Contributed Paper

Linguistic diversity and conservation opportunities at UNESCO World Heritage Sites in Africa

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Abstract: Africa contains much of Earth's biological and cultural–linguistic diversity, but conserving this diversity is enormously challenging amid widespread poverty, expanding development, social unrest, and rapidly growing human population. We examined UNESCO (United Nations Educational, Scientific and Cultural Organization) Natural World Heritage Sites (WHSs) on continental Africa and nearby islands—48 protected areas containing globally important natural or combined natural and cultural resources—to gauge the potential for enlisting Indigenous peoples in their conservation. We used geographic information system technology to identify instances where Natural WHSs co-occur with Indigenous languages, a key indicator of cultural diversity. And, we compared the geographic ranges for 4 taxa and selected freshwater species with occurrence of all Indigenous languages within Natural WHSs and subsections of WHSs covered by the geographic extent of Indigenous languages to measure the correlation between linguistic and biological diversity. Results indicated that 147 languages shared at least part of their geographic extent with Natural WHSs. Instances of co-occurrence where a WHS, a language, or both were endangered marked localities particularly deserving conservation attention. We examined co-occurrence of all languages and all species, all languages and endangered species, and endangered languages and endangered species and found a correlation between linguistic and biological diversity that may indicate fundamental links between these very different measures of diversity. Considering only endangered species or endangered languages and species reduced that correlation, although considerable co-occurrence persisted. Shared governance of government-designated reserves is applicable for natural WHSs because it capitalizes on the apparent connection between culture and nature. Natural WHSs in Africa containing speakers of Indigenous languages present opportunities to conserve both nature and culture in highly visible settings where maintaining natural systems may rely on functioning Indigenous cultural systems and vice versa.

Keywords: language–nature co-occurrence, protected area shared governance

Diversidad Lingüística y Oportunidades de Conservación en los Sitios de Patrimonio Mundial UNESCO en África

Resumen: África contiene mucha de la diversidad biológica, cultural y lingüística de la Tierra, aunque conservar esta diversidad es un reto enorme debido a la pobreza extendida, el desarrollo en expansión, la inestabilidad social y el rápido crecimiento de la población humana. Examinamos los Sitios de Patrimonio Mundial (SPM) de la UNESCO (Organización de las Naciones Unidas para la Educación, Ciencia y Cultura) en África continental y en las islas aledañas—48 áreas protegidas que contienen recursos naturales o una combinación de recursos culturales y naturales de importancia mundial—para conocer el potencial para enlistar a los pueblos indígenas como parte de su conservación. Usamos tecnología de sistemas de información geográfica para identificar las instancias en donde coincidieron los SPM Naturales con los lenguajes indígenas, un indicador importante de la diversidad cultural. También comparamos la distribución geográfica de cuatro taxones y seleccionamos especies de agua dulce con incidencias en todos los idiomas indígenas dentro de los SPM Naturales y las subsecciones de los SPM para medir la correlación entre la diversidad biológica y la diversidad lingüística. Los resultados indicaron que 147 lenguajes comparten al menos una parte de su distribución geográfica con los SPM Naturales. Las instancias

de coincidencia en donde un SPM, un lenguaje o ambos se encuentran en peligro marcaron a las localidades particularmente merecedoras de atención para su conservación. Analizamos la coincidencia de todos los lenguajes y todas las especies, todos los lenguajes y todas las especies en peligro, y los idiomas en peligro y las especies en peligro y encontramos una correlación entre la diversidad lingüística y la diversidad biológica que podría indicar conexiones fundamentales entre estas dos medidas muy diferentes de la diversidad. Cuando sólo se consideró a las especies en peligro o a los lenguajes en peligro y a las especies en peligro en conjunto, esa correlación se vio reducida, aunque persistió una coincidencia considerable. La administración compartida de las reservas designadas por el gobierno puede aplicarse a los SPM naturales porque capitaliza la conexión aparente entre la cultura y la naturaleza. Los SPM Naturales en África que incluyen a hablantes de lenguajes indígenas representan una oportunidad para conservar a la cultura y a la naturaleza en escenarios altamente visibles en donde mantener los sistemas naturales puede depender de los sistemas culturales indígenas funcionales y viceversa.

Palabras Clave: administración compartida de las áreas protegidas, coincidencia natural de lenguajes

Introduction

Africa hosts much of the planet's biological, cultural, and linguistic diversity (Moore et al. 2002; UNEP-WCMC 2016; Kandybowicz & Torrence 2017), although conserving this diversity amid widespread poverty, rapid population growth and development, and social conflict found throughout much of the continent presents an enormous challenge. As in other parts of the world, government agencies, conservationists, and communities often turn toward protected areas—localities created to conserve cultural and natural resources (separately or in combination) (Dudley 2008)—to help maintain the continent's natural and cultural heritage (Tranquilli et al. 2014).

Protected areas vary in their contribution to conservation, from small local parks to localities globally recognized for the resources they contain. Despite their key role in conservation strategies, many reserves fail to maintain natural and cultural resources. Studies of protected area effectiveness identify several reasons for failure, including management shortcomings, inadequate funding, and insufficient engagement of stakeholders (Dudley et al. 2004; Leverington et al. 2010). Many researchers interested in protected area performance recommend increased involvement of local communities in reserve design and management to improve effectiveness (Argawal & Gibson 1999; Berkes 2007), rather than continued reliance on conventional top-down government management. Prior research indicates that protected areas often host speakers of Indigenous languages (Gorenflo et al. 2012), marking Indigenous peoples as potential conservation partners for many reserves. Given the enormous conservation challenges present, might Indigenous peoples be increasingly enlisted to improve the effectiveness of protected areas in Africa?

We examined the potential for engaging Indigenous partners in conserving United Nations Educational, Scientific, and Cultural Organization (UNESCO) World Heritage Sites (WHSs) in continental Africa and on nearby islands. World Heritage designation is assigned to reserves recognized for the globally significant cultural or natural heritage they contain. Focusing on WHSs defined for natural or for combined natural and cultural content (defined by UNESCO as "mixed" sites), hereafter Natural WHSs, we identified co-occurrence of these sites with speakers of Indigenous languages in Africa. Co-occurrence where a Natural WHS, an Indigenous language, or both are endangered identifies special conservation opportunities. We evaluated WHSs and the geographic extent of languages within them in terms of biodiversity based on the ranges of 4 taxa (amphibians, birds, mammals, and reptiles) and selected freshwater groups (crabs, crayfish, dragonflies and damselflies, fishes, mollusks, plants, and shrimp) to assess correlation of linguistic and biological diversity as well as potential to coordinate their conservation. We also examined the geographic overlap between languages and endangered species and between endangered languages and endangered species, both to assess their relationship and to identify opportunities for focused conservation intervention in parts of culture and nature at risk of disappearing. We considered the opportunity for shared governance of Natural WHSs in Africa through enlistment of speakers of the Indigenous languages in these reserves, possibly taking advantage of the UN International Decade of Indigenous Languages (2022–2032), to improve the conservation of natural settings as well as the Indigenous cultures and languages that share their geographic space.

Methods

We used geographic information system (GIS)-based analyses to identify co-occurrences of Natural WHSs and Indigenous languages in Africa. We also used GIS technology to identify species whose ranges included WHS locations, to gauge the biodiversity content of these high-profile sites and the potential role of Indigenous cultures they host for conserving this biodiversity.

Natural WHSs contain one or more of the following features (UNESCO and Intergovernmental Committee for the Protection of the World Cultural and Natural Heritage 2019): natural physical and biological formations of

outstanding universal value for aesthetics or science; geological and physiographical formations and precisely defined areas comprising habitat of threatened plant or animal species of outstanding universal value for science or conservation; and natural sites or precisely defined areas of outstanding universal value for science, conservation, or natural beauty. Mixed Cultural–Natural WHSs have at least 1 of the above qualities and meet cultural criteria, the latter representing important examples of human creativity, monuments, buildings, landscapes, artistic or literary works, settlement, land use, or sea use (UNESCO and Intergovernmental Committee for the Protection of the World Cultural and Natural Heritage 2019). As of January 2021, UNESCO designated 252 Natural and Mixed Cultural–Natural WHSs—213 of the former and 39 of the latter (UNESCO 2021). The World Database on Protected Areas contains GIS data for these sites (UNEP-WCMC & IUCN 2020).

We also examined Natural WHSs on the List of World Heritage in Danger (UNESCO 2021). Natural WHSs are considered endangered due to ascertained dangers, such as adverse impacts on the species, natural beauty, or scientific value used to justify World Heritage status, resulting from natural or human-related threats (UNESCO and Intergovernmental Committee for the Protection of the World Cultural and Natural Heritage 2019). Sites also are considered endangered due to potential dangers, such as outbreak or threat of armed conflict, planned development, inadequate management, or weakened protective status. As of January 2021, UNESCO categorized 17 Natural WHSs as endangered, 12 of them in Africa (UNESCO 2021).

SIL International maintains global language data in a regularly updated catalog called *Ethnologue*. Global Mapping International created a GIS version of these language data. Their most recent version (Global Mapping International 2016) is based on the 7,097 languages described in the 19th edition of *Ethnologue* (Lewis et al. 2016). The language data we used comprise polygons representing geographic extent of occurrence for all languages. *Ethnologue* complements this information with other pertinent data, including estimated number of speakers of each language. We focused solely on Indigenous and nonmigrant languages (hereafter Indigenous languages) associated with particular cultures and localities, rather than languages spread by colonization or other processes (e.g., Portuguese in Angola).

In addition to data on all Indigenous languages, we also examined endangered languages as a special subset possibly marking cultural systems under duress. We used 2 indicators of linguistic endangerment: small numbers of speakers and reduced intergenerational transmission. For the former, we considered 2 thresholds—1,000 or fewer and 10,000 or fewer speakers. Although number of speakers does not always mark a language at risk of extinction, languages used by smaller numbers of indi-

viduals tend to be more susceptible to disruption from various causes because they have fewer speakers to lose (Gorenflo et al. 2012). The expanded graded intergenerational disruption scale (EGIDS) serves as a measure of intergenerational transmission of language (Lewis & Simons 2010), recognizing that languages persist only when successfully passed between generations. We considered the following EGIDS designations as signifying endangered status: 6b (threatened), 7 (shifting), 8a (moribund), and 8b (nearly extinct).

