

# Chapter 20

## Conclusions: Biodiversity Research and Conservation Opportunities



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**Abstract** Angola is a country full of opportunities. Few countries offer more exciting prospects for young scientists to discover and document the rich biodiversity, complex ecosystem processes and undescribed species of plants and animals that are to be found in its amazing diversity of landscapes and seascapes. The current expanding support of the Angolan government and of international partners is unprecedented, and the positive response from young students ensures the growth of a new generation of biodiversity researchers and conservation professionals. Based on a synthesis of biodiversity research and conservation activities of the past century, we outline opportunities, approaches and priorities for a strengthened collaborative research and conservation agenda.

**Keywords** Africa · Angola · Biological discovery · Checklists · Endemic species · Research priorities · Science collaboration · Socio-ecological systems · Threatened species

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## **Context: Challenges and Opportunities**

This book was conceived on the basis of three simplistic assumptions. First, that very little information is available on the biodiversity of Angola. The second assumption was that colonial governments had neglected, and post-independence authorities have been unsupportive of research on the fauna, flora and ecosystems of Angola. Thirdly, we assumed that existing biodiversity knowledge was mostly lost in dusty government archives or inaccessible scientