Received: 15 December 2020 | Revised: 23 June 2021 | Accepted: 27 June 2021

DOI: 10.1111/csp2.496

Conservation Science and Practice
A journal of the Society for Conservation Biology
Open Access
WILEY

PERSPECTIVE

The future of human-chimpanzee coexistence in West Africa: Reconsidering the role of shifting agriculture in chimpanzee (*Pan troglodytes verus*) conservation planning

Vincent Leblan[1,2] | **Serge Pacome Keagnon Soiret**[3,4]

[1]Patrimoines Locaux, Environnement et Globalisation (PALOC), Institut de recherche pour le Développement, Muséum national d'Histoire naturelle, Sorbonne Universités, Paris, France

[2]Institut des Sciences Anthropologiques de Développement (ISAD), Université Félix Houphouët-Boigny, Abidjan, Côte d'Ivoire

[3]Centre Suisse de Recherches Scientifiques en Côte d'Ivoire (CSRS), Adiopodoumé, Côte d'Ivoire

[4]Laboratoire de Zoologie et de Biologie Animale, Université Félix Houphouët-Boigny, Abidjan, Côte d'Ivoire

Correspondence
Vincent Leblan, UMR 208 "Patrimoines Locaux, Environnement et Globalisation" (IRD-MNHN), Muséum National d'Histoire Naturelle, Département Homme et Environnement, 57 rue Cuvier, CP 51, 75231 Paris Cedex 05, France.
Email: vincent.leblan@ird.fr

Abstract

The IUCN has recently updated its 2003 western chimpanzee conservation action plan for the period 2020–2030. Recent estimates find an 80% population reduction occurred between 1990 and 2014. Further, 83% of these chimpanzees are estimated to live outside any high-level protected area. Ivory Coast's drastic chimpanzee decline, within a commercial agriculture setting, has much inspired this new protected area-centered action plan. We discuss two contrasting mechanisms contributing to population decline within Ivory Coast in order to assess their relevance to address range-wide conservation issues. We then consider the role of rotational agriculture, which dominates the subsistence economy of neighboring countries, as either a threat or a part of the solution to this subspecies' conservation. We identify knowledge gaps in three critical areas. First, little is known about the habitat types that have experienced the greatest losses across the range of the western chimpanzee. Second, relatively little is known about chimpanzee use of fallowed agricultural fields. Finally, little is known about farmer's ecological knowledge about chimpanzees and their potential to coexist. Establishing new protected areas over the next decade will likely be as an offset to areas used in infrastructure development, implying that ever larger areas will be lost to subsistence farming. We propose to broaden conservation plans for the western chimpanzee. Specifically, we call for deeper consideration of habitat sharing of agricultural fallows within subsistence agricultural landscapes as a means to foster human-chimpanzee coexistence. A focus on coexistence could help mitigate conservation-subsistence farming conflicts.

KEYWORDS

chimpanzee (*Pan troglodyte verus*), commercial agriculture, conservation planning, fallow vegetation, human-wildlife coexistence, local ecological knowledge, protected area, shifting agriculture, West Africa

1 | INTRODUCTION

The IUCN SSC Primate Specialist Group recently updated its 2003 conservation action plan (Kormos, Boesch, Bakarr, & Butynski, 2003) for the western chimpanzee subspecies *Pan troglodytes verus*. The new action plan is intended to cover the species through 2020–2030 (IUCN, 2020). In 2003, about two-thirds of the 55 priority sites for chimpanzee conservation in West Africa were wholly or partially in protected areas (PA's). This choice may have reflected the limited state of scientific knowledge outside of PA's. The design of the 2020 action plan does not allow a straightforward comparison with that figure, but the recent West African-wide estimates, which have been central to the new action plan, make it possible to draw a more precise picture of how western chimpanzee populations relate to PA's. As much as 83% individuals are estimated to live outside PA's able to afford them institutional protection (Heinicke et al., 2019). The study that prompted the IUCN to upgrade the western chimpanzee to "critically endangered" reported a striking 80% decline in population size from 1990 to 2014 (Kühl et al., 2017). This prompts us to consider whether these steep declines represent a total collapse of populations outside of PA's or severed declines both inside PA's and out. As Ivory Coast's drastic chimpanzee decline reported in the 2000s (Campbell, Kuehl, N'Goran Kouamé, & Boesch, 2008) has much inspired this new PA-centered action plan, we begin by looking at two different mechanisms of chimpanzee population reduction in Ivory Coast. We assess the extent to which the country's economic development of rural areas, based primarily on commercial monoculture and the associated human population growth, accounts for range-wide western chimpanzee population losses. We also reconsider the role of rotational agriculture, which dominates the subsistence economy of neighboring countries, as either a threat or a part of the solution to the subspecies' conservation. If rotational agriculture provides opportunities for conservation, then calling for a better integration of protected and non-protected lands in upcoming conservation plans is warranted.

We focus on knowledge gaps about the habitat types (some of them human-modified) that have suffered the most severe chimpanzee population declines over the subspecies' range. We discuss the potential for chimpanzee dwelling in rotational agricultural fields with successional vegetation, and about farmers' ecological knowledge concerning their coexistence with chimpanzees. We recommend a broader suite of approaches to human-chimpanzee coexistence to include the role of fallows in agricultural settings as potential chimpanzee habitat. We discuss increased involvement with ecological anthropologists in order to address ecological knowledge-building for the planning of chimpanzee conservation in rotational agricultural landscapes.

2 | CHIMPANZEE DECLINE IN A PERENNIAL AGRICULTURE SETTING: THE IVORIAN CASE

Despite a strong majority of western chimpanzees living in unprotected areas, the 2020 action plan emphasizes how PAs in West Africa "frequently serve as the last vestiges of chimpanzee persistence while habitat is lost around them" (IUCN, 2020, p. 45). The IUCN report considers Ivory Coast as emblematic in this regard.

Indeed, chimpanzees were already known to have suffered a 90% population decline since the late 1980s in the Ivory Coast. This chimpanzee decline is explained by a 50% increase in the country's population between 1989 and 2007, inducing high hunting pressure and deforestation; problems that were exacerbated by Ivory Coast's wars in the 2000s. Two striking examples have been used to emphasize this decline: (a) the Marahoué National Park (MNP) where a survey concluded that some 900 chimpanzees were reduced to less than 50, and (b) Taï National Park (TNP) where an estimated 480 chimpanzees were reported as representing a tenth of the former population size (Campbell et al., 2008). These population declines were confirmed by later surveys in 2013, which revealed no signs of chimpanzee presence in MNP and a drop to little more than 300 individuals in TNP (Normand, Dowd, Furnell, & Boesch, 2015). The most recent censuses report the disappearance of chimpanzees from at least 15 PAs in the Ivory Coast (Kühl et al., 2017). While we believe that the majority of these reported chimpanzee extirpations are real, later field observations disprove them in the case of Mont Péko National Park where 67 nests, including 7 fresh ones, were detected during a 5-day survey in April 2018 (Leblan, unpubl. data).

In many cases, however, the decline of chimpanzees has a direct and simple explanation. In the MNP case, the departure of a conservation organization from the area in 2002 was proposed to explain its abrupt chimpanzee decline (Campbell, Kuehl, Diarassouba, N'Goran, & Boesch, 2011). This loss of NGO presence translates as "inadequate law enforcement, lack of immigration controls and poor park management" in the new action plan (IUCN, 2020, p. 5). In other words, the 2002–2011 episode of high political instability in Ivory Coast, which strongly contributed to chimpanzee decline, was removed from these later accounts. However, recent research has detailed how a 93% forest cover reduction within the park

during this period was driven by people displaced in war situations in search of arable land (Kouakou, Coulibaly, Kaba, Anoh, & Courtin, 2018).

In the TNP case, the steep park-wide decline is not mentioned in the new action plan. The park is even described as one among 8 high or stable chimpanzee density sites in the subspecies' range (IUCN, 2020, p. 6). But this report probably concerns only the fraction of the park inhabited by habituated chimpanzees. Here, chimpanzee decline is associated not with habitat loss but with a rise of poaching levels, which are more clearly linked to the 2002–2011 period of civil unrest (Boesch, 2019; Zon, 2016), than to human population pressure. This conclusion can be inferred from the absence of particular worries concerning the park's chimpanzee population (Marchesi, Marchesi, Fruth, & Boesch, 1995) after a 900% human increase had occurred in the park's neighboring districts between 1971 and 1988. This population increase was likely driven by State-led singlecrop farming policies. The conclusion that the rise of poaching levels in the TNP is more clearly linked to civil unrest than to human population pressure is also supported by the absence of any firm evidence as to the effects of Ivory Coast's wars on human population numbers of the TNP region (Schwartz, 2017). The chimpanzee population decline could also be related to various highly lethal diseases, such as Ebola (Formenty et al., 1999) and Anthrax (Leendertz et al., 2004). However, to our knowledge the extreme demographic effects could not be researched outside habituated chimpanzee communities. Interestingly, though, the category "disease" is not listed in the IUCN plan among the top six threats concerning chimpanzees living in "large, continuous forests", as in TNP. It concerns only those inhabiting "small fragmented forests" and "agricultural mosaics" (table 3, p. 10), implying that only those diseases that can be more easily traced to human activities would be a major threat to chimpanzee conservation. This unbalanced analysis of disease threats by the IUCN primate specialist group, not considering the risk of chimpanzee to chimpanzee spread in larger continuous forests, reflects a bias against conservation opportunities in non-protected areas.

Overall, then, MNP and TNP exhibit highly contrasted mechanisms of chimpanzee population reduction, amidst very high human population growth related to Ivory Coast's plantation economy. As recognized by Kühl et al. (2017), Ivory Coast's economic development of rural areas centered on a monoculture export policy has led to unparalleled chimpanzee habitat loss in West Africa. This is well expressed by the fact that their 20% range-wide reduction since 1990 is almost totally centered on this country. Ivory Coast, along with Ghana, exhibits the region's lowest rates of cultivated surfaces allocated to crops for direct human consumption (as low as 30% of total cultivated land). By contrast, this rate reaches 80 to 100% in neighboring countries (Foley et al., 2011, Figure 1, no data for Liberia).

Ivory Coast's perennial commercial agriculture has thus induced very high tensions with conservation agendas, on PA peripheries and often within them. We suggest, in light of this, a need to reconsider the role of shifting subsistence agriculture as either a threat or a part of the solution to the subspecies' conservation in places where this remains the dominant land use.

3 | WESTERN CHIMPANZEES' COEXISTENCE WITH SHIFTING CULTIVATORS

The notion of an 80% population drop over 24 years in West Africa is hard to reconcile with the fact that 83% of chimpanzees still live outside any high-level PA. This is especially true because the 90% drop in Ivory Coast (Campbell et al., 2008) went along with the near total elimination of chimpanzees outside PAs. These contrasting situations imply very different conservation challenges. What factors could have triggered a decline of this magnitude? Given the Ivorian evidence, it appears that overhunting, habitat loss, and disease are all involved to some degree. However, as the 80% range-wide decline was mainly calculated from PAs (19/20 of the sampled sites), there is a clear data bias given that 83% of chimps were later reported to be living outside these surveyed areas (Heinicke et al., 2019). We agree that chimpanzee population losses outside of PA's have also likely been substantial. However, we do not precisely know which areas of the subspecies' range (outside of Ivory Coast) and which of the land use types referred to in the IUCN plan (a) agricultural mosaics, (b) large and continuous forests, (c) savanna mosaics, (d) small and fragmented forests) have experienced the most severe declines. This is an important data gap that constrains the capacity to infer that conservation can only succeed within PA's.

The IUCN action plan (table 3, p. 10) considers subsistence agriculture as a "high" threat to chimpanzees (i.e., concerning 31–70% of the population before 2030, p. 71) in all types of land use, with the unsurprising exception of agricultural mosaics in which this threat is rated as "very high." But it then inconsistently ends up summarizing it as "very high" (i.e., concerning 71–100% of the population before 2030) across the four types of land use. In addition, it is not clear how these scores simultaneously represent the percentage of the subspecies' population likely to be affected by the identified threats, the severity of threats and their possible irreversibility as claimed p. 71–72.

(a)

(b)

(c)

FIGURE 1 Representing slash-and-burn agriculture as destructive (a) undergoing regrowth (b & c)—Guinea, Tristao Islands, 2009. © Vincent Leblan. (a) Recently cut and burnt patch of fallow vegetation. (b) Vegetation regrowth 2 years old containing 5 oil palm chimpanzee nests. (c) Vegetation regrowth several years old containing tens of oil palm chimpanzee nests (background)

That a significant proportion of western chimpanzee populations are found within subsistence agriculture settings outside of Ivory Coast is not surprising. This has been the case in various peri-Fouta Djalon localities (Guinea, Senegal), for example, for more than a century (Leblan, 2014). In fact, high chimpanzee densities are still found in this region today (Heinicke et al., 2019). However, only 5% of all western chimpanzees are reported to live in cropland habitat, as opposed to savanna-mosaic habitat (78%) and forest-dominated habitat (16%) (Heinicke et al., 2019). In this vegetation classification, the cropland category encompasses both "croplands" ("lands covered with temporary crops followed by harvest and a bare soil period") and "natural vegetation mosaic" (i.e., "forests, shrublands and grasslands") (Loveland & Belward, 1997).

We argue that this opposition between agriculture and natural vegetation categories misses the various stages of vegetation succession in which chimpanzees also dwell. This blind spot is also obvious in studies of chimpanzee diets in agricultural environments, which focus on crop foraging and treat all other foods as "wild foods" (e.g. Garriga, Marco, Casas-Días, Amarasekaran, & Humle, 2018; Hockings & McLennan, 2012), that is, independently of the successional stages in which they also grow. The way slash-and-burn agriculture is depicted in the two IUCN action plans follows the same pattern (Kormos et al., 2003, p. 131, 139; IUCN, 2020, p. 13): it is systematically represented by photographs of burnt land rather than fallow vegetation (Figure 1). In addition, some of the shrublands comprised within this classification's savanna-mosaic habitat could derive from shifting agriculture as well. For example, chimpanzees are systematically reported in the vicinity of Northwestern Guinea's villages, an area defined as savanna-mosaic habitat (Heinicke et al., 2019) in which, noteworthy, shifting agriculture is by far the main human subsistence activity (Brugière, Badjinca, Silva, & Serra, 2009). Overall, a better discrimination of fallows and their inclusion in the definition of agricultural surfaces would lead to a more accurate picture of how chimpanzees relate to rotational agriculture areas.

To our knowledge, three studies, not cited in the new action plan, emphasize the importance of successional habitats' food resources to some western chimpanzees. At Bossou, in the forest region of Southeast Guinea, more than half of the habitat consists of a mix of secondary forests 15–70 years age. These habitats offer abundant and diverse food species, with old fallow vegetation potentially containing a diversity of available saplings whose phenology yet needs to be investigated (Bryson-Morrison, Matsuzawa, & Humle, 2016). In Northwestern Guinea (Boké region), although chimpanzees' preferred foods are mainly distributed in riparian forests and other dense forests, up to 1/3 (Bourounda) and more than 50% (Niama Yara) of all food resources include successional habitats

among their main habitat types (Leblan, 2017). These studies echo another one conducted on Tiwai Island, Sierra Leone, which describes chimpanzees selecting regrowth habitats more often than expected (Fimbel, 1994).

The description of suitable chimpanzee habitat by means of an agriculture/forest dichotomy is thus obviously accurate in the case of Ivory Coast's monoculture, but cannot be systematically extrapolated to all of West Africa, even though a steep population decline was documented at this scale. Significant densities of chimpanzees are reported from some agroecosystems in Guinea (Leblan, 2017) and Sierra Leone (Brncic et al., 2015, Garriga et al., 2018). In Northwestern Guinea, the closed shrublands comprised of dense and thorny successional vegetation are not only a source of food, but also act as a buffer between humans and chimpanzees. Chimpanzees appear to easily navigate this dense vegetation, in contrast to the human inhabitants, which may partly explain why chimpanzees persist there. Although, local religious practices also forbid their consumption (Leblan, 2017).

Chimpanzees' tolerance of relative levels of cropland versus fallow lands of various ages needs further investigation. The most comprehensive review to date of vertebrate species diversity in West African forest-agriculture mosaics reveals lower species richness in successional habitats than in older secondary forests (Norris et al., 2010). However, among vertebrates, this study considered only a selection of birds, amphibians and small mammals (with a focus on the rainforest biome). In contrast, various types of fallow have been reported to buffer human presence for large mammals such as antelopes, chimpanzees and elephants (Marchesi et al., 1995), mountain gorillas (Hockings & Humle, 2009) and probably pygmy hippopotamuses (Hillers et al., 2017). The potential conservation value of rotational agricultural landscapes is further supported by evidence of brushy follow vegetation as an obstacle to large mammal hunting because of poor visibility (Naughton-Treeves & Salafsky, 2004). Similarly, agents of Mont Péko National Park, Ivory Coast, report in 2021 a recent drop of poaching levels following the colonization of destroyed cocoa plantations by impenetrable successional vegetation (Amani and Leblan, unpubl. data).

For farmers of the Boké region of Guinea, the "cropland" and "forest" categories actually only refer to the two extremities of a gradient of diverse farming opportunities, encompassing multiple stages of vegetation regrowth from early succession to old forest. This echoes other tropical farming practices in which "shifting cultivators see forests and gardens as part of a dynamic agricultural system that continually rotates through the processes of ecological succession" (Wilkie & Lee, 2004). This dynamic categorization of landscape mosaics, derived from farmers' knowledge and experience, should invite us to take seriously the complex pattern of the habitats they share with chimpanzees (Leblan, 2017). It is not clear, however, how seriously "local ecological knowledge" (IUCN, 2020, p. 31) is considered in the new action plan, nor what this document refers to when mentioning this concept. Indeed, the description of human inhabitants' cognition throughout the IUCN plan is limited to "superstitious practices," "taboos" or "beliefs" about chimpanzees. The IUCN plan fails to explicitly acknowledge local knowledge of vegetation management for rotational agriculture that provides any auxiliary environmental benefits. This simply does not jibe with our experiences in working with such people. In addition to the plan's emphasis on subsistence agriculture as a main threat, and on PAs as a main conservation tool, the limited perspective of inhabitant's cognition of their agricultural matrix strongly suggests that the integration of farmers' ecological knowledge in upcoming conservation actions is unlikely. The inclusion of ecological anthropologists in the IUCN species specialist group would help overcome such limitations.

4 | CONCLUSION

Although a 2019 IUCN motion promoted great ape conservation in non-protected areas (https://www.iucncongress2020.org/fr/motion/115/58217), obstacles remain to achieve that goal. Rotational crop agriculture is still too readily blamed for the decline of chimpanzee population in the new action plan. The evidence from various West African regions presented here suggests that the story is likely more complex. The IUCN working group recommendations lack a socio-ecological context that allows for nuanced strategies taking different agricultural systems into account (Table 1). Conservation practice should rely on any available scientific evidence (including doubts and unanswered questions) and be much more contextual.

As mentioned in the IUCN plan (p. 43), addition of new or expanded PAs over the next decade will be as an offset to areas used in infrastructure development (roads and dams), industrial agriculture, logging and mining. This implies that ever larger areas will be lost to subsistence farmers. The loss of land currently used for subsistence agriculture exacerbates conditions for land-use conflicts with institutional conservation stakeholders. This will probably happen even where no significant human-chimpanzee conflicts were initially reported (Leblan, 2016). Although the IUCN has already promoted strategies to favor human-ape coexistence with a focus on crop feeding issues (Hockings & Humle, 2009), more research is needed to understand how complementary stages of vegetation regrowth are frequented by chimpanzees and may sustain them. This is especially the case in regions where chimpanzee densities are considered