Most of the data on species occurrence we used came from the International Union for Conservation of Nature (IUCN) Red List of Threatened Species (IUCN 2019). The IUCN Red List provides data on taxonomic classification, geographic occurrence, and conservation status for globally evaluated plants, animals, and fungi (IUCN 2020). The IUCN maintains GIS datasets on amphibians, mammals, and reptiles, as well as selected freshwater groups (crabs, crayfish, damselflies and dragonflies, fishes, mollusks, plants, and shrimp) considered here. One of the most important types of information in these data sets is range data based on known, inferred, or projected localities of occurrence of species in a particular taxon (IUCN 2012). We also used GIS data on ranges of bird species compiled by BirdLife International and the Handbook of Birds of the World (BirdLife International & Handbook of the Birds of the World 2019). Bird occurrence data relied on specimen localities, observer records, documented presence in important bird areas, distribution atlases, distribution maps in handbooks and field guides, and expert opinion. The IUCN data on terrestrial and freshwater species and the BirdLife-Handbook of Birds of the World GIS data on birds we used date to December 2019.

In addition to data on amphibians, birds, mammals, reptiles, and freshwater species, we considered species in these taxa at risk of extinction. The IUCN evaluates risk based on 3 criteria: declining numbers, geographic range, and population size (IUCN 2012). Categories of conservation status we considered to indicate noteworthy risk were vulnerable, endangered, critically endangered, and extinct in the wild. BirdLife International and Handbook of Birds of the World have adopted these categories for their assessment of bird species as well.

To explore the potential link between Indigenous languages and biodiversity at Natural WHSs, we determined the number of species in selected taxa (amphibians, birds, mammals, and reptiles) and freshwater groups with geographic ranges occurring in those reserves. This began by focusing on entire WHSs. However, because one focus of this study was the interface between biological and linguistic diversity, we also identified species whose ranges overlapped with the geographic extent of Indigenous languages present in a WHS. Although the ranges of Indigenous languages often cover much of a WHS, occasionally this is not the case and focusing on language ranges enabled us to account for such instances

and measure the geographic interface of language and species ranges more precisely. Species range data do not guarantee that the species occurs throughout that entire range. Guidelines for data use recommend reliance on localities with focused evaluations of species occurrences, such as key biodiversity areas (IUCN 2016). Of the 48 Natural WHSs, 45 also are key biodiversity areas (exceptions are Lake Malawi National Park, Lakes of Ouniaga, and Vredefort Dome WHSs). Although site-specific examinations underlying key-biodiversity-area status provide more reliable information on resident species in particular localities than species ranges, comprehensive data on species in key biodiversity areas are unavailable. However, the high percentage of WHSs that also are key biodiversity areas does increase confidence in the accuracy of the range data in these reserves.

Results

Of the 252 Natural WHSs recognized by UNESCO, 48 (19.0%) occur in continental Africa and on nearby islands. The WHSs are found in all 5 regions recognized by the African Union (Chitiga & Manby 2009), more than half in East and Central Africa (Fig. 1a; Table 1). Site sizes varied from <1 to >78,500 km^2. Some 147 Indigenous languages co-occurred with those 48 sites. Although this total represented only about 7.0% of more than 2100 languages spoken in Africa, it accounted for nearly one-third of the total languages intersecting Natural WHSs globally, and their combined geographic extents covered much of the continent (Fig. 1b). The number of languages intersecting Natural WHSs varied widely, from 0 in Namib Sand Sea in Namibia to 13 in the Cliff of Bandiagara (Land of the Dogons) in Mali. Of languages involved, 37 were considered endangered by our criteria: 16 based on EGIDS, 8 spoken by 1,000 or fewer, and 20 spoken by 1,001–10,000 (some languages met both EGIDS and numerical criteria).

The 12 endangered WHSs in Africa represented 71% of all Natural WHSs considered endangered by UNESCO (Fig. 1a). Half of the endangered sites in Africa occurred in Central Africa; a few were in East and West Africa. Though endangerment can occur for several reasons, in all cases human impacts underlaid endangered status in Africa. More than 60 Indigenous languages shared at least part of their geographic footprint with endangered Natural WHSs in Africa (see Fig. 1b), nearly all in West, Central, or East Africa. Some 16 endangered languages co-occurred with endangered Natural WHSs, marking reserves and associated languages that are particularly high priorities for conservation.

Amid important site-specific contrasts, there were 2 recurring characteristics in many of the 48 reserves in Africa (see descriptions of 5 Natural WHSs in Appendix S1): high biodiversity and human impacts. UNESCO uses

Table 1. Summary of distribution of Natural World Heritage Sites (WHSs) in Africa and co-occurrence with selected categories of indigenous languages by African Union Region.

