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ORIGINAL PAPER

Assessing awareness on biodiversity conservation among Nigerians: the Aichi Biodiversity Target 1

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Abstract

The adoption of the Aichi Biodiversity Targets (ABTs) was supposed to increase conservation awareness in different countries and regions of the world. However, there seems to be a limited understanding of the importance of ecosystem services, offered by biological diversity. Thus, the continued decline in biodiversity, especially in developing countries. This study appraised the level of success of the first target of Nigeria's National Biodiversity Strategy and Action Plan (NBSAP), which is hinged on the first ABT. In a national survey, data were obtained from a total of 1,124 respondents (839 professionals and 285 non-professionals), using a structured questionnaire. Information on the respondents' knowledge of biodiversity conservation and the associated ecosystem services, were elicited. Most of the non-professionals had a low level of understanding of biodiversity concepts (4.9 ± 1.7 to $20.5 \pm 3.4\%$), while there was a moderate level of understanding among the professionals (48.0 ± 8.6 to $88.8 \pm 3.4\%$). Awareness of the NBSAP was low for both groups ($43.8 \pm 7.2\%$ professionals and $12.1 \pm 3.7\%$ non-professionals). The study concludes that there is a need to step up campaigns on biodiversity conservation in Nigeria and promote visits to natural sites. Youth engagement through the employment of graduates of biology-related disciplines, to educate the public on biodiversity conservation and the action plan, could also be a strong determinant to the success of the NBSAP targets.

Keywords Biodiversity action plan · Biodiversity conservation · Convention on biological diversity · Economy · Ecosystem services · Environmental education

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Introduction

Biodiversity continues to face serious challenges and a global decline particularly with the loss of natural habitats, reduced species distributions and populations (Butchart et al. 2010). To tackle these problems, the Convention on Biological Diversity (CBD) treaty was signed by over 150 contracting states (parties) at the Earth Summit in Rio de Janeiro, Brazil 1992 (Rosendal 2013). The treaty was a significant conservation commitment towards the end of the last century. It provided important guidelines for conserving earth's biological resources, with serious implications for the fate of humanity on the planet (Hambler and Canney 2013). The CBD focuses on biodiversity conservation and the equitable sharing of the various benefits (ecosystem services) derivable from biological diversity, with a strong emphasis on sustainable utilization of biological resources. It also aimed to ensure fairness and equitable distribution of benefits accruable from the use of genetic resources (Hambler and Canney 2013; Rosendal 2013; Tittensor et al. 2014). The treaty outlines guidelines and modalities for member states to set objectives that could be implemented locally or nationally (Glowka et al. 1994). Hence, countries produced biodiversity action plans (BAPs) and set national targets with specific timelines. Unfortunately, very little progress was made towards reaching the targets set in 2002. It was observed that not much was achieved in the quest to reduce the rate of global biodiversity loss; contribute to poverty alleviation and provide benefits for all living things (Adenle et al. 2015). To overcome these challenges, the contracting parties held a meeting in Nagoya Japan, in 2010, where they adopted the Strategic Plan for Biodiversity. The new plan had five strategic goals and 20 targets known as the 'Aichi Biodiversity Targets' (ABTs). These targets were to be achieved within a decade (2010–2020). The vision was to restore, value and conserve biodiversity for the benefit of humanity by 2050. The ABTs main goal was to increase the level of global success in biodiversity conservation while providing a workable guide for regions and nations to set their targets (CBD Secretariat 2010; Tittensor et al. 2014; O'Connor et al. 2015).

Like many developing nations in the Southern Hemisphere, Nigeria has a rich biodiversity reserve (Glowka et al. 1994). The country has over three hundred threatened species ranging from plants to invertebrates, fishes, amphibians, reptiles, birds and mammals (Sedghi 2013). The nation also has several conservation areas being managed at various levels of authority, e.g. sacred groves, forest reserves, game reserves, national parks, biosphere reserves, Ramsar sites, and World Heritage Sites (Federal Ministry of Environment 2015). Nigeria is also endowed with about 64 endemic animals, e.g. the lower Guinean damselfly (*Pentaphlebia gamblesi*) (Dijkstra 2021), West African worm lizard (*Baikia africana*), Ondo Forest gecko (*Cnemaspis petrodroma*), Ibadan Malimbe (*Malimbus ibadanensis),* the Niger Delta red colobus (*Piliocolobus epieni*), and Savanna swamp shrew (*Crocidura longipes*) (Uetz et al. 2018). Biodiversity plays a vital role in the livelihoods and survival of many Nigerians. It provides diverse ecosystem (provisioning, support, regulating and cultural) services, such as climate regulation, provision of food and medicine, raw materials, and aesthetic values (Lohbeck et al. 2016). It is believed that over 90% of rural dwellers in Nigeria depend on forest biodiversity resources for survival, while more than 70% rely on fuel wood for energy needs (NBSAP 2014–2020).

Ironically, biodiversity is one of the most undervalued and unappreciated natural resources in Nigeria. These biological resources are continually threatened by increasing rates of ecosystem degradation and biodiversity loss (Akindele et al. 2020). The situation is exacerbated by the exponential growth rate of the human population in Nigeria, which increased from 38 million (in 1950) to 200 million (in 2019). The population is also

projected to be over 400 million and the third-largest in the world by 2050 (UN DESA 2019). The manifestations of this exponential human population growth include urbanisation, deforestation, desertification, land degradation, conflicts and all kinds of pollution (Olajuyigbe 2018; Anwadike 2020). Moreover, it is well documented that there is a strong relationship between human population growth and biodiversity loss (Williams 2013; Paradis 2018). As the human population increases, there is usually a corresponding decrease in plant and animal species, abundance, richness, and density, with an eventual extinction of vulnerable species if no action is taken (Luck 2007; Jantz et al. 2015). Hence, anthropogenic activities such as indiscriminate timber harvesting, illegal wildlife trade, increased exploitation of biological resources, land-use changes, and corruption have all taken their toll on biodiversity in Nigeria. For instance, over 1.4 million logs of Rosewood (*Pterocarpus erinaceus)* were illegally exported to China from Nigeria between 2012 and 2016 (Environmental Investigation Agency 2017). This exploitation has destroyed vast amounts of forest cover, causing a reduction in both plant and animal diversity (Ahmed et al. 2016). Also, the socio-economic conditions of people have been identified as some of the key factors that determine the attainment of conservation success (Boersema et al. 2009). Hence, various governments have intensified efforts in recent years to improve the socioeconomic status of their citizens. For instance, in 2015, world leaders committed themselves to end extreme poverty by 2030 in the historic Sustainable Development Goal (SDG 1) agreed by many countries (UN DESA 2015). Currently, about 40.1% of the Nigerian population is classified as poor (National Bureau of Statistics 2020), and this high poverty rate has had a negative impact on biodiversity conservation. For example, Chukwu (2008) asserted that there was an indirect relationship between poverty and biodiversity loss and environmental degradation in Nigeria. Furthermore, some social implications such as insecurity have been reported as consequences of poverty and one of those factors that stall biodiversity conservation in Nigeria. Thus, armed bandits and terrorism have hindered the growth of ecotourism and caused wanton destruction of some conservation areas in the country (Shittu 2013).

Nigeria became a party to the CBD in 1994 (Federal Ministry of Environment 2015). As a contracting party, the country developed its first National Biodiversity Strategy and Action Plan (NBSAP) which was to run from 2001–2010 (Anwadike 2020). However, the first NBSAP was reviewed to conform to the ABTs in 2015. The revised version covered the period 2016–2020. The revised NBSAP had 14 National Targets with 21 impact indicators and 67 Actions; aimed at ensuring that the CBD's broad objectives were achieved by 2020. First among these targets is 'raising the level of awareness on the importance of biodiversity among Nigerians' (Federal Ministry of Environment 2015). This was important because; the level of awareness and participation of citizens, to a large extent, will determine the actualization of BAPs (Berkes 2004; Halpern et al. 2013). To this end, Ola-Adams (2001) advocated the importance of education, awareness building and training among Nigerians on the need for conservation of natural areas such as Omo Biosphere Reserve. Ijeomah and Abazi (2014) and Akande et al. (2019) also reported that increased environmental education and citizen enlightenment were paramount to achieving conservation objectives at the Kainji Lake National Park, Niger State Nigeria. In a bid to actualize the NBSAP, the International Union for Conservation of Nature (IUCN) published a Biodiversity Conservation Strategy for the Niger-Delta region of the country in 2018. The policy document focused on the biodiversity potentials of the region, threats to its biodiversity and proposed conservation plans that would ensure the attainment of the ABTs/NBSAP (IUCN 2018). However, it did not focus on awareness creation among the local populace on the importance of biodiversity or NBSAP. Also, there is limited empirical data, at a

national scale, on the level of awareness of biodiversity conservation or NBSAP among Nigerians. To fill this knowledge gap, this study appraised the level of success achieved by the first ABT and the first target of Nigeria's NBSAP among Nigerians. The study compared the level of biodiversity conservation awareness among the professionals (those with tertiary education) and non-professionals (those with basic education or no formal training), with the assumption that the two groups have different levels of exposure to educational information. It was hypothesized that the first Aichi and national targets are critical to the overall realization of the NBSAP by 2020; since social understanding among the populace is very important in the quest to actualize conservation objectives (Berkes 2004; Halpern et al. 2013).