TABLE 1 Framework of chimpanzee conservation outcomes in perennial singlecrop agriculture Vs shifting cultivation systems, as detailed in the article. Each broad type of agriculture implies opposite modes of separation between humans and chimpanzees (row 1), which generate specific spatial–temporal properties (row 2), which in turn are related to divergent conceptions of local knowledge (row 3)

	Perennial singlecrop agriculture	**Shifting subsistence agriculture**
Type of human-chimpanzee buffer	Enforced administrative boundaries through protected areas	Spontaneously growing impenetrable successional vegetation
	Imposed on/saved from farmed areas	Generated by/constituent of farming practices
Spatio-temporal implications	Mutually exclusive conservation and farming	Conservation-farming matrix
	Opposition between natural and agricultural vegetation	Continual rotation from cropland to old growth vegetation
	Static, permanent separation	Cyclical, dynamic space occupation by humans and chimpanzees
Related view of local knowledge	Superstitious practices and beliefs about chimpanzees	Practical, experiential, ecological knowledge about interspecific coexistence

significant. Conservation plans should better match the extent and socio-ecological diversity found within the current chimpanzee range. This should be considered by the IUCN with a view to start building links between conservation research and action in non-protected areas, where a majority of western chimpanzees still live.

UNESCO's "cultural landscape" approach (whc.unesco.org/en/culturallandscape/), which recognizes conservation value to certain types of local ecological knowledge and practices, could inspire more inclusive action plans for the western chimpanzee and help to enlarge the conservation focus on the value of shifting agriculture areas. Another inspiring concept is that of "voluntary natural reserves," a recent type of PA in Ivory Coast designed to better involve local communities, and which could be developed alongside current Ivorian PAs in commercial agriculture areas where chimpanzees are still found (Soiret et al., 2019). These practices could possibly inspire similar actions in neighboring countries. Discarding an antiquated fixation on "superstitions" and "beliefs" in favor of full attention to genuine local ecological knowledge would be an important step in favor of the communities' "local engagement" (IUCN, 2020, p. 15) expected in the next decade.

ACKNOWLEDGMENTS

This article was written with the support of IRD (French National Research Institute for Sustainable Development). Thanks to Amanda Leblan and Mark Schwartz for proofreading in English, and to a couple of reviewers for their helpful comments.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHOR CONTRIBUTIONS

Vincent Leblan conceived of the paper and led design. Vincent Leblan and Serge Soiret conducted the literature search. Vincent Leblan wrote the first draft with input from Serge Soiret, who also revised the manuscript before submission.

ETHICS STATEMENT

Institutional ethics review was not required. The manuscript only used the opinions of the authors.

ORCID

Serge Pacome Keagnon Soiret https://orcid.org/0000-0001-6773-500X

REFERENCES

Boesch, C. (2019). War and peace in the Taï chimpanzee forest: Running a long-term chimpanzee research project. In C. Boesch, R. Wittig, C. Crockford, L. Vigilant, T. Deschner, & F. Leendertz (Eds.), *The chimpanzees of the Taï Forest: 40years of research* (pp. 1–27). Cambridge, UK: Cambridge University Press.

Brncic, T., Amarasekaran, B., McKenna, A., Mundry, R., & Kühl, H. S. (2015). Large mammal diversity and their conservation in the human-dominated land-use mosaic of Sierra Leone. *Biodiversity and Conservation*, *24*, 2417–2438.

Brugière, D., Badjinca, I., Silva, C., & Serra, A. (2009). Distribution of chimpanzees and interactions with humans in Guinea-Bissau and Western Guinea, West Africa. *Folia Primatologica*, *80*, 353–358. https://doi.org/10.1159/000259335

Bryson-Morrison, N., Matsuzawa, T., & Humle, T. (2016). Chimpanzees in an anthropogenic landscape: Examining food resources across habitat types at Bossou, Guinea, West Africa. *American Journal of Primatology*, *78*, 1237–1249. https://doi.org/10.1002/ajp.22578

Campbell, G., Kuehl, H., N'Goran Kouamé, P., & Boesch, C. (2008). Alarming decline of West African chimpanzees in Côte d'Ivoire. *Current Biology*, *18*, 903–904. https://doi.org/10.1016/j.cub.2008.08.015