African Union Region	Natural WHSs (endangered WHSs)[a]	All languages intersecting WHSs[a]	Languages endangered based on EGIDS[a,b]	Languages with ≤1,000 speakers[a]	Languages with 1,001–10,000 speakers[a]	Total endangered languages[a,c]
Central	12 (6)	44 (35)	4 (3)	2 (1)	7 (6)	10 (8)
East	17 (5)	58 (34)	10 (8)	3 (1)	5 (4)	14 (10)
North	4	6	1	–	–	1
South	10	17	2	2	2	6
West	9 (3)	40 (9)	3 (2)	2	8 (1)	11 (2)
Total[d]	48 (12)	147 (63)	16 (10)	8 (1)	20 (9)	37 (16)

[a] Languages intersecting endangered WHSs in parentheses.
[b] Expanded graded intergenerational disruption scale. Categories considered endangered consist of 6b, threatened; 7, shifting; 8a, moribund; 8b, nearly extinct.
[c] Totals for some geographic rows may not equal sums of those rows due to languages categorized for both number of speakers and EGIDS.
[d] Totals for some columns may not equal sums of those columns due to WHSs and languages occurring in >1 region.
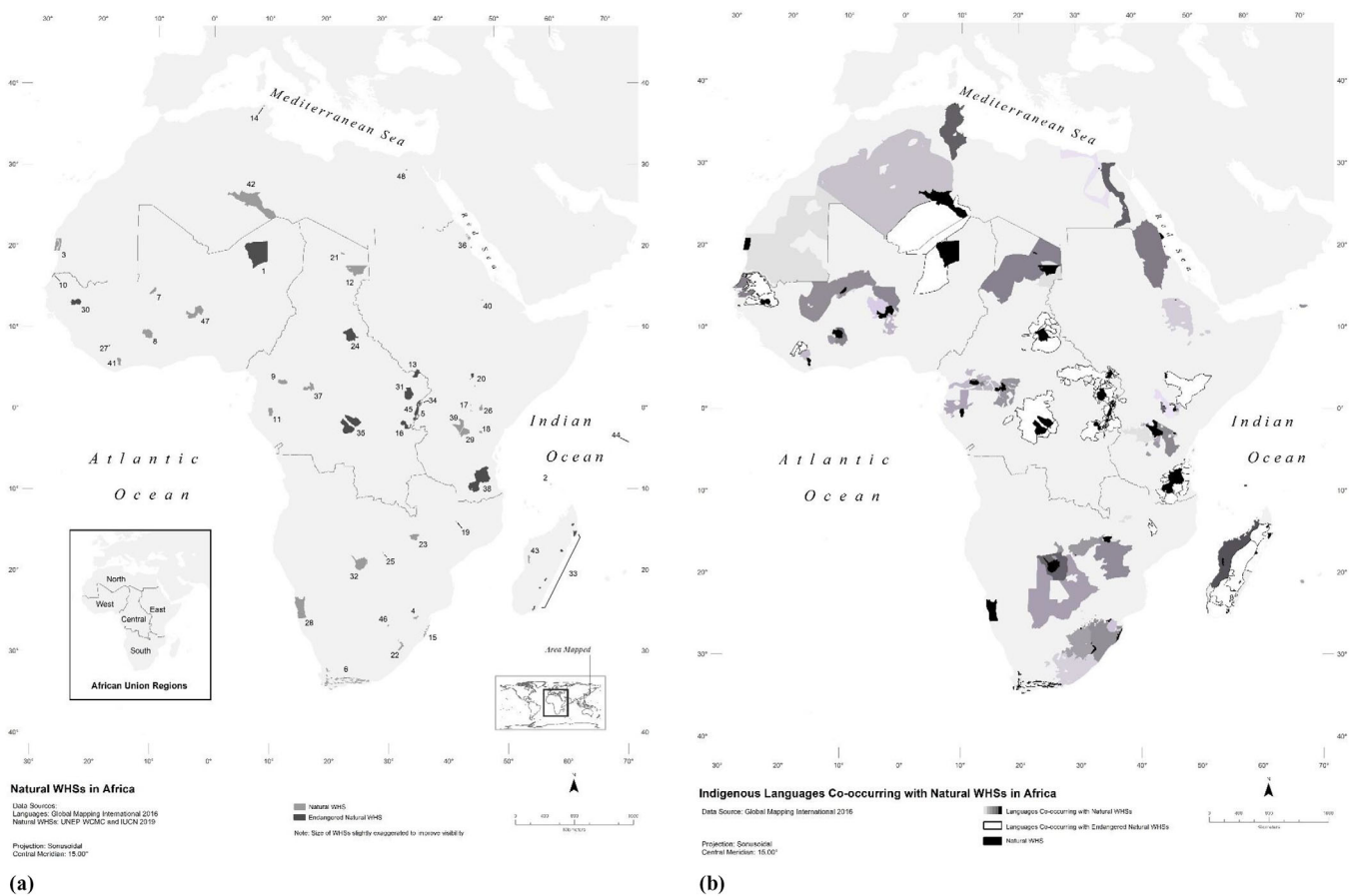
Figure 1. *(a) Natural World Heritage Sites (WHSs) on Continental Africa and nearby islands and (b) Indigenous languages co-occurring with WHSs (1, Air and Ténéré Natural Reserves; 2, Aldabra Atoll; 3, Banc d'Arguin National Park; 4, Barberton Mkonjwa Mountains; 5, Bwindi Impenetrable National Park; 6, Cape Floral Region Protected Areas; 7, Cliff of Bandiagara [Land of the Dogons]; 8, Comoé National Park; 9, Dja Faunal Reserve; 10, Djoudj National Bird Sanctuary; 11, Ecosystem and Relict Cultural Landscape of Lopé-Okanda; 12, Ennedi Massif: Natural and Cultural Landscape; 13, Garamba National Park; 14, Ichkeul National Park; 15, iSimangaliso Wetland Park; 16, Kahuzi-Biega National Park; 17, Kenya Lake System in the Great Rift Valley; 18, Kilimanjaro National Park; 19, Lake Malawi; 20, Lake Turkana National Parks; 21, Lakes of Ounianga; 22, Maloti-Drakensberg Park; 23, Mana Pools National Park, Sapi and Chewore Safari Areas; 24, Manovo-Gounda St. Floris National Park; 25, Mosi-oa-Tunya Victoria Falls; 26, Mount Kenya National Park/Natural Forest; 27, Mount Nimba Strict Nature Reserve; 28, Namib Sand Sea; 29, Ngorongoro Conservation Area; 30, Niokolo-Koba National Park; 31, Okapi Wildlife Reserve; 32, Okavango Delta; 33, Rainforests of the Atsinanana; 34, Rwenzori Mountains National Park; 35, Salonga National Park; 36, Sanganeb Marine National Park and Dungonab Bay—Mukkawar Island Marine National Park; 37, Sangha Trinational; 38, Selous Game Reserve; 39, Serengeti National Park; 40, Simien National Park; 41, Taï National Park; 42, Tassili n'Ajjer; 43, Tsingy de Bemaraha Strict Nature Reserve; 44, Vallée de Mai Nature Reserve; 45, Virunga National Park; 46, Vredefort Dome; 47, W-Arly-Pendjari Complex; 48, Wadi Al-Hitan (Whale Valley).*

