremely hostile.	
Male Ostrich	Increased Mortality	A Male ostrich died of malnutrition.	Site 1
Male geese		A Male geese perished of hunger.	
Crocodile	Disease outbreak	Due to an uneven water change during the Pandemic period, a male crocodile developed an infection in the left eye.	Site 1
Porcupine		Due to modifications in the zoo's operation during that time, Porcupine became sick with skin ailments.	
Jaguar	Cannibalism	Jaguar broke into the house of the civet cat, killed and ate it.	Site 2
Caracal		Male caracal killed and ate the female caracal	
Warthog	Death	Warthog died due to excessive rainfall	Site 2

Simon *et al.*, (2021) confirmed in their study on the Pandemic Impact on Revenue Loss and Its Relationship to Animal Welfare and zoos advised the adopt several key measures to better prepare for future pandemics. These recommendations include enhanced sanitation protocols, health screening, visitor management, quarantine facilities, public education campaigns, improved animal nutrition and welfare, remote monitoring and research, and financial resilience strategies. The researchers verified these recommendations through physical observations and interviews with the respondents present in the sampled zoos. Sampled Respondents were asked to rate the post-COVID-19 measures implemented by the zoos on a checklist.




Table 4: Post-COVID-19 Measures Implemented by Respondents in the Sampled Zoos

S/N	Zoo	Measures Assessment	Description	Responses (50)	%	Grade Based on Researchers Observation
1	Site 1	Enhanced Sanitation Protocols	Increased frequency of cleaning and disinfecting animal enclosures, visitor areas, and staff facilities to minimize the risk of disease transmission.	Good - 45	90	Good
				Fair - 4	8	
				Poor - 1	2	
				Total		
				100		
		Health Screening	Regular health checks observed and monitoring of both animals and staff to detect and manage potential health issues promptly	Good - 15	30	Fair
				Fair - 20	40	
				Poor - 15	30	
				Total		
				100		
		Visitor Management	Implementation of social distancing measures, visitor capacity limits, and mandatory mask policies to ensure the safety of both visitors and animals	Good - 10	20	Fair
				Fair - 16	32	
				Poor - 24	48	
				Total		
				100		
		Quarantine Facilities	Establishment or improvement of quarantine facilities for new or sick animals to prevent the spread of diseases within the zoo.	Good - 2	4	Poor
				Fair - 2	4	
				Poor - 46	92	
				Total		
				100		

		Public Education Campaigns	Increased efforts to educate the public about zoonotic diseases, their transmission, and the importance of wildlife conservation and proper hygiene practices	Good - 12 Fair - 30 Poor - 8	24 60 16	Fair
				Total -	100	
		Improved Animal Nutrition and Welfare	Enhanced feeding programs and enrichment activities to support the physical and mental well-being of animals, reducing stress and vulnerability to diseases.	Good - 17 Fair - 23 Poor - 10	34 46 20	Fair
				Total	100	
		Remote Monitoring and Research	Investment in technology for remote monitoring of animal health and behavior, as well as conducting research on zoonotic diseases and their impact on wildlife.	Good - 5 Fair - 6 Poor - 39	10 12 78	Poor
				Total	100	
		Financial Resilience Strategies	Development of financial contingency plans, including fundraising, grants, and partnerships, to ensure the zoo's sustainability and ability to maintain high standards of care during future crises.	Good - 21 Fair - 25 Poor - 4	42 50 8	Fair
				Total	100	
		Enhanced Sanitation Protocols	Increased frequency of cleaning and disinfecting animal enclosures, visitor areas, and staff facilities to minimize the risk of disease transmission.	Good - 21 Fair - 20 Poor - 9	42 40 18	Fair
				Total	100	
		Health Screening	Regular health checks and monitoring of both animals and staff to detect and manage potential health issues promptly	Good - 22 Fair - 18 Poor - 10	44 36 20	Good
				Total	100	
2	Site 2	Visitor Management	Implementation of social distancing measures, visitor capacity limits, and mandatory mask policies to ensure the safety of both visitors and animals	Good - 30 Fair - 17 Poor - 3	60 34 6	Good
				Total	100	