Materials and methods

Study area

Nigeria has a land area covering 923,768 km^2 with 13.6% rainforest, 78.7% savanna, and 7.7% in the derived savanna zones. A large proportion of the country is on a plateau, which is divided into three parts by the Niger and Benue Rivers, both of which flow into the country from the North-West and North-East regions respectively. The two rivers form a confluence at Lokoja and flow southwards as the Niger River which in turn forms a delta and ultimately flows into the Gulf of Guinea. The annual temperature in Nigeria is typical of a tropical climate and varies from 22–36 °C. There are two major seasons of the year, the rainy season which spans from April to October and the dry season which lasts from November to March. The country has a rich cultural diversity and is endowed with more than 250 ethnic groups (Federal Ministry of Environment 2015).

Data collection

A structured questionnaire was used to interview Nigerians, who were resident in Nigeria from 4th June 2020 to 12th July 2020 (Appendices 1 and 2). The country was stratified into six administrative/geopolitical zones (North-East, North-West, North-Central, South-East, South-West and South-South), covering the 36 States and the Federal Capital Territory (Fig. 1). The respondents were further stratified into two groups: professionals (those with tertiary level educational training) and non-professionals (those with primary or secondary educational training or no formal education). Data for professionals were collected randomly and electronically through an online survey using Google Forms. A link to the Google form was sent to Nigerians who were resident in each author's state/region through social media platforms such as WhatsApp and Facebook. The administration of the forms was non-discriminatory as it was sent to all the social contacts of the 16 authors, irrespective of their educational backgrounds. The authors interviewed the non-professionals and also submitted the Google form on their behalf. A great number of non-professionals were first educated on the term 'biodiversity' before further questioning. In all, about 5000 Nigerians were invited to participate in this survey. All the questions (A1-A5 and B1-B17) were meant to assess the respondents' understanding of biodiversity and its importance to the ecology and economy of the nation, in conformity with the first ABT and NBSAP. All responses were automatically transmitted to a central database in Google Drive, once

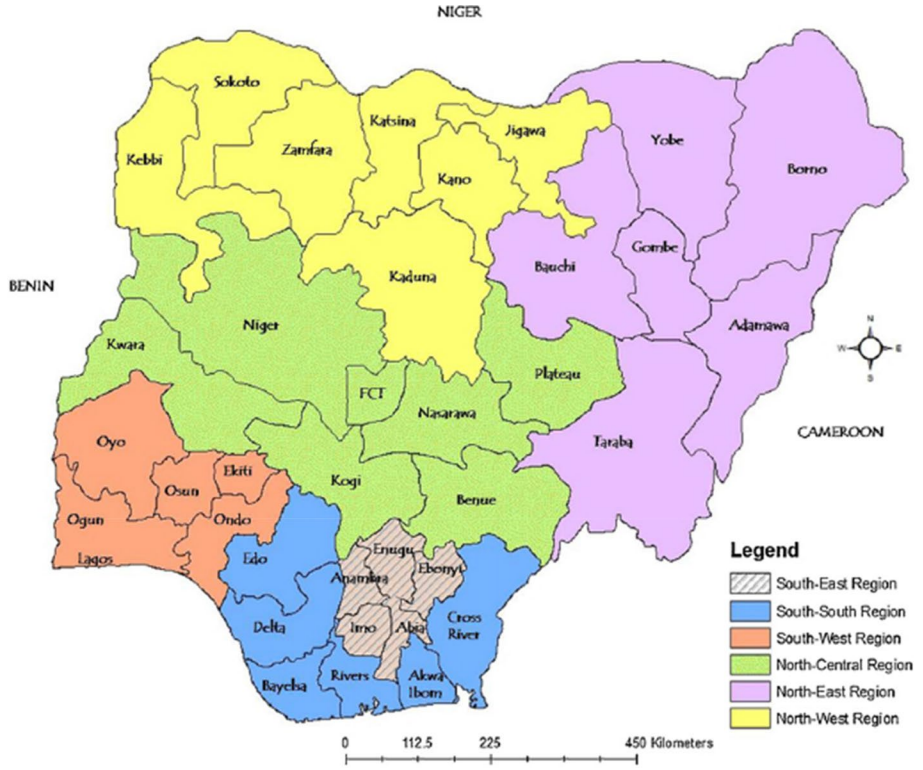

Fig. 1 Map of Nigeria showing the geopolitical zones (*Source:* Ekong et al. 2012)

submitted. The central database had responses to all the questions indicated in Appendices 1 and 2.

Data analysis

Data were analysed for both professional and non-professional categories based on (a) their understanding of the term 'biodiversity' (indicated as A1-A5) and (b) their perception of biodiversity conservation (indicated as B1-B17). The data set was not normally distributed, and generalized linear models (GLM) were used to determine significant differences between the level of awareness among professionals and non-professionals, as well as across the geo-political zones of the country. The overdispersion within each of the models was tested using the "AER" package in R, while the quasi-likelihood estimation method was used to account for overdispersion, and the data were fitted to Poisson distribution (Bolker et al. 2009). All statistical tests were conducted using R (R Development Core Team 2017).

Results

Demographics of the participants

A total of 1124 respondents participated in the survey. These included 839 professionals (74.64%) and 285 non-professionals (25.36%). There were 667 males (59.34%) and 457 females (40.66%) in the survey. The highest number of respondents was from the South West (24%) geo-political zone while the lowest was from the North Central (7%) (Fig. 2).

Respondents understanding of biodiversity (A1-A5)

Professionals had a higher level of understanding of biodiversity with a higher number of responses being "yes" ($p < 0.0001$) in the five survey questions (Fig. 3 and Table 1). The lowest value ($48.0 \pm 8.6\%$) recorded by the professionals in this category was in their level of participation in community-based conservation activities (A5), while the highest ($88.8 \pm 3.4\%$) was on their awareness of the term 'biodiversity' (A1) (Appendix 3). The non-professionals recorded the lowest value ($4.9 \pm 1.7\%$) in A5 and the highest ($20.5 \pm 3.4\%$) in A1. The levels of respondents' understanding of biodiversity across the geo-political zones were fairly the same, except in the South-east where relatively low values were recorded. The general linear model, however, indicated significant differences ($p < 0.05$) among the zones for only two questions, i.e. small organisms as an integral component of biodiversity, and participation of the respondents in community-based conservation activities (Table 1).

Awareness of biodiversity conservation promotion and biodiversity action plan (B1-B6)

The general linear model test revealed that higher percentages of professional respondents agreed and strongly agreed ($p < 0.0001$) that biodiversity conservation was being promoted in the electronic media, social media and print media, as against the non-professionals (Fig. 4a and Table 2). In this category, biodiversity conservation promotion through social media (B2P) recorded the highest value ($70.5 \pm 7.5\%$) for professionals, while electronic