4 criteria to determine whether sites are worthy of Natural WHS status; 2 involve biodiversity: criterion x, which explicitly lists biological diversity and endangered species, and criterion ix, which includes communities of plants and animals (UNESCO and Intergovernmental Committee for the Protection of the World Cultural and Natural Heritage 2019). Of the 48 Natural WHSs in Africa, 40 were so designated based on criterion ix, x, or both (Appendix S1). Individual site totals from our analyses

varied from 132 to >2150 species per WHS (Fig. 2a & Appendix S1). Thirty-two Natural WHSs in Africa were within the ranges of 1000 or more species for the taxa and freshwater groups considered, and 45 of these sites contain key biodiversity areas with biological content that has been carefully scrutinized and determined to be high. Eleven of the 12 endangered WHSs in Africa were within the ranges of 1000 or more species, providing further reason to develop strategies to protect these
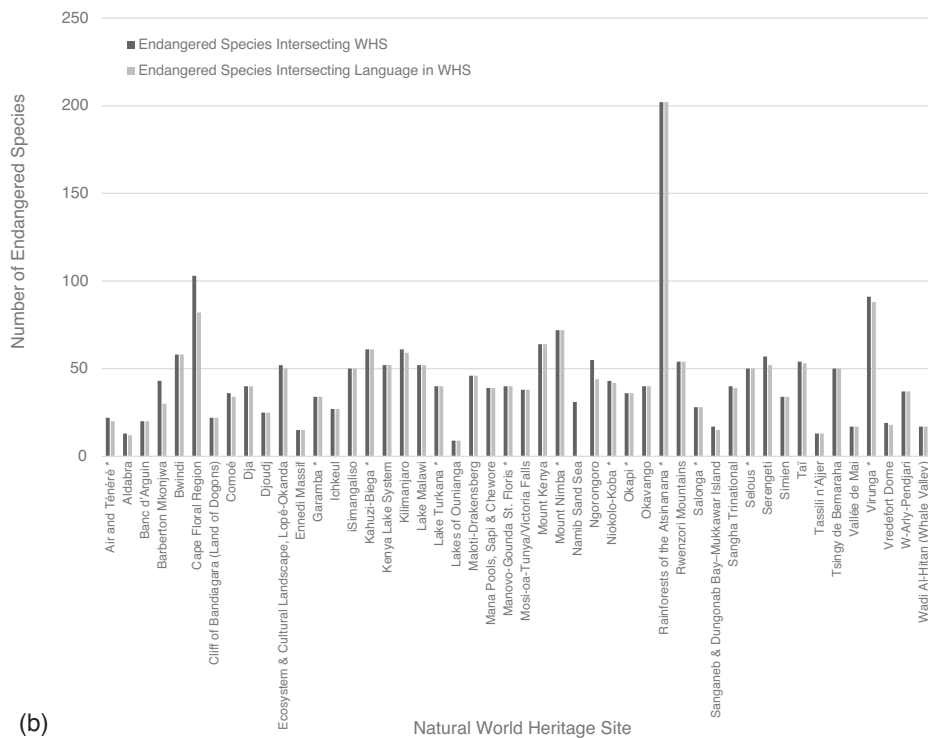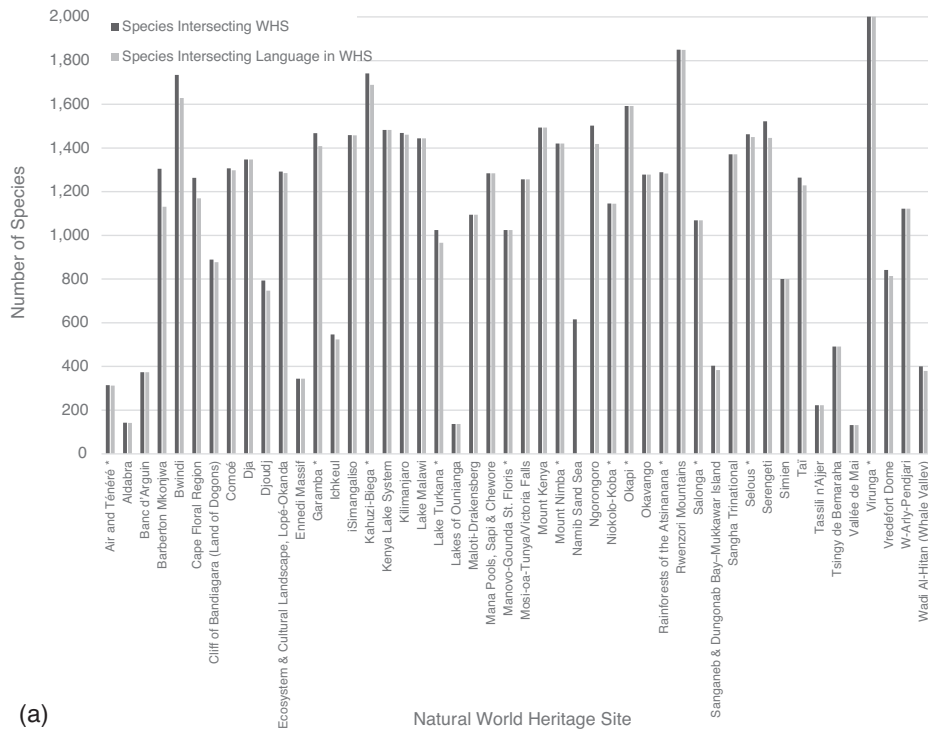
(a)