Campbell, G., Kuehl, H., Diarassouba, A., N'Goran, P. K., & Boesch, C. (2011). Long-term research sites as refugia for threatened and over-harvested species. *Biology Letters*, *7*, 723–726. https://doi.org/10.1098/rsbl.2011.0155

Fimbel, C. (1994). The relative use of abandoned farm clearings and old forest habitats by primates and a forest antelope at Tiwai, Sierra Leone, West Africa. *Biological Conservation*, *70*, 277–286. https://doi.org/10.1016/0006-3207(94)90173-2

Foley, J. A., Ramakutty, N., Brauman, K. A., Cassidy, E. S., Gerber, J. S., Johnston, M., ... Zaks, D. P. M. (2011). Solutions for a cultivated planet. *Nature*, *487*, 337–342. https://doi.org/10.1038/nature10452

Formenty, P., Boesch, C., Wyers, M., Steiner, C., Donati, F., Dind, F., ... Le Guenno, B. (1999). Ebola virus outbreak among wild chimpanzees living in a rain forest of Côte d'Ivoire. *The Journal of Infectious Diseases*, *179*, S120–S126. https://doi.org/10.1086/514296

Garriga, R. M., Marco, I., Casas-Días, E., Amarasekaran, B., & Humle, T. (2018). Perceptions of challenges to subsistence agriculture, and crop foraging by wildlife and chimpanzees *Pan troglodytes verus* in unprotected areas in Sierra Leone. *Oryx*, *52*, 761–774. https://doi.org/10.1017/S0030605316001319

Heinicke, S., Mundry, R., Boesch, C., Amarasekaran, B., Barrie, A., Brncic, T., ... Kühl, H. S. (2019). Advancing conservation planning for western chimpanzees using IUCN SSC A.P.E.S.—The case of a taxon-specific database. *Environmental Research Letters*, *14*, 064001. https://doi.org/10.1088/1748-9326/ab1379

Hillers, A., Buchanan, G. M., Garteh, J. C., Tommy, S. M., Fofana, M. L., & Lindsell, J. A. (2017). A mix of community-based conservation and protected forests is needed for the survival of the endangered pygmy hippopotamus *Choeropsis liberiensis*. *Oryx*, *51*, 230–239. https://doi.org/10.1017/S003060531600020X

Hockings, K., & Humle, T. (2009). *Best practices guidelines for the prevention and mitigation of conflicts between humans and great apes*. Gland, Switzerland: IUCN SSC Primate Specialist Group. https://doi.org/10.2305/IUCN.CH.2009.SSC-OP.37.en

Hockings, K., & McLennan, M. (2012). From forest to farm: Systematic review of cultivar feeding by chimpanzees—Management implications for wildlife in anthropogenic landscapes. *PLoS One*, *7*, e33391. https://doi.org/10.1371/journal.pone.0033391

IUCN SSC Primate Specialist Group. (2020). *Regional action plan for the conservation of western chimpanzees (Pan troglodytes verus) 2020–2030*. Gland, Switzerland: IUCN.

Kouakou, A. C. A., Coulibaly, B., Kaba, D., Anoh, K. P., & Courtin, F. (2018). Dynamique de peuplement et modification paysagère dans le parc national de la Marahoué (Côte d'Ivoire). *Tropicultura*, *36*, 206–216.

Kormos, R., Boesch, C., Bakarr, M. I., & Butynski, T. M. (Eds.). (2003). *West African chimpanzees: Status survey and conservation action plan*. Gland, Switzerland and Cambridge, UK: IUCN SSC Primate Specialist Group.