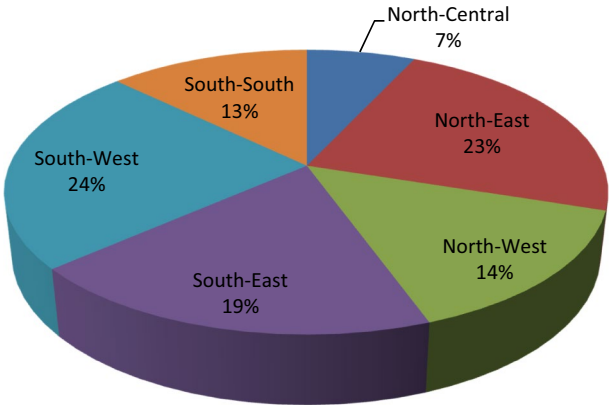

Fig. 2 Relative distribution of the respondents among the geo-political zones

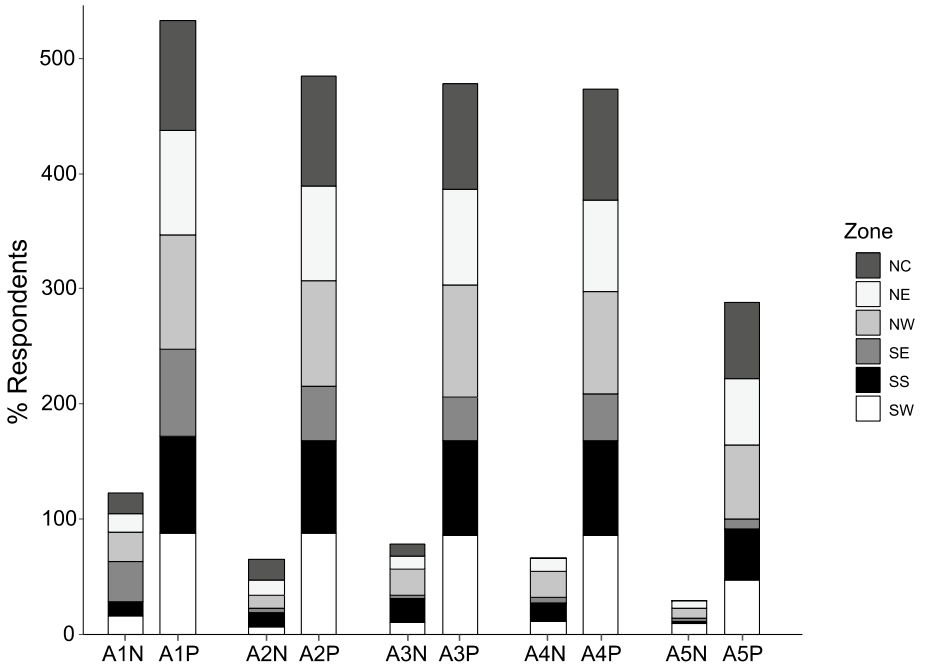

Fig. 3 Comparison of respondents' awareness of the term "biodiversity" among Geo-political zones and between professionals and non-professionals. Different shades of stacked bars indicate the levels of awareness among 100% respondents at each geo-political zone. (A1P/A1N: Have you ever heard the term 'biodiversity? A2P/A2N: Do you understand the meaning of the word' biodiversity? A3P/A3N: Do you know that biodiversity includes small organisms? A4P/A4N: Do you know that human beings are also part of biodiversity? A5P/A5N: Do you participate in any community-based conservation activities?)

Table 1 GLM test (F-values) for the respondents' understanding of the term 'biodiversity

Question	Professionals vs Non-professionals		Geo-political zones	
	F-value	P value	F-value	P value
A1: Have you ever heard the word 'biodiversity'?	91.6579	< 0.0001	0.2737	0.926
A2: Do you understand the meaning of the word 'biodiversity'?	121.477	< 0.0001	1.6092	0.1697
A3: Do you know that biodiversity includes small organisms?	97.1749	< 0.0001	2.4453	0.04271
A4: Do you know that human beings are also part of biodiversity?	105.1982	< 0.0001	1.7189	0.1423
A5: Do you participate in any community-based conservation activities?	104.5996	< 0.0001	4.4869	0.00138

Degree of freedom = 1 for professionals vs non-professionals, and 5 for geo-political zones

media promotion (B1N) recorded the highest (20.3 ± 4.3%) for non-professionals (Appendix 3). The percentages of the professionals and non-professionals that agreed to the awareness and understanding of Nigeria's Biodiversity Action Plan (B4N/P and B5N/P) were comparatively lower than those recorded for media promotion awareness. In both

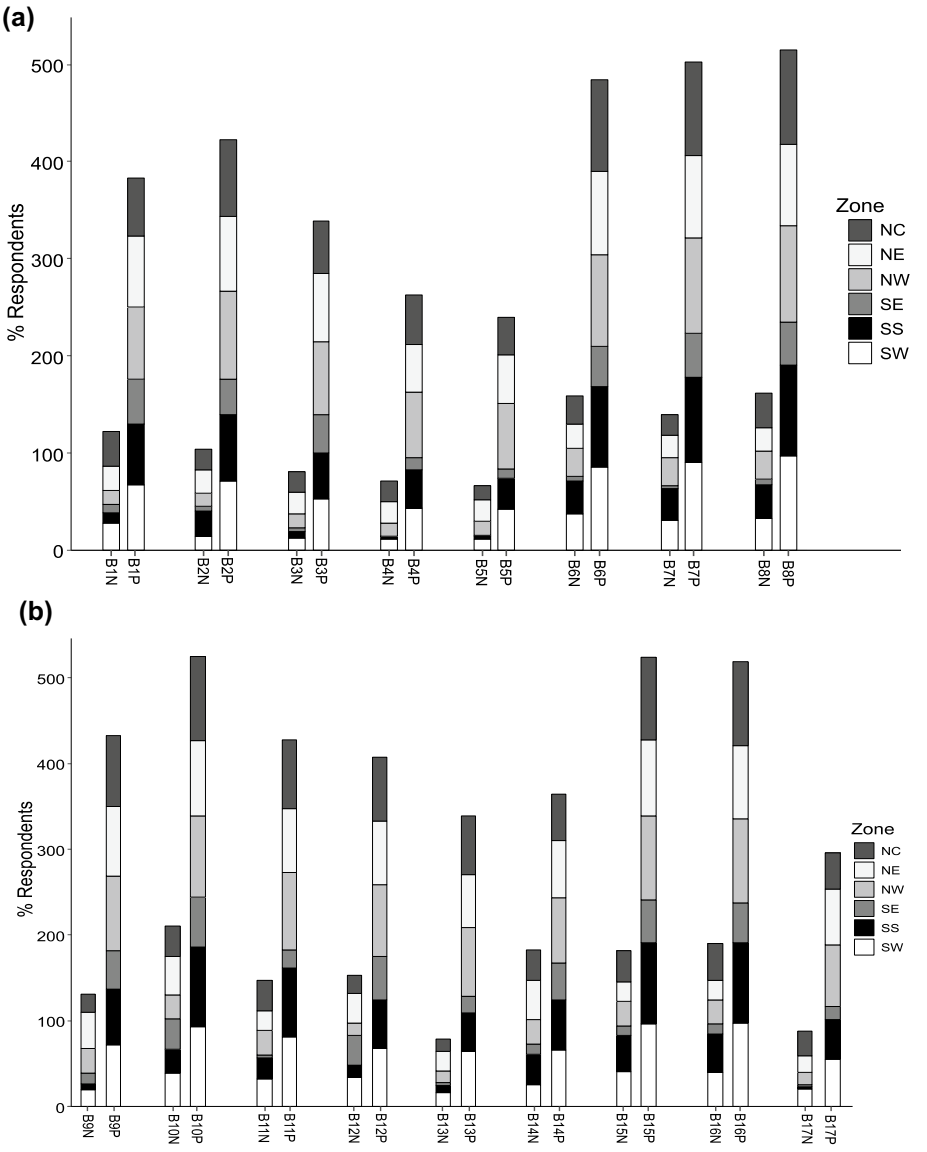

Fig. 4 Comparison of respondents' awareness of conservation promotion and action plan, as well as their perception to the importance of biodiversity to ecology and economy among the geo-political zones and between professionals and non-professionals. Different shades of stacked bars indicate the levels of awareness among 100% respondents at each geo-political zone. (B1P/BIN: Biodiversity conservation promotion on the electronic media; B2P/B2N: Biodiversity conservation promotion on the social media; B3P/B3N: Biodiversity conservation promotion in the print media; B4P/B4N: Awareness of Nigeria's biodiversity action plan; B5P/B5N: Understanding of Nigeria's biodiversity action plan; B6P/B6N: Nigeria is rich in biodiversity; B7P/B7N: Biodiversity is important to me in many ways; B8P/B8N: Healthy forests, rivers, streams and lakes are important for biodiversity; B9P/B9N: I do visit in situ conservation areas; B10P/B10N: It is important to conserve endangered wildlife; B11P/B11N: I am aware of wildlife species that should not be killed or traded; B12P/B12N: I do visit ex situ conservation areas; B13P/B13N: I do monitor biodiversity conservation programmes in the media; B14P/B14N: Endangered wild animals can serve as a source of food or income; B15P/B15N: Biodiversity conservation can provide job opportunities to Nigerians; B16P/B16N: Biodiversity conservation can serve as a source of revenues to governments; B17P/B17N: Government often promotes ecotourism in my state of residence or a state close by)