(b)

Figure 2. (a) Species with ranges that co-occur with Natural World Heritage Sites (WHSs) and areas occupied by Indigenous language ranges within Natural WHSs and (b) endangered species with ranges that co-occur with Natural WHSs and areas occupied by Indigenous language ranges within Natural WHSs (*WHSs on List of World Heritage in Danger).

reserves from current and pending threats. In all, Natural WHSs occurred within the ranges of >8200 species in the taxa and freshwater groups we examined.

Although many WHSs were covered entirely by the ranges of Indigenous languages, in some cases these ranges involved only small subsections of Natural WHSs. Constraining our analysis to species ranges in those por-

tions of WHSs that included Indigenous language polygons indicated that in 21 of the 48 Natural WHSs in Africa ranges for all species that occur in an entire reserve also occurred in that part of a reserve intersecting the footprints of Indigenous languages (Fig. 2a & Appendix S1). For the remaining WHSs, reduction in total species varied but were mostly small (Namib Sand Sea

had no Indigenous languages). Of the 12 sites on the List of World Heritage in Danger, 9 showed a small reduction in total species covered when we focused solely on the footprints of Indigenous language. In all, subsections of Natural WHSs that hosted Indigenous languages were within the ranges of nearly 8100 species for the taxa and freshwater groups analyzed.

Numbers of endangered species whose ranges occurred within the entire reserve and those whose ranges occurred only in parts of the reserve within the geographic extent of an Indigenous language were much smaller than the total number of species (Fig. 2b & Appendix S1). Only 18 of the 48 African WHSs were within the ranges of 50 or more endangered species for the taxa and freshwater groups examined. Reduction in coverage when constraining the analysis to areas in WHSs that host Indigenous languages continued to be minimal, despite the small total number of endangered species per site. None of the 12 endangered Natural WHSs showed a large reduction of endangered species ranges when we limited the analysis to Indigenous language polygons within the reserves. Natural WHSs occurred within the ranges of nearly 900 species in the taxa and freshwater groups analyzed. Those portions of WHSs that hosted Indigenous languages, in turn, intersected the ranges of >860 endangered species.

For Natural WHSs in Africa, a positive statistical relationship existed between the number of Indigenous languages in a reserve and the species ranges intersected by language footprints (Fig. 3a) (Pearson correlation coefficient of 0.47, $p < 0.01$, effect size [Glass's delta] 2.0). This statistical connection, at a fairly small geographic scale, may indicate some functional link between these 2 very different measures of diversity. A positive relationship also existed between the number of Indigenous languages in a Natural WHS and endangered species ranges within endangered language footprints (Fig. 3b). But the strength of this second correlation was less (Pearson coefficient of 0.29, $p < 0.05$, effect size [Glass's delta] 1.3). Focusing solely on endangered diversity—endangered languages and endangered species—further reduced the relationship between linguistic and biological diversity (Fig. 3c). Only 22 of the Natural WHSs examined contained endangered languages; the Pearson correlation of 0.10 was not statistically significant.