Kühl, S. K., Sop, T., Williamson, E. A., Mundry, R., Brugière, D., Campbell, G., ... Boesch, C. (2017). The critically endangered western chimpanzee declines by 80%. *American Journal of Primatology*, *79*, e22681. https://doi.org/10.1002/ajp.22681

Leblan, V. (2014). The impact of west African trade on the distribution of chimpanzee and elephant populations (Guinea, Guinea-Bissau, Senegal, 19th-20th century). *Human Ecology*, *42*, 455–465. https://doi.org/10.1007/s10745-014-9654-8

Leblan, V. (2016). Territorial and land-use rights perspectives on human-chimpanzee-elephant coexistence in West Africa (Guinea, Guinea-Bissau, Senegal, nineteenth to twenty-first centuries). *Primates*, *57*, 359–366. https://doi.org/10.1007/s10329-016-0532-4

Leblan, V. (2017). *Aux frontières du singe. Relations entre hommes et chimpanzés au Kakandé, Guinée (XIXe-XXIe siècle)*. Paris: Editions de l'Ecole des Hautes Etudes en Sciences Sociales.

Leendertz, F. H., Ellerbrok, H., Boesch, C., Couacy-Hymann, E., Mâtz-Rensing, K., Hakenbeck, R., ... Pauli, G. (2004). Anthrax kills wild chimpanzees in a tropical rainforest. *Nature*, *430*, 451–452. https://doi.org/10.1038/nature02722

Loveland, T. R., & Belward, A. S. (1997). The International Geosphere Biosphere Programme data and information system global land cover data set (DISCover). *Acta Astronautica*, *41*, 681–689. https://doi.org/10.1016/S0094-5765(98)00050-2

Marchesi, N., Marchesi, P., Fruth, B., & Boesch, C. (1995). Census and distribution of chimpanzees in Côte d'Ivoire. *Primates*, *36*, 591–607.

Naughton-Treeves, L., & Salafsky, N. (2004). Wildlife conservation in agroforestry buffer zones: Opportunities and conflict. In G. Schroth, G. A. B. da Fonseca, C. A. Harvey, C. Gascon, H. L. Vasconcelos, & A. M. N. Izac (Eds.), *Agroforestry and biodiversity conservation in tropical landscapes* (pp. 319–345). Washington: Island Press.

Normand, E., Dowd, D., Furnell, S., & Boesch, C. (2015). *Baseline assessment of chimpanzee and elephant populations in the Mano River union countries—Côte d'Ivoire, Liberia, Sierra Leone and Guinea (2007–2014)*. Cologny, Switzerland: Wild Chimpanzee Foundation.

Norris, K., Asase, A., Collen, B., Gockowksi, J., Mason, J., Phalan, B., & Wade, A. (2010). Biodiversity in a forest-agriculture mosaic—The changing face of West African rainforests. *Biological Conservation*, *143*, 2341–2350. https://doi.org/10.1016/j.biocon.2009.12.032

Schwartz, A. (2017). Remarques sur l'article de Bertin Kadet: « L'ouest forestier ivoirien: enjeux et problèmes d'une zone grise ». *Les Cahiers d'Outre-Mer*, *271*, 437–458. https://doi.org/10.4000/com.7789

Soiret, S., Kouakou, C. Y., Koffi, J.-C., Kadjo, B., Kouassi, P., Gomez, P. J., ... Koné, I. (2019). The diversity and conservation of mammals in the Dodo coastal forest in southwestern Côte d'Ivoire, western Africa: A preliminary study. *Journal of Threatened Taxa*, *11*, 13654–13666. https://doi.org/10.11609/jott.4641.11.6.13654-13666

Wilkie, D. S., & Lee, R. J. (2004). Hunting in agroforestry systems and landscapes: Conservation implications in west-central Africa and southeast Asia. In G. Schroth, G. A. B. da Fonseca, C. A. Harvey, C. Gascon, H. L. Vasconcelos, & A. M. N. Izac (Eds.), *Agroforestry and biodiversity conservation in tropical landscapes* (pp. 346–370). Washington: Island Press.

Zon, D. A. (2016). *Le braconnage dans les parcs nationaux en Côte d'Ivoire: cas du Parc national de Taï*. PhD thesis, Félix Houphouët-Boigny University.

How to cite this article: Leblan, V., & Soiret, S. P. K. (2021). The future of human-chimpanzee coexistence in West Africa: Reconsidering the role of shifting agriculture in chimpanzee (*Pan troglodytes verus*) conservation planning. *Conservation Science and Practice*, *3*(9), e496. https://doi.org/10.1111/csp2.496