Quarantine Facilities	Establishment or improvement of quarantine facilities for new or sick animals to prevent the spread of diseases within the zoo.	Good - 15	30	Fair
		Fair - 10	20	
		Poor - 25	50	
		Total	100	
Public Education Campaigns	Increased efforts to educate the public about zoonotic diseases, their transmission, and the importance of wildlife conservation and proper hygiene practices	Good - 30	60	Good
		Fair - 15	30	
		Poor - 5	10	
		Total	100	
Improved Animal Nutrition and Welfare	Enhanced feeding programs and enrichment activities to support the physical and mental well-being of animals, reducing stress and vulnerability to diseases.	Good - 15	30	Fair
		Fair - 25	50	
		Poor - 10	20	
		Total	100	
Remote Monitoring and Research	Investment in technology for remote monitoring of animal health and behavior, as well as conducting research on zoonotic diseases and their impact on wildlife.	Good - 11	22	Poor
		Fair - 8	16	
		Poor - 31	62	
		Total	100	
Financial Resilience Strategies	Development of financial contingency plans, including fundraising, grants, and partnerships, to ensure the zoo's sustainability and ability to maintain high standards of care during future crises.	Good - 20	40	Fair
		Fair - 17	34	
		Poor - 13	26	
		Total	100	

Researchers Interpretation of the Observed Measures

	Good	Meets expectations
	Fair	Satisfactory performance meets basic expectations but needs improvement.
	Poor	Unsatisfactory Performance

Respondents at Site One were asked to rate their opinions on the post-pandemic measures implemented by the zoo, as shown in Table 4. The enhanced sanitation protocol received a 90% rating of good, 8% fair, and 2% poor, likely due to the visible cleanliness and regular sanitization practices. Health screening measures were rated 30% good, 40% fair, and 30% poor, possibly reflecting concerns about efficiency and thoroughness. Visitor management was evaluated with 20% rating it as good, 32% as fair, and 48% as poor, indicating dissatisfaction with crowd control. Quarantine

facilities available or renovated were rated 4% good, 4% fair, and 92% poor, suggesting a significant gap in preparedness. Public education and campaign efforts received 24% good, 60% fair, and 16% poor, perhaps due to insufficient outreach or engagement. Improved animal nutrition and welfare were rated 34% good, 46% fair, and 20% poor, which may reflect good perceptions of animal care improvements. Remote monitoring and research garnered 10% good, 12% fair, and 78% poor, indicating inadequate implementation or visibility of these measures. Financial resilience strategies were rated 42% good, 50% fair, and 8% poor, reflecting a generally positive response to the zoo's economic measures but with room for improvement.

At Site 2, respondents provided the following ratings: Enhanced sanitation protocols were rated as good by 42% of respondents, fair by 40%, and poor by 18%, reflecting varying perceptions of cleanliness and effectiveness. Health screening measures received 44% good, 36% fair, and 20% poor ratings, indicating a generally positive view with some concerns. Visitor management was rated good by 60%, fair by 34%, and poor by 6%, showing strong approval of these measures. Quarantine facilities present or put in place received 30% good, 20% fair, and 50% poor ratings, suggesting significant inadequacy. Public education campaigns were rated good by 60%, fair by 30%, and poor by 10%, highlighting their perceived effectiveness. Improved animal nutrition and welfare were rated good by 30%, fair by 50%, and poor by 20%, pointing to mixed opinions on their success. Remote monitoring and research received 22% good, 16% fair, and 62% poor ratings, indicating less efforts and financial resilience strategies were rated good by 40%, fair by 34%, and poor by 26% respondents, reflecting moderate satisfaction but also notable concerns.

Pandemic's Impact and Post-Impact on Zoo Activities Animals by Sampled Respondents

The study results confirmed that none of the respondents visited the zoo during the COVID-19 pandemic, with 100% reporting no visits. Post-pandemic, respondents were asked about their visitation frequency: 44% reported visiting 2-3 times a year, 38% visiting monthly, and 18% visiting more than three times a year. Additionally, 64% of zoo visitors indicated that the pandemic did not change their visiting behavior, 36% reported a slight change, and none reported a significant change, reflecting their strong interest in nature and animals. When asked about the implementation of post-pandemic measures by the zoos, 72% of respondents confirmed that such measures were in place, while 26% indicated they were not. Regarding the effectiveness of these measures, 40% found them effective, 30% found them non-effective, 20% were unsure, and 8% rated them as very effective, as shown in Table 5..