Table 2 GLM test (F – values) for the respondents' views on varied question

Item	Professionals vs Non-professional		Geo-political zones	
	F value	P value	F value	P value
B1: I do hear biodiversity/conservation programmes being promoted on the electronic media (radio and TV)	32.2721	< 0.0001	0.7392	0.5967
B2: I do hear biodiversity/conservation programmes being promoted on the social media (Facebook, Whatsapp etc.)	54.7066	< 0.0001	1.7326	0.1392
B3: I do hear biodiversity/conservation programmes being promoted in the print media (newspaper, magazine)	37.0203	< 0.0001	1.1209	0.3578
B4: I am aware of Nigeria's Biodiversity Action Plan	25.9165	< 0.0001	2.7204	0.02684
B5: I understand the Nigeria's Biodiversity Action Plan	22.1418	< 0.0001	2.8783	0.02055
B6: Nigeria is rich in biodiversity	53.3962	< 0.0001	2.0366	0.08458
B7: Biodiversity is beneficial to me in many ways	50.695	< 0.0001	2.336	0.05133
B8: I understand that healthy forests, rivers, streams and lakes are very important requirements for a rich biodiversity in Nigeria	47.6872	< 0.0001	1.7993	0.1249
B9: I do visit in situ conservation areas (e.g. national parks, game reserves, forest reserves, waterfalls, sacred groves)	38.9024	< 0.0001	0.0423	0.7883
B10: It is important to conserve endangered wildlife	33.2614	< 0.0001	3.3829	0.0088
B11: I am aware of a number of wildlife species that should not be killed or traded	32.3116	< 0.0001	0.4585	0.8057
B12: I do visit ex situ conservation areas (e.g. botanical garden, zoological garden, aquarium, seed bank) in my state of residence or zone)	40.8067	< 0.0001	2.4348	0.04348
B13: I do monitor programmes on biodiversity conservation in the media	40.4314	< 0.0001	1.9929	0.09093
B14: Endangered wild animals can as well serve as a source of food or income to Nigerians	15.7281	< 0.0001	1.0145	0.4162
B15: Biodiversity conservation can provide job opportunities to Nigerians	43.5696	< 0.0001	1.7089	0.1287
B16: Biodiversity or nature conservation can serve as a source of revenues to the federal and state governments in Nigeria	38.429	< 0.0001	2.029	0.08566
B17: Government often promotes ecotourism (visits to conservation areas) in my state of residence or a state close by	23.9949	< 0.0001	2.3645	0.0489

Degree of freedom = 1 for professionals vs non-professionals, and 5 for geo-political zones

groups, B4N and B4P recorded 12.1 ± 3.7% and 43.8 ± 7.2%, while B5N and B5P recorded 11.0 ± 3.3% and 40.0 ± 8.0%, respectively. There was no significant difference ($p > 0.05$) among the geopolitical zones concerning biodiversity conservation promotion (B1-B3), and understanding of Nigeria's biodiversity richness (B6). However, there was a significant difference ($p < 0.05$) in respondents' awareness and understanding of Nigeria's Biodiversity Action Plan (B4 & B5).

Perception of Nigerians on the role of biodiversity conservation in Nigeria's ecology and economy

The professionals strongly agreed and agreed, with higher percentages than the non-professionals, concerning the following items: biodiversity is important to me in many ways (B7); I understand that healthy forests, rivers, streams and lakes are very important requirements for rich biodiversity in Nigeria (B8) (Fig. 4a); I do visit *in-situ* conservation areas (e.g. national parks, game reserves, forest reserves, waterfalls, sacred groves) (B9); and, it is important to conserve endangered wildlife' (B10). Other items include: I am aware of some wildlife species that should not be killed or traded (B11); I do visit *ex-situ* conservation areas (e.g. botanical garden, zoological garden, aquarium, seed bank) in my state of residence or zone) (B12); I do monitor biodiversity conservation programmes in the media (B13); endangered wild animals can as well serve as a source of food or income to Nigerians (B14); biodiversity conservation can provide job opportunities for Nigerians (B15); biodiversity or nature conservation can serve as a source of revenue to the federal and state governments in Nigeria (B16); and, the government often promotes eco-tourism in my state of residence or a state close by (B17) (Fig. 4b). All the aforementioned items were significantly different ($p < 0.0001$) between the professionals and non-professionals (Table 2). The professionals recorded their highest value (87.4 ± 6.0%) in B10, while the lowest value (49.3 ± 8.2) was recorded in B17. The non-professionals recorded the highest value in B10 (35.2 ± 2.5%), while the lowest value was in B13 (13.1 ± 2.7%) (Fig. 4a and b, and Appendix 3). There were only two responses that significantly differed ($p < 0.05$) among the zones (i.e. B11 and B17), with the southern zones (South-east in particular) recording the lowest values. A high proportion (~61%) of the additional feedback comments from the respondents indicated a low level of awareness of biodiversity, conservation and ecotourism in different parts of Nigeria (Table 3).

Discussion

Findings from this study showed that the professionals were more acquainted with the concept of biodiversity than the non-professionals. An appreciable percentage of the respondents (especially the professionals) understood the meaning of the word 'biodiversity' and the fact that it includes small organisms. A good number of professionals and some non-professionals also subscribed to most of the terms that relate biodiversity to the ecology and economy of Nigeria. Leiserowitz et al. (2005) reported that the high level of concern among citizens on the state of environmental protection around the world was not usually translated into corresponding actions. For example, in a 2011 poll of British adults, 94% were bothered about biodiversity conservation, but only 15% took action to conserve biodiversity (Hambler and Canney 2013). The findings of this study, where many respondents agreed that endangered wildlife could also serve as sources of food, despite

Table 3 Some feedback comments from our respondents

S/N	Category of respondent	State of residence	Age (yr)	Sex	Comments
1*	P	Akwa Ibom	39	M	Sadly not until this questionnaire did I even understand the word biodiversity. And I am sure the governments don't care about it else it should have been a major topic in our country
2*	P	Kano	55	M	This is the first time I am having a full glimpse of what biodiversity is all about in full. This research outcome needs to be made known and then biodiversity promoted by the Federal & State governments. The biodiversity body must rise to sensitize and promote the knowledge of biodiversity in the nation This is a rich eye-opener research questionnaire to me on biodiversity
3*	P	Anambra	21	F	I thought biodiversity was about different culture until today. Please it is high time we helped educate others… Thanks
4*	NP	Osun	20	F	I think many Nigerians don't care about this kind of thing. I would say about 85% of Nigerians don't care about these things
5	P	Kaduna	34	M	Reports of surveys like this should reach out to the people in authority for them to see how bad our biodiversity has been interrupted. This survey alone is a good move as it could be further used positively in replenishing our hitched biodiversity
6	P	Kaduna	37	M	I am a fan of this program/projects, I will advise Nigeria Government to establish a project on this as a source of employment, more especially to the Botany and Zoology graduates lacking jobs and try to introduce a kind of ecotourism, conservation, amusement parks for tourism as a source of employment opportunity. I am one of the university graduates looking for job in Nigeria after graduating with B.Sc. Botany
7	P	Jigawa	28	F	I recommend that Nigerian universities introduce this as general course to every department in Faculty of Science. I also recommend government itself to provide all necessary tools needed in protected areas
8*	P	Delta	31	M	Biodiversity is not being taken seriously by the Nigerian government or even state governments as we have seen the continued degradation of our forest reserves. In my opinion more stringent measures need to be taken to protect our forests
9*	P	Benue	62	M	The knowledge of biodiversity or nature conservation for rural populace in Nigeria especially in my state (Benue state) is grossly lacking which obviously has its ugly and negative consequences. I think there is urgent need for immediate action in this regard for the benefit of man and nature
10*	P	Oyo	48	M	There is need to act and stop paying lip service to conservation of our biodiversity. We seem to pay so much attention to research and do virtually nothing in reality. How many states are promoting tourism, conservation etc. in Nigeria today? Instead they give license to miners to destroy our environment

Table 3 (continued)