The second recurring characteristic was the presence of human impacts, both in all Natural WHSs and in those on the List of World Heritage in Danger (Appendix S1). Of the 2020 descriptions of all 48 Natural WHSs in Africa we examined, 40 reported impacts from local people, including poaching, livestock grazing, fishing, logging, mining, agriculture, fire, tourism, and habitat conversion. Three others discussed likely future impacts from people. Frequently encountering negative influences from humans is not surprising, given that impacts on reserves usually are of human origin. But it suggests that
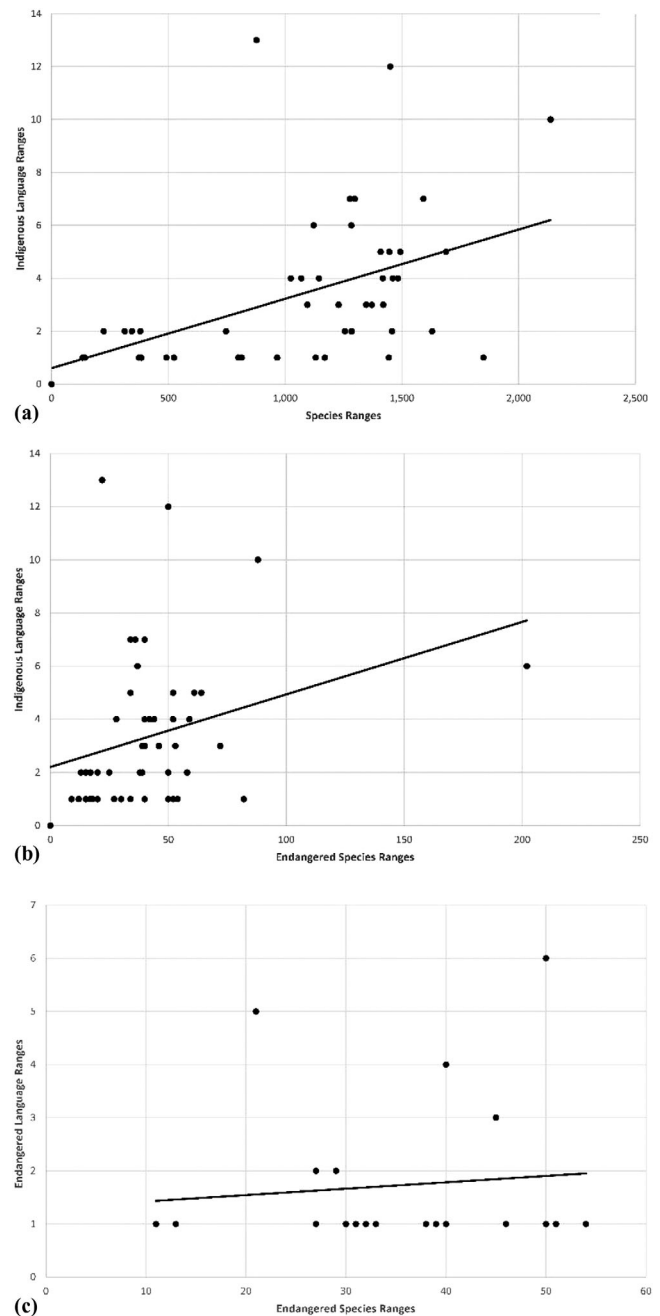
Figure 3. Comparison of the number of Indigenous languages in Natural WHSs with the number of species ranges intersecting geographic extents of those languages: (a) all languages and all species, (b) all languages and endangered species, and (c) endangered languages and endangered species.

addressing impacts at minimally 40 sites should involve engaging local people or altering engagement already in place, acknowledging that those involved may not all be speakers of nearby Indigenous languages.

Discussion

The analyses described above revealed that nearly all Natural WHSs in Africa co-occur with Indigenous languages. Examining ranges of species in selected taxa and freshwater groups indicated the likely presence of considerable biodiversity in the WHSs, consistent with criteria used to accord World Heritage status to most sites and with earlier studies involving subsets of previous Natural WHS lists (Bertzky et al. 2013; Le Saout et al. 2013). High levels of biodiversity persisted when we limited species co-occurrences to those subsections of WHSs within the geographic extents of resident languages. And most WHSs also occurred within the ranges of large numbers of endangered species, as did subsections of those reserves where Indigenous language polygons occurred. Clearly, sites on the World Heritage List are noteworthy thanks to broad recognition of their global importance. Most Natural WHSs likely host large numbers of species in addition to speakers of Indigenous languages. In the face of human impacts on many of these sites, maintaining most of them could involve engaging speakers of Indigenous languages that share WHSs with several nonhuman species. This engagement would provide an opportunity to conserve globally important nature by enlisting the assistance of speakers of Indigenous languages and in the process help to conserve those languages and the cultural systems that host them.

The correlation between the number of Indigenous languages and the number of species ranges in Natural WHSs suggests a link between these 2 very different measures of diversity at a much smaller geographic scale than previously found. The nature of this connection remains unclear in the absence of geographically focused, site-specific research. Moreover, when we introduced endangerment to species, languages, or both, the correlation declined, with endangered languages showing little connection with endangered species. These reduced correlations did not remove the potential benefits to nature of conserving Indigenous cultures or the benefits to Indigenous cultures of conserving nature, though impacts would be diminished. The reasons for lessened statistical links may reflect different processes affecting variables that occurred over very different geographic ranges.

At UNESCO's 43rd session of the World Heritage Committee in July 2019, Indigenous peoples stressed that language is key to safeguarding World Heritage because it conveys values and traditional ecological knowledge (TEK) that make conservation and management more effective (UNESCO 2019). Our results indicate regular co-occurrence of Indigenous languages and Natural WHSs in Africa, a pattern found elsewhere, notably Asia and Europe (Romaine & Gorenflo 2017, 2020). Africa presently hosts more than 2000 Indigenous languages (Eberhard et al. 2020). Although conservative estimates project the rate of language loss every 25 years at 2.5% in Sub-Saharan Africa throughout this century, much lower than in other parts of the globe (Simons 2019), many languages lack documentation and reliable population information. Some believe the level of endangerment has been grossly underestimated (Kandybowicz & Torrence 2017; Sands 2017). Africa displays an inclination to shift, from minority languages to locally dominant languages, rather than replace minority languages with a national or global language (Mufwene & Vigouroux 2008). Thus, a small hunter–gatherer population near Ngorongoro Conservation Area in Tanzania that speaks Hadza, a language isolate unrelated to other languages, is shifting to Sukuma, a Bantu language spoken by more than 7 million (Sands 2017). Meanwhile, younger Sukuma speakers no longer acquire TEK due to depleted ecosystems, reduced exposure to the natural environment, and schooling in Tanzania's national language, Swahili (Batibo 2013). Widespread urbanization likely will increase the rate of language shift.

