

# The impacts of climate change, population growth and land-use change on protected areas in Africa

July 18 2022

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Africa's protected areas are considered the last strongholds of the continent's unique biodiversity. Credit: Martens/Senckenberg

Ph.D. student Carola Martens together with other researchers from Senckenberg and South Africa's Stellenbosch University has investigated how climate change could affect vegetation in protected areas in Africa. In their study, which was published in the journal *Conservation Biology*, the team shows where these effects may coincide with population growth and land use changes. According to their simulations, biodiversity in almost all protected areas will be threatened by at least one of these factors by the end of the 21st century.

African elephant, white rhinoceros, leopard, Cape buffalo, and lion—the "Big Five" are symbolic of Africa's unique wildlife. "Africa's [protected areas](#) harbor a far greater biodiversity than just these five iconic animals. They are the last strongholds of the continent's unique biodiversity," explains Carola Martens of the Senckenberg Biodiversity and Climate Research Center (SBIK-F) and Goethe University Frankfurt, and she continues, "But this diversity is threatened by [climate](#) change, [population](#) growth, and future land-use changes."

Martens and her colleagues Prof. Dr. Thomas Hickler (SBIK-F), Dr. Simon Scheiter (SBIK-F), and Prof. Dr. Guy F. Midgley (Stellenbosch University) have studied the future impacts of climate-induced vegetation changes in Africa's protected areas, incorporating population density and land use, for two scenarios up to the end of the 21st century. Their modeling study aims to show where the three factors will be important in the coming decades and where they may interact—in order to support meaningful conservation planning. "Climate change is increasingly threatening biodiversity as vegetation zones and habitats change for many species. In addition, the growing world population combined with globally rising living standards requires more and more land for food production, to meet the rising demand for meat, and for bioenergy. We can only halt biodiversity loss if we understand the interactions between climate change, population growth, and land use," says Martens explaining the approach.

The simulations were carried out using the "adaptive dynamic global vegetation model" (aDGVM) for the following two scenarios: The "middle-of-the-road" scenario in which current societal developments continue and some climate change mitigation measures are adopted, and the "fossil-fueled development" scenario. In the latter, social and [economic development](#) is based on the increased exploitation of fossil fuel resources with a high coal content and an energy-intensive lifestyle worldwide. In addition, the researchers analyzed global scenarios for the development of the human population and of land use.

"The results show that in both scenarios, [tree cover](#) generally increases in today's grasslands and savannas in Africa. For protected areas in West Africa, our analyses revealed climate-induced vegetation change combined with high future population and land use pressures. Only for North Africa, we expect that a large share of protected areas to be without vegetation changes in combination with decreased pressure from population and land use—generally, the pressure on protected areas is therefore increasing," says the researcher. According to the study, the "fossil-fueled development" scenario resulted in greater climate-induced changes in tree cover and higher land-use pressure at the continental scale, while the "middle-of-the-road" scenario was characterized by higher future population pressure.

"Our work demonstrates that in the future, almost all protected areas are threatened by at least one factor: climate change leading to major vegetation changes, a large increase in the population around the protected area, or growing land-use pressure. The biodiversity of protected areas in West Africa may be particularly affected by this—facing a combination of strong [climate change](#) impacts, [population growth](#), and land-use changes," says Martens, and she provides an outlook: "A sound understanding of individual socio-economic and ecological conditions as well as of existing or potential future conflicts is an important basis for the planning of protected areas. Conservation and

protection strategies need to be regionally and locally adapted. This can contribute to the protection of the unique diversity of Africa's ecosystems."

**More information:** Carola Martens et al, Combined impacts of future climate-driven vegetation changes and socioeconomic pressures on protected areas in Africa, *Conservation Biology* (2022). [DOI: 10.1111/cobi.13968](https://doi.org/10.1111/cobi.13968). [conbio.onlinelibrary.wiley.com ... i/10.1111/cobi.13968](https://onlinelibrary.wiley.com/doi/10.1111/cobi.13968)

Provided by Senckenberg Research Institute and Natural History Museum

Citation: The impacts of climate change, population growth and land-use change on protected areas in Africa (2022, July 18) retrieved 3 May 2024 from <https://phys.org/news/2022-07-impacts-climate-population-growth-land-use.html>

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