S/N	Category of respondent	State of residence	Age (yr)	Sex	Comments
11*	P	Taraba	34	M	Taraba State is blessed with biodiversity but these diversities are facing a terrible threat. There is need for able hands (conservationists) to overhaul human activities that are detrimental to conservation of biological diversities in Taraba
12*	P	Akwa Ibom	31	M	I consume news and information almost exclusively through digital formats and my answers reflect that and not what government is or is not doing to promote biodiversity in TV/Radio and Print
13*	P	Jigawa	23	F	I have never heard of biodiversity conservation. If it is important there should be proper awareness
14*	P	Rivers	32	F	I am NOT aware of any activities by the government of Rivers state to promote and protect biodiversity in the state
15*	P	Plateau	35	M	One thing I am sure about Nigeria in terms biodiversity is there is no sustainable policy, which is why there is clash between human and wildlife. Most people are not well
16*	P	Bauchi	29	M	Topics or courses on BIODIVERSITY should be taught from Primary school level up to Secondary schools
17*	P	Kwara	46	M	As important as this subject, biodiversity is to Nigeria, little is being heard about it. There is a need for an improved public enlightenment on the subject matter
18*	NP	Bauchi	14	F	I want to know what biodiversity action plan is
19	P	Ekiti	47	M	This will provide job opportunities for Nigerians
20	P	Osun	40	M	Let the awareness be intensified on the promotion of biodiversity across Nigeria
21*	P	Osun	36	M	Public awareness about the subject matter by the government is very low, hence, there is need to sensitise the public especially the rural settlement
22	NP	Imo	22	F	Biodiversity conservation should be taught in secondary schools for more awareness
23*	NP	Borno	27	F	No comment but I do not know much about biodiversity
24*	NP	Osun	17	M	I need to know why biodiversity is so important to me
25*	NP	Osun	14	M	Wild plants and animals are only good for traditional doctors
26*	P	Rivers	34	F	Nigeria's biodiversity is hugely untapped aspect of her culture and economy
27	P	Oyo	34	M	Very interesting and educative
28	P	Kwara	22	M	The Nigeria Biodiversity Action Plan should encourage active participations of students, who are studying closely related fields in Nigerian Universities

Table 3 (continued)

S/N	Category of respondent	State of residence	Age (yr)	Sex	Comments
29	P	Gombe	30	M	It is a vital research in this our contemporary life due to human activities that destabilize the natural system
30	P	Gombe	27	M	Biodiversity can serve as source of income to the entire nation if government will invest and protect the wild animals, Many people from outside and inside the Nigeria will visit the place during their holidays and spend money
31*	P	Kwara	35	F	I believe the knowledge of biodiversity conservation is not well circulated in my environment. More awareness needs to be created on the importance of conservation
32*	P	Taraba	28	M	Government should do more in enlightening the public about the importance of the subject matter; many people are ignorant of biodiversity
33*	P	Bauchi	24	M	Conservation matters need serious attention in my nation
34*	P	Kaduna	39	M	Social media is potentially an avenue that can boost education on biodiversity to public but people don't seem to patronize handles that carry such messages! Even policymakers appear to be unaware of biodiversity and its place in revenue and job creation, a gap that should be bridged
35*	P	Kano	33	M	Biodiversity conservation in Nigeria is not given much priority as do other sects of the economy. But investments in biodiversity conservation have proven to be a huge source
36	P	Rivers	34	F	Biodiversity studies like this as well as practical evaluations of biodiversity of water and soil should be encouraged
37*	P	Rivers	55	M	Nigerian governments, federal and state, are unserious about biodiversity conservation
38	P	Borno	40	M	Nigeria is blessed with very rich biodiversity, the problem is proper supervision and adequate management. Most people feel that biodiversity is government business with little or no effort from community
39	P	Niger	35	F	I hope the survey will be of positive impact to the nation at large thanks
40	NP	Kano	18	F	Would love to be a biodiversity conservationist
41	P	FCT Abuja	29	M	I will love to receive a copy of published report
42	P	Taraba	26	M	I consider it a privilege to have participated in this survey. I hope that my response will help you in analysing and understanding the biodiversity level of my dear state in Nigeria
43*	P	Oyo	46	F	The awareness of biodiversity is still low in Nigeria

Table 3 (continued)

S/N	Category of respondent	State of residence	Age (yr)	Sex	Comments
44*	P	Cross River	35	M	This is a good survey, I am a practicing Forester, so, I can boldly say that the Nigerian plans for biodiversity conservation are not adequate. The current rate of deforestation and biodiversity lost is alarming, and this is largely due to neglect of people living in forest-rich communities and their complete dependence on the forest for livelihoods

P professional, *NP* non-professional, *M* male, *F* female

*Comments that indicate a low level of awareness of biodiversity, conservation, biodiversity action plan and ecotourism in different parts of Nigeria

their understanding of biodiversity were similar to those from the British poll (Hambler and Canney 2013), and the report of Leiserowitz et al. (2005). It is also worth emphasizing that some respondents (particularly from the South-east zone) did not know that, small organisms were an integral part of biodiversity. The current level of awareness raises a red flag and highlights the need for increased enlightenment on the importance of biodiversity conservation in developing countries such as Nigeria (Adenle et al. 2015).

The level of awareness or understanding of the NBSAP among the respondents was very low since a significant percentage of the non-professionals and the professionals did neither know nor understand the NBSAP. The additional comments provided by some respondents suggest that topical issues such as biodiversity conservation, NBSAP or ABTs were not being discussed or promoted adequately in Nigeria. For instance, some respondents had neither heard of the term 'biodiversity conservation' nor had a full understanding of its concept and importance until after this survey. Some respondents also rated the state and federal governments low in the promotion of biodiversity conservation. Perhaps the best way to address this problem is through environmental or biodiversity education which has been recognized as a good approach for solving the current biodiversity crises and creating environmentally conscious individuals (Tuncer and Erol 1992; Uzun et al. 2006). Several studies (e.g. Cosquer et al. 2012; Adenle et al. 2015) suggested that awareness creation depends largely on the high involvement of the media (social media, print, radio and television), and it can shape public opinion and perception of biodiversity conservation. Findings from this survey revealed that social media was a very suitable platform for reaching professionals, followed by electronic media. The reverse was however the case for non-professionals who got informed about biodiversity conservation mostly through the electronic media, followed by the social media. One of the basic concepts of environmental and biodiversity education is the improvement of the quality of life for the present generation without handing over an impaired environment to future generations (Erkal and Gürsoy 2013; Hambler and Canney 2013). This approach needs to be introduced early enough in the life of an individual, beginning at the pre-school stage up to the university level and for the rest of the individual's life. This has been suggested as a way of increasing interaction with nature among people and developing a pro-conservation attitude in both developed and developing countries (Cosquer et al. 2012). Thus, environmental or conservation education could help Nigeria realize its NBSAP and Aichi targets. This is because it approaches biodiversity conservation from a broader point of view (i.e. quality of life/ecosystem services), and not just because each species has a fundamental right to exist (i.e. intrinsic value). This anthropocentric approach has been suggested as one way of getting the attention of the relevant stakeholders, most especially political office holders who are involved in policy and decision-making related to biodiversity conservation (Hambler and Canney 2013; Adenle et al. 2015). Environmental education could also make the populace appreciate the concept of payment for ecosystem/environmental services (PES) which has been introduced in some countries. In Tanzania, for instance, PES has drastically reduced the conflicts between parks and people (Nelson et al. 2010). In the same vein, the introduction of PES in the Wolong Nature Reserve of China made the people consider cooking gas

an alternative to firewood, thereby reducing deforestation and increasing the forest cover in the Panda Reserve (Liu et al. 2001).

Findings from this study also showed that governments need to step up campaigns on eco-tourism as many of our respondents disagreed with the idea that there was enough awareness in this regard. A good number of the rare natural sites in the country (e.g. Mambilla Plateau, Sankwala Mountains, Oowu Waterfalls) are yet to be fully explored for their eco-tourism potentials due to lack of good access roads, inadequate security and poor accommodation facilities for would-be tourists. Visits to some of these natural sites and areas of outstanding ecological or cultural interest have been recognized as a mainstay of the economy for many developing nations (Okello 2014; Anwadike 2020). Perhaps, this is one way by which the Federal and State Governments in Nigeria can boost their revenue base, and diversify the economy while conserving biodiversity and improving the economies of local communities (Chiutsi et al. 2011). Moreover, visit and contact with nature and wildlife via sustainable ecotourism has been reported to produce the following health benefits: reduced stress, improved mental health and capacity, faster recovery from surgery, faster reduction of blood pressure, reduced anger and anxiety, and happiness (Hartig et al. 2003; Mitchell and Pophan 2008; Zari 2018; Campbell-Arvai 2019; Mills et al. 2019). The economic and health benefits of eco-tourism are doubtlessly enormous. However, such visits should be done in a sustainable manner, e.g. small numbers of tourists, eco-marketing activities, and little impact on the natural environment and wildlife, as well as reduced development of tourism facilities (Dorobantu and Nistoreanu 2012; Samia et al. 2017).

Perhaps this study would have recorded a greater level of participation in terms of the number of respondents if most of our social contacts responded to the call, especially the professionals who were interviewed through the Google forms. The global COVID-19 pandemic and social restrictions also limited the extent to which we could reach out to non-professionals. Nonetheless, this study allowed us to enlighten the populace in general, especially the non-professionals, on the subject of biodiversity conservation. Some professionals also had a better understanding of biodiversity conservation and the NBSAP as captured in their additional comments after the survey. The additional comments underscore the assertion that it is important to evaluate the knowledge of people on biodiversity and understand their attitudes, perception and convictions (Teel and Manfredo 2009; Schultz 2011). The educative approach employed in this study could thus foster biodiversity conservation in Nigeria and help the country actualize its NBSAP and ABTs.