Table 5: Zoo visitors' response to the COVID-19 pandemic's impact and post-impact on zoo

QUESTION	PARAMETER	Site 1	Site 2	Response	%
DID YOU VISIT THE ZOOS DURING THE COVID-19 PANDEMIC?	Yes	0	0	0	0
	No	27	23	50	100
	Total			50	100
HOW OFTEN DO YOU VISIT THE ZOOS AFTER THE PANDEMIC	Never	0	0	0	0
	Monthly	8	11	19	38
	2-3 times a year	17	5	22	44
	More than 3 times a year	2	7	9	18
	Total			50	100
HOW HAS YOUR ZOO VISITING BEHAVIOR CHANGED DUE TO THE PANDEMIC?	No change	17	15	32	64
	Slight Changes	10	8	18	36
	Huge Changes	0	0	0	0
	Total			50	100
HAVE YOU NOTICED ANY NEW MEASURES OR CHANGES IMPLEMENTED BY ZOOS POST-PANDEMIC?	Yes	19	17	36	72
	No	8	6	14	28
	Total			50	100
IN YOUR OPINION, HOW EFFECTIVE ARE THESE MEASURES IN ENSURING ANIMAL WELFARE AND PUBLIC SAFETY?	Very effective	1	3	4	8
	Somewhat effective	12	9	21	42
	Not effective	6	9	15	30
	Unsure	8	2	10	20
	Total			50	100



Plate 1: Sites 1 and 2 during and after the Covid-19 pandemic

EPE WILDLIFE MARKET

Pandemic's Impact and Post-Impact on Bush-Meat Trade and Supply Chain By Sampled Respondents

The interviews with bushmeat traders in this study confirmed their long-standing involvement in the illegal wildlife trade, with some unaware of its illegality while others depend on it for livelihood. Forty-three percent of respondents have engaged in this trade for 6-10 years, 38% for more than 10 years, 17% for 5 years, and 2% for less than a year. All respondents indicated that the pandemic affected their ability to trade and hunt due to strict movement restrictions imposed during that period. The adherence of these traders to strict movement laws confirms the possibility of enforcing stricter laws on poaching activities and illegal bushmeat trade. Traders also cited factors such as reduced hunting opportunities, decreased customer demand, increased law enforcement restrictions, and supply chain disruptions as additional challenges during the pandemic.

A significant number of respondents reported earnings above the monthly minimum wage of ₦35,000 in Nigeria, with 45% earning ₦200,000, 28% earning ₦300,000, and 10% earning ₦500,000 and above monthly. Fast forward to the post-pandemic period, the majority of respondents (100%) confirmed an improvement in wildlife sales as shown in Table 6 below.

Table 6: Pandemic's Impact and Post-Impact on Bushmeat Trade and Supply Chain by Site 3 respondents

Data	Parameter	Responses	%
How long have you been involved in the bush meat trade	Less than 1 year	1	2
	5 years	8	17
	6-10 years	22	43
	More than 10 years	19	38
	Total	50	100
Did the pandemic affect your ability to hunt or trade bush meat	Yes	50	100
	No	0	0
	Total	50	100
If yes, how did the pandemic affect your bush meat trade?	Reduced hunting opportunities	10	20
	Reduced customer demand	10	20
	Increased law enforcement restrictions	20	40
	Supply chain disruptions	8	16
	Health concerns	2	4
	Total	50	100
What was your average monthly income from bush meat	₦150000	3	5
	₦200000	25	45
	₦300000	14	28
	₦400000	3	5
	₦500000 and above	5	10
	Total	50	100
Has the bush meat trade returned to pre-pandemic levels	Yes	50	100
	No	0	0
	Total	50	100