Although most languages co-occurring with Natural WHSs are not endangered by the criteria we considered, the traditional linguistic ecology responsible for maintaining languages and cultures has been threatened by evictions of Indigenous peoples and restrictions on their access to certain ancestral territories (Buhereko 2014; Kidd 2014). Numerous African reserves also were inscribed on the World Heritage List without free, prior, and informed consent of Indigenous residents (African Commission on Human & Peoples' Rights [https://www.achpr.org/]).

Indigenous groups in or near Natural WHSs present extremely important opportunities to engage key local partners in conservation (Berkes 2007). Indigenous people have long associations with particular localities and maintain strong cultural connections with natural elements of those localities (Beltrán 2000). Researchers increasingly view humans as part of ecosystems rather than separate from nature (Orr et al. 2015), suggesting that Indigenous peoples with extended presence in particular places likely contributed substantially to the condition of those localities (Borrini-Feyerabend et al. 2004). This functional connection is important. Much of the globally important natural heritage in Natural WHSs in Africa probably is thanks in large part to the Indigenous people present and their long-term management of resources. Conversely, characteristics of the Indigenous cultural systems are in part due to opportunities and challenges posed by the Natural WHSs where they live.

Engaging local and Indigenous peoples in conserving established protected areas often involves a shift from governance by national or more local government agencies to their sharing governance with rightsholders and stakeholders (Borrini-Feyerabend et al. 2014). This shift involves identifying who sets objectives, makes decisions to meet those objectives, and is accountable for those decisions (Borrini-Feyerabend & Hill 2015).

Conservationists increasingly recognize integrating Indigenous people in the governance of protected areas as acknowledgment of legal or customary rights of those people over the land, water, and natural resources in reserves, creating a moral imperative for Indigenous involvement. However, the role of these peoples in protecting natural resources in reserves prior to formal protection introduces a functional imperative for Indigenous participation in governance as well. Community involvement in managing protected areas in Africa usually takes the form of community conserved areas and generally has positive ecological outcomes tempered by negative or mixed social outcomes (Galvin et al. 2018). Expanding management of high-visibility government reserves to include Indigenous rightsholders will be a big step, one requiring demonstrated social benefits (including cultural–linguistic conservation) to those groups in addition to improved conservation outcomes. Efforts in recent years in Australia and Canada to introduce shared governance of protected areas previously managed by government agencies offer examples of such initiatives (Bauman et al. 2013; Indigenous Circle of Experts 2018). Establishment of the International Indigenous Peoples Forum on World Heritage in 2017 provides a body that represents Indigenous people at World Heritage Committee meetings (International Indigenous Peoples' Forum on World Heritage 2019 [https://iipfwh.org/]). As such, the forum is well-placed to promote shared governance through the World Heritage Committee to the nations that manage Natural WHSs. Indigenous support for renomination as mixed sites already exists in Okavango Delta and Sangha Trinational (Amougou-Amougou & Woodburne 2014; International Indigenous Peoples' Forum on World Heritage 2019), explicitly acknowledging the role of Indigenous people in these 2 WHSs.

Conserving remaining nature and Indigenous languages and cultures on a planet where both are disappearing at alarming rates is an enormous challenge. UNESCO Natural WHSs offer protection for natural resources internationally recognized as globally significant, but as with other protected areas face many challenges. We found that Natural WHSs in Africa often host speakers of Indigenous languages. The high level of co-occurrence, often involving multiple languages, presents opportunities to enlist Indigenous people in the governance of these reserves as key contributors to, or leaders of, their conservation. The broad connection between nature and people likely indicates some functional relationship—a proposition borne out by the correlation between the numbers of species and Indigenous languages in the reserves examined—such that African WHSs cannot persist in the long term without effective protection of the Indigenous cultures whose resource management helped create those sites, and vice versa. Seen in this light, loss of endangered languages or endangered WHSs has broader implications. By promoting shared governance of Natural WHSs, UNESCO can support a strategy that would help conserve not only nature, but also Indigenous languages and the cultural systems that use them in places benefitting from international recognition of their importance. Specific actions would, of course, require field studies first to confirm current Indigenous occupations as well as resident biodiversity, and our results help justify such efforts. Designation of 2022–2032 as the International Decade of Indigenous Languages by the United Nations, with UNESCO serving as lead agency, will provide an excellent opportunity to explore integrated conservation strategies to maintain Indigenous languages at Natural WHSs—through the general emphasis on human rights of Indigenous people and the more precise focus on conserving biodiversity by maintaining and applying TEK (UNESCO 2020). Success at such highly visible reserves could serve as a model for other sites that might also benefit from such strategies but lack the global recognition of World Heritage.

Acknowledgments

Supporting Information

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Literature Cited

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