Conclusion and recommendations

The study revealed some areas of deficiency and how crucial the first national target is to biodiversity conservation in Nigeria. With an appreciable level of awareness on NBSAP among the populace, the task of biodiversity conservation by individuals, local

communities, government agencies and other stakeholders could be easily implemented. It is recommended that current topical issues related to biodiversity conservation, NBSAP and ABTs be incorporated into the curricula of the different levels of education. Partnership with the media and the use of local languages could also increase the scale of national and public discourse. Among other services to the nation, governments should engage the services of graduates of Biology-related disciplines (e.g. Botany, Forestry, Wildlife Management and Zoology among others) to sensitize the public on the multifarious ecosystem services of biological diversity and the need to conserve it.

Appendix 1

Basic concepts of biodiversity

1. Have you ever heard the word '**biodiversity**'?

   YES..... NO.....
2. Do you understand the word '**biodiversity**'?

   YES..... NO.....
3. Did you know that biodiversity includes small organisms like bacteria, insects and plants?

   YES..... NO.....
4. Did you know that human being (i.e. *Homo sapiens*) is also part of biodiversity?

   YES..... NO.....
5. Do you participate in any community-based conservation activities?

   YES..... NO.....

Appendix 2

See Table 4.

Table 4 Awareness of Biodiversity Conservation Efforts and the Importance of Biodiversity to Ecosystem Services and the Economy

S/N	Item	SA	A	U	D	SD
1	I do hear biodiversity/conservation programmes being promoted on the electronic media (radio and TV)					
2	I do hear biodiversity/conservation programmes being promoted on the social media (Facebook, Whatsapp etc.)					
3	I do hear biodiversity/conservation programmes being promoted in the print media (newspaper, magazine)					
4	I am aware of Nigeria's Biodiversity Action Plan					
5	I understand the Nigeria's Biodiversity Action Plan					
6	I do monitor programmes on biodiversity conservation in the media					
7	Nigeria is rich in biodiversity					
8	Biodiversity is beneficial to me in many ways					
9	I understand that healthy forests, rivers, streams and lakes are very important requirements for a rich biodiversity in Nigeria					
10	I do visit in situ conservation areas (e.g. national parks, game reserves, forest reserves, waterfalls, sacred groves)					
11	It is important to conserve endangered wildlife					
12	I am aware of a number of wildlife species that should not be killed or traded					
13	I do visit ex situ conservation areas (e.g. botanical garden, zoological garden, aquarium, seed bank) in my state of residence or zone]					
14	Endangered wild animals can as well serve as a source of food or income to Nigerians					
15	Biodiversity conservation can provide job opportunities to Nigerians					
16	Biodiversity or nature conservation can serve as a source of revenues to the federal and state governments in Nigeria					
17	Government often promotes ecotourism (visits to conservation areas) in my state of residence or a state close by					

Appendix 3

See Table 5.

Table 5 Percentages of professional and non-professional respondents who subscribed to the question items listed in the questionnaire across the geo-political zones

Question	Category of respondents	Mean ± s.e.m						
		North Central	North East	North West	South East	South South	South West	Overall
A1	Professional	95.7 ± 3.0	90.8 ± 3.0	98.6 ± 2.1	75.5 ± 5.1	84.0 ± 5.4	88.2 ± 3.5	88.8 ± 3.4
	Non-professional	17.9 ± 11.8	15.9 ± 7.3	25.7 ± 16.7	34.7 ± 8.3	12.2 ± 7.8	16.5 ± 8.7	20.5 ± 3.4
A2	Professional	95.6 ± 3.5	81.7 ± 1.6	91.8 ± 4.5	47.0 ± 6.9	80.6 ± 6.3	87.9 ± 3.3	80.8 ± 7.2
	Non-professional	17.9 ± 11.8	12.7 ± 5.9	11.4 ± 11.4	4.18 ± 2.3	7.3 ± 3.6	11.6 ± 7.4	10.8 ± 1.9
A3	Professional	92.1 ± 3.9	82.7 ± 1.8	97.7 ± 1.6	37.9 ± 8.0	82.0 ± 5.0	85.9 ± 4.6	79.7 ± 8.7
	Non-professional	10.7 ± 7.4	11.0 ± 5.0	22.9 ± 15.4	2.5 ± 2.5	21.1 ± 13.4	10.6 ± 6.4	13.1 ± 3.1
A4	Professional	96.3 ± 2.9	79.0 ± 2.5	89.0 ± 4.5	40.6 ± 5.4	81.5 ± 5.4	86.5 ± 3.7	78.8 ± 8.0
	Non-professional	0	10.7 ± 5.0	22.9 ± 15.4	4.9 ± 2.5	12.0 ± 6.5	15.6 ± 10.4	11.0 ± 3.3
A5	Professional	66.1 ± 10.1	57.2 ± 6.4	63.9 ± 6.3	8.4 ± 2.6	44.9 ± 6.1	47.4 ± 7.2	48.0 ± 8.6
	Non-professional	0	6.8 ± 3.8	8.6 ± 8.6	1.9 ± 1.3	2.2 ± 2.2	10.0 ± 4.5	4.9 ± 1.7
B1	Professional	59.1 ± 12.0	73.3 ± 3.6	74.5 ± 8.3	45.5 ± 5.9	63.2 ± 8.0	67.1 ± 6.6	63.8 ± 4.4
	Non-professional	35.7 ± 18.0	24.6 ± 11.9	14.3 ± 14.3	8.7 ± 2.5	11.1 ± 7.0	27.5 ± 12.9	20.3 ± 4.3
B2	Professional	79.2 ± 6.6	76.9 ± 3.6	90.9 ± 3.4	36.3 ± 4.7	68.7 ± 10.4	71.1 ± 3.3	70.5 ± 7.5
	Non-professional	21.4 ± 14.9	23.5 ± 12.2	14.3 ± 14.3	4.2 ± 2.3	26.1 ± 12.2	14.6 ± 7.2	17.4 ± 3.3
B3	Professional	54.3 ± 11.9	70.3 ± 3.7	75.0 ± 7.0	39.7 ± 7.0	47.1 ± 4.5	52.5 ± 6.8	56.5 ± 5.6
	Non-professional	21.4 ± 14.9	22.1 ± 12.3	14.3 ± 14.3	4.2 ± 2.3	6.7 ± 6.7	12.5 ± 7.4	13.5 ± 3.0
B4	Professional	50.4 ± 9.3	49.9 ± 8.5	66.7 ± 8.4	13.1 ± 1.8	38.9 ± 8.4	43.5 ± 8.0	43.8 ± 7.2
	Non-professional	21.4 ± 14.9	21.8 ± 12.0	14.3 ± 14.3	1.3 ± 1.3	2.2 ± 2.2	11.8 ± 7.6	12.1 ± 3.7
B5	Professional	38.4 ± 8.4	50.2 ± 8.7	67.9 ± 8.2	9.1 ± 2.4	32.1 ± 7.5	42.0 ± 6.3	40.0 ± 8.0
	Non-professional	14.3 ± 14.3	22.1 ± 12.3	14.3 ± 14.3	0	2.2 ± 2.2	11.8 ± 7.6	10.8 ± 3.4
B6	Professional	94.0 ± 2.3	86.1 ± 3.7	93.9 ± 2.4	41.4 ± 3.7	82.6 ± 4.9	86.1 ± 4.5	80.7 ± 8.1
	Non-professional	28.6 ± 18.4	25.6 ± 12.4	28.6 ± 18.4	5.0 ± 2.1	37.2 ± 18.5	33.9 ± 15.9	26.5 ± 4.6
B7	Professional	96.7 ± 1.7	85.0 ± 1.7	97.8 ± 1.5	44.9 ± 5.0	88.3 ± 4.2	90.1 ± 2.4	83.8 ± 8.0

Table 5 (continued)