Epe bush-meat market after the Pandemic



Epe bush-meat market during the Pandemic

Plate 2: Epe wildlife market during and after the COVID-19 pandemic

DISCUSSIONS

Humanity has urged scientists to re-establish their connection with nature to avoid even graver consequences. The COVID-19 lockdown highlighted the dire conditions in zoos and the insufficient health and welfare of animals. Movement restrictions significantly halted the bushmeat trade and distribution, impacting wildlife and conservation activities in Lagos, Nigeria. Tourist numbers at conservation centers plummeted, resulting in job losses and financial struggles for private reserves reliant on ecotourism, many facing potential closure due to border restrictions. This finding agrees with the study carried out by the Wildlife Society (2020) on how the COVID-19 lockdown impacted wildlife and the Harvard Gazette's insights into human-wildlife interactions (Wildlife Society, 2020). They confirmed that the lockdown resulted in both positive and negative impacts on animals, with some benefiting from fewer human interactions while others suffered from inadequate care and increased stress (Harvard Gazette, 2020). The data gathered from zoo respondents indicated a stark contrast in the condition of zoo animals before and during the pandemic. Before the pandemic, animal conditions were predominantly excellent with no reports of poor conditions. However, the pandemic led to significant deterioration in the supply of food, medical care, and veterinary services, resulting in a majority reporting poor conditions. Respondents from the sampled zoos highlighted several measures taken during the pandemic, such as closing visitation, enhancing hygiene protocols, and adjusting animal diets, though only a few reported increasing veterinary care. The pandemic also led to reported illness cases among animals, largely attributed to loneliness and depression, with the majority of the staff acknowledging this issue. The behavior of zoo animals during this period had both positive and negative effects. Some animals suffer from loneliness, depression, malnutrition, and inadequate medical care. Increased carnivorous behavior and aggressiveness were observed in some

animals, while others exhibited heightened mating behaviors. Free-roaming animals reportedly enjoyed their time during the pandemic, reclaiming roads, gardens, and streets. Natural habitats of certain species were also rejuvenated, according to zoo respondents.

The Sampled respondents were asked to rate the post-COVID-19 measures implemented by the zoos using a checklist. This method is similar to the study conducted by Luebke *et al.* (2016) on zoo visitors' affective responses to observing animal behaviors. Recommendations from experts like Simon Marsh, Georgina Groves, Dave Morgan, and Karen Fifield (2021), as well as the World Association of Zoos and Aquariums (2021), emphasized the need for improved sanitation, health screening, visitor management, quarantine facilities, public education, enhanced animal nutrition, remote monitoring, and financial resilience to better prepare for future pandemics. In view of these recommendations, the researcher interviewed respondents in the zoos and observed whether these measures had been put in place. The overall response from the respondents and the researcher's observations indicated that the sampled zoos received a fair rating. Their performance was deemed satisfactory, meeting basic expectations but with areas needing improvement.

The study indicates a positive impact of the COVID-19 pandemic in reducing the bushmeat distribution trade by respondents. The COVID-19 pandemic significantly disrupted the bushmeat distribution trade, bringing about a series of profound changes. With markets closed and gatherings restricted, traditional channels for selling bushmeat were severely limited. The heightened concerns about zoonotic diseases led to increased enforcement and surveillance of wildlife trade regulations with many people facing reduced incomes, which affected their purchasing power and potentially decreased the demand for bushmeat. The heightened awareness about the links between wildlife trade and pandemics made many people wary of consuming bushmeat, reducing its popularity.

However, post-lockdown, wet markets thrived, and human exploitation resumed. According to the sampled Respondents after the pandemic and the lockdowns were lifted, wet markets began to thrive once again, and the human exploitation of wildlife resources resumed with renewed vigor. The pent-up demand for bushmeat and other wildlife products led to a resurgence in the trade, as economic pressures drove many back into the bushmeat business.

Wet markets, which had been under scrutiny during the pandemic, saw a return to normalcy. The bustling activity in these markets highlighted the persistent demand for bushmeat and other wildlife products. The complex socio-economic dynamics meant that, despite the lessons of the pandemic, human exploitation of wildlife resources continued much as it had before. This resurgence underscored the challenges in achieving long-term changes in behavior and policy.

CONCLUSION

The post-COVID-19 pandemic era has necessitated a new lifestyle for zoos surviving this period, adapting with techniques and proactive measures to prepare for future pandemics and shocks. The assessment ranking of the sampled zoos on their post-pandemic implementation measures revealed that they have either not done enough or have become complacent in maintaining the proactive measures necessary to prevent and absorb the shock from future zoonotic

diseases. Conversely, wildlife markets involved in the trade of endangered species, such as pangolins, experienced a sudden surge in sales and poaching activities post-pandemic.

Therefore, this study recommends the following: strengthening conservation efforts to protect wildlife and conservation areas; improving the conditions of zoos and wildlife facilities; promoting sustainable ecotourism to support private reserves and conservation centers; enhancing enforcement and regulation of the bushmeat trade; increasing public awareness and education about the importance of wildlife conservation and the risks associated with illegal wildlife trade; and supporting local communities with alternative livelihoods to reduce their dependence on bushmeat trade. This study calls on conservationists, academics, governments, NGOs, and individuals to collaborate towards a more harmonious and respectful relationship with nature, ensuring the safeguarding and preservation of wildlife for future generations.

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