Question	Category of respondents	Mean ± s.e.m						
		North Central	North East	North West	South East	South South	South West	Overall
	Non-professional	21.4 ± 14.9	23.3 ± 11.7	28.6 ± 18.4	2.5 ± 2.5	32.8 ± 16.3	31.0 ± 16.3	23.2 ± 4.5
B8	Professional	96.7 ± 1.7	83.9 ± 2.2	99.1 ± 0.6	44.5 ± 4.3	93.5 ± 2.4	96.9 ± 1.5	85.8 ± 8.5
	Non-professional	35.7 ± 18.0	24.1 ± 11.3	28.6 ± 18.4	6.0 ± 2.3	33.9 ± 15.9	33.2 ± 16.3	26.9 ± 4.5
B9	Professional	82.8 ± 5.8	80.5 ± 5.2	87.1 ± 5.9	44.9 ± 5.1	65.2 ± 8.0	71.9 ± 2.7	72.1 ± 6.3
	Non-professional	21.4 ± 14.9	41.9 ± 12.5	28.6 ± 18.4	12.7 ± 4.7	6.7 ± 6.7	19.9 ± 9.1	21.9 ± 5.0
B10	Professional	97.6 ± 1.6	88.2 ± 3.8	94.4 ± 4.6	57.9 ± 7.1	93.0 ± 3.1	93.3 ± 2.6	87.4 ± 6.0
	Non-professional	35.7 ± 18.0	44.6 ± 10.1	28.6 ± 18.4	34.8 ± 10.8	28.3 ± 14.5	38.9 ± 20.0	35.2 ± 2.5
B11	Professional	80.0 ± 5.9	74.8 ± 5.0	90.0 ± 3.5	21.4 ± 7.1	80.3 ± 4.9	81.3 ± 4.7	71.3 ± 10.2
	Non-professional	35.7 ± 18.0	22.6 ± 11.5	28.6 ± 18.4	3.6 ± 1.5	24.5 ± 15.6	32.4 ± 17.4	24.6 ± 4.6
B12	Professional	74.4 ± 6.9	73.9 ± 2.1	84.0 ± 3.8	50.0 ± 4.9	57.2 ± 9.0	67.6 ± 5.6	67.9 ± 5.1
	Non-professional	21.4 ± 14.9	34.3 ± 14.0	14.3 ± 14.3	35.0 ± 8.4	14.4 ± 9.5	33.9 ± 16.6	25.6 ± 4.1
B13	Professional	68.8 ± 8.5	61.2 ± 3.2	80.2 ± 5.7	19.7 ± 2.6	64.6 ± 5.7	44.4 ± 5.0	56.5 ± 8.8
	Non-professional	14.3 ± 14.3	22.2 ± 11.6	14.3 ± 14.3	3.4 ± 2.4	7.8 ± 7.8	16.5 ± 10.0	13.1 ± 2.7
B14	Professional	54.1 ± 10.8	65.9 ± 5.4	76.8 ± 6.8	42.8 ± 6.1	58.6 ± 3.5	65.7 ± 10.1	60.7 ± 4.8
	Non-professional	35.7 ± 18.0	45.2 ± 7.8	28.6 ± 18.4	12.5 ± 3.7	25.6 ± 12.6	35.0 ± 16.6	30.4 ± 4.5
B15	Professional	96.8 ± 1.6	88.1 ± 2.7	98.1 ± 1.1	50.4 ± 4.0	94.6 ± 2.9	96.1 ± 1.8	87.4 ± 7.5
	Non-professional	35.7 ± 18.0	23.4 ± 11.6	28.6 ± 18.4	10.4 ± 3.0	42.2 ± 19.4	41.1 ± 18.9	30.2 ± 4.9
B16	Professional	97.5 ± 1.2	85.2 ± 1.7	98.6 ± 0.9	46.3 ± 6.9	94.1 ± 3.0	97.0 ± 2.0	86.5 ± 8.3
	Non-professional	42.9 ± 20.2	22.7 ± 11.8	28.6 ± 18.4	11.8 ± 3.3	44.5 ± 20.5	39.9 ± 18.6	31.7 ± 5.3
B17	Professional	42.3 ± 9.8	64.8 ± 7.7	71.9 ± 6.1	15.3 ± 2.2	46.6 ± 6.4	54.9 ± 5.0	49.3 ± 8.2
	Non-professional	28.6 ± 18.4	20.0 ± 12.3	14.3 ± 14.3	2.2 ± 1.4	2.2 ± 2.2	20.8 ± 9.8	14.7 ± 4.4

A1: Have you ever heard the term 'biodiversity? A2: Do you understand the meaning of the word' biodiversity? A3: Do you know that biodiversity includes small organisms? A4: Do you know that human beings are also part of biodiversity? A5: Do you participate in any community-based conservation activities? B1: Biodiversity conservation promotion on the electronic media; B2: Biodiversity conservation promotion on the social media; B3: Biodiversity conservation promotion in the print media; B4: Awareness of Nigeria's biodiversity action plan; B5: Understanding of Nigeria's biodiversity action plan; B6: Nigeria is rich in biodiversity; B7: Biodiversity is important to me in many ways; B8: Healthy forests, rivers, streams and lakes are important for biodiversity; B9: I do visit in situ conservation areas; B10: It is important to conserve endangered wildlife; B11: I am aware of wildlife species that should not be killed or traded; B12: I do visit ex situ conservation areas; B13: I do monitor biodiversity conservation programme in the media; B14: Endangered wild animals can serve as a source of food or income; B15: Biodiversity conservation can provide job opportunities to Nigerians; B16: Biodiversity conservation can serve as a source of revenues to governments; B17: Government often promotes ecotourism in my state of residence or a state close by)

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References

Adenle AA, Stevens C, Bridgewater P (2015) Global conservation and management of biodiversity in developing countries: An opportunity for a new approach. Environ Sci Policy 45:104–108. https://doi.org/10.1016/j.envsci.2014.10.002

Ahmed YM, Oruonye ED, Ayuba HK (2016) Socio-economic impact of commercial production of rosewood (*Pterocarpus erinaceus*) in Taraba State, Nigeria. J Agric Ecol 7:1–9. https://doi.org/10.9734/JAERI/2016/25151

Akande OA, Ahmad YA, Yusuf HO, Akinade TG (2019) Assessment of Wildlife Conservation Awareness and practices in some selected secondary school around Kainji Lake National Park. Nigeria World Sci News 115:91–103

Akindele EO, Omisakin OD, Oni OA, Aliu OO, Omoniyi GE, Akinpelu OT (2020) Heavy metal toxicity in the water column and benthic sediments of a degraded tropical stream. Ecotoxicol Environ Saf 190:110153. https://doi.org/10.1016/j.ecoenv.2019.110153

Anwadike BC (2020) Biodiversity conservation in Nigeria: perception, challenges and possible remedies. Curr Invest Agric Curr Res 8(4):10. https://doi.org/10.32474/CIACR.2020.08.000293

Berkes F (2004) Rethinking community-based conservation. Conserv Biol 18:621–630. https://doi.org/10.1111/j.1523-1739.2004.00077.x

Boersema J, Blowers A, Martin A (2009) Biodiversity loss, poverty and climate change: can one solution fit all? JIES 6(4):239–245. https://doi.org/10.1080/19438150903432701

Bolker BM, Brooks ME, Clark CJ, Geange SW, Poulsen JR, Stevens MHH, White JSS (2009) Generalized linear mixed models: a practical guide for ecology and evolution. Trends Ecol Evol 24:127–135

Butchart SHM, Walpole M, Collen B, van Strien A, Scharlemann JPW, Almond RE et al (2010) Global biodiversity: indicators of recent declines. Science 328:1164–1168. https://doi.org/10.1126/science.1187512

Campbell-Arvai V (2019) Engaging urban nature: improving our understanding of public perceptions of the role of biodiversity in cities. Urban Ecosyst 22:409–423. https://doi.org/10.1007/s11252-018-0821-3

CBD Secretariat (2010) The strategic plan for biodiversity 2011–2020 and the Aichi biodiversity targets. In Secretariat of the Convention on Biological Diversity, Nagoya, Japan. UNEP/CBD/COP/DEC/X/2

Chiutsi S, Mukoroverwa M, Karigambe P, Mudzengi BK (2011) The theory and practice of ecotourism in Southern Africa. J Hosp Tour 2:14–21. https://doi.org/10.5897/JHMT.9000008

Chukwu GU (2008) Poverty-driven causes and effects of environmental degradation in Nigeria. Pac J Sci Technol 9(2):599–602

Cosquer A, Raymond R, Prevot-Julliard AC (2012) Observations of everyday biodiversity: a new perspective for conservation? Ecol Soc 17:2. https://doi.org/10.5751/ES-04955-170402

Dijkstra KDB (2021) African dragonflies and damselflies online. http://addo.adu.org.za/index.php?taxon_id=12800. Accessed 18 Jan 2021

Dorobantu MR, Nıstoreanu P (2012) Rural tourism and ecotourism—the main priorities in sustainable development orientations of rural local communities in Romania. Economy Transdisciplinarity

Ekong PS, Ducheyne E, Carpenter TE, Owolodun OA, Oladokun AT, Lombin LH, Berkvens D (2012) Spatio-temporal epidemiology of highly pathogenic avian influenza (H5N1) outbreaks in Nigeria, 2006–2008. Prev Vet Med 103:170–177. https://doi.org/10.1016/j.prevetmed.2011.10.001

Environmental Investigation Agency (2017) The rosewood racket: Chinas' billion dollar illegal trade and the devastation of Nigeria's forests. https://content.eia-global.org/assets/2017/rosewoodracket/PDF/Rosewood+Racket+Report+(High+Res).pdf. Accessed 29 Aug 2020

Erkal S, Gürsoy N (2013) Importance of environmental education to achievement of sustainable development. AWERProcedia advances in applied sciences. In: Proceedings of Global Conference on Environmental Studies (CENVISU-2013), 24–27 April 2013, Zeynep Sentito Hotel, Belek – Antalya, Turkey.1, pp 1042–1045. http://www.world-education-center.org/index.php/paas.

Federal Ministry of Environment (2015) Federal Republic of Nigeria: National Biodiversity Strategy and Action Plan 2016–2020. Federal Ministry of Environment, p 157. https://www.cbd.int/doc/world/ng/ng-nbsap-v2-en.pdf. Accessed 29 June 2020

Glowka L, Burhenne-Guilmin F, Synge H, McNeely JA, Gündling L (1994) A guide to the convention on biological diversity. IUCN, Gland, p 161

Hambler C, Canney SM (2011) Conservation, 2nd edn. Cambridge University Press, Cambridge

Halpern BS, Klein CJ, Brown CJ, Beger M, Grantham HS, Mangubhai S et al (2013) Achieving the triple bottom line in the face of inherent trade-offs among social equity, economic return, and conservation. In: Cowling RM (ed) PNAS, vol 110, pp 6229–6234. https://doi.org/https://doi.org/10.1073/pnas.1217689110

Hartig T, Evans GW, Jamner LD, Davis DS, Arling TG, Avle G (2003) Tracking restoration in natural and urban field settings. J Environ Psychol 23:109–123. https://doi.org/10.1016/S0272-4944(02)00109-3

Ijeomah HM, Abazi E (2014) Assessment of environmental education and manpower development strategies in Kainji Lake National Park. Nigeria TARE 17(1):1–9

IUCN Niger Delta Panel (2018) Developing a biodiversity conservation strategy for the Niger Delta: Integrating biodiversity considerations into SPDC's operation. IUCN, Gland,pp viii+36

Jantz SM, Barker B, Brooks TM, Chini LP, Huang Q, Moore RM et al (2015) Future habitat loss and extinctions driven by land-use change in biodiversity hotspots under four scenarios of climate-change mitigation. Conserv Biol 29:1122–1131. https://doi.org/10.1111/cobi.12549

Leiserowitz A, Kates R, Parris T (2005) Do global attitudes and behaviours support sustainable development? Environ Sci Policy Sustain Dev 47:22–38. https://doi.org/10.3200/ENVT.47.9.22-38

Liu J, Linderman M, Ouyang Z, An L, Yang J, Zhang H (2001) Ecological degradation in protected areas: the case of Wolong Nature Reserve for giant pandas. Science 292:98–101. https://doi.org/10.1126/science.1058104

Lohbeck M, Bongers F, Martinez-Ramos M, Poorter L (2016) The importance of biodiversity anddominance for multiple ecosystem functions in a human-modified tropical landscape. Ecology 97:2772–2779. https://doi.org/10.1002/ecy.1499

Luck GW (2007) A review of the relationships between human population density and biodiversity. Biol Rev 82:607–645. https://doi.org/10.1111/j.1469-185X.2007.00028.x

Mills JG, Brookes JD, Gellie NJC, Liddicoat C, Lowe AJ, Sydnor HR et al (2019) Relating urban biodiversity to human health with the 'holobiont'concept. Front Microbiol 10:550. https://doi.org/10.3389/fmicb.2019.00550

Mitchell R, Popham F (2008) Effect of exposure to natural environment on health inequalities: an observational population study. Lancet 372:1655–1660. https://doi.org/10.1016/S0140-6736(08)61689-X

Mora C, Sale PF (2011) Ongoing global biodiversity loss and the need to move beyond protected areas: a review of the technical and practical shortcomings of protected areas on land and sea. Mar Ecol Prog 434:251–266. https://doi.org/10.3354/meps09214

National Bureau of Statistics (2020) 2019 poverty and inequality in Nigeria: executive summary. National Bureau of Statistics, Abuja

Nelson F, Foley C, Foley LS, Leposo A, Loure E, Peterson D, Peterson M, Peterson T, Sachedina H, Williams A (2010) Payments for ecosystem services as a framework for community-based conservation in northern Tanzania. Conserv Biol 24(1):78–85. https://doi.org/10.1111/j.1523-1739.2009.01393.x

O'Connor B, Secades C, Penner J, Sonnenschein R, Skidmore A, Burgess ND, Hutton JM (2014) Earth observation as a tool for tracking progress towards the Aichi Biodiversity Targets. Remote Sens Ecol Conserve 1:19–28. https://doi.org/10.1002/rse2.4

Okello MM (2014) Economic contribution, challenges and way forward for wildlife-based tourism industry in Eastern African countries. J Tour Hosp 3:122. https://doi.org/10.4172/2167-0269.1000122

Ola-Adams BA (2001) Education, awareness building and training in support of biosphere reserves: experience from Nigeria. In: United Nations Educational, Scientific and Cultural Organisation (ed) Proceedings of the 'Seville + 5' International Meeting of experts on the implementation of the Seville Strategy

for Biosphere Reserves, MAB Report Series No.69. United Nations Educational, Scientific and Cultural Organisation, Paris, France, pp 167–170
Olajuyigbe S (2018) Green gold of Africa: Nigeria's forest, a depleted but resilient renewable resource. Irish For 75:92–112
Paradis E (2018) Nonlinear relationship between biodiversity and human population density: evidence from Southeast Asia. Biodivers Conserv 27:2699–2712. https://doi.org/10.1007/s10531-018-1563-5
R Development Core Team (2017) R: a language and environment for statistical computing. R Foundation for Statistical Computing, Vienna
Rosendal GK (2013) The convention on biological diversity and developing countries, vol 25. Springer, New York
Samia DS, Angeloni LM, Bearzi M, Bessa E, Crooks KR, D'Amico M et al (2017) Best practices toward sustainable ecotourism. In: Blumstein D, Geffroy B, Samia D, Bessa E (eds) Ecotourism's Promise and Peril. Springer, Cham
Schultz PW (2011) Conservation means behaviour. Conserv Biol 25:1080–1083. https://doi.org/10.1111/j.1523-1739.2011.01766.x
Sedghi A (2013) Redlist 2013: threatened species across the regions of the world. The Guardian. Retrieved from http://www.theguardian.com/news/datablog/2013/nov/26/iucn-red-listthreatened-species-by-country-statistics
Shittu ML (2013) Effect of insecurity on conservation areas and its consequences on international ecotourist patronage of game/national parks in Nigeria. J Trop For Res 29(1):54–64
Teel TA, Manfredo MJ (2009) Understanding the diversity of public interests in wildlife conservation. Conserv Biol 24:128–139. https://doi.org/10.1111/j.1523-1739.2009.01374.x
Tittensor DP, Walpole M, Hill SLL et al (2014) A mid-term analysis of progress toward international biodiversity targets. Science 346:241–244. https://doi.org/10.1126/science.1257484
Tuncer M, Erol D (1992) The environmental education in Turkey: some view and proposals of biopolitics. In: 5th BIO International Conference 7–10 May, Istanbul, Turkey
Uetz P, Freed P, Hosek J (2018) The Reptile Database. http://www.reptile-database.org. Accessed 14 Nov 2018
United Nations, Department of Economic and Social Affairs (2015) Transforming Our World: The 2030 Agenda for Sustainable Development. Resolution Adopted by the UN General Assembly. 25 September 2015. https://sustainabledevelopment.un.org/post2015/transformingourworld. Accessed 29 Jan 2021
United Nations, Department of Economic and Social Affairs, Population Division (2019) World population prospects 2019: highlights (ST/ESA/SER.A/423).
Uzun N, Sağlam S (2006) Ortaöğretim Öğrencileri İçin Çevresel Tutum Ölçeği Geliştirme ve Geçerliliği. H.Ü. Eğitim Fakültesi Dergisi 30:240–250
Williams JN (2013) Humans and biodiversity: population and demographic trends in the hotspots. Popul Environ 34:510–523. https://doi.org/10.1007/s11111-012-0175-3
Zari MP (2018) The importance of urban biodiversity–an ecosystem service approach. Biodivers Int J 2:357–360. https://doi.org/10.15406/bij.2018.02.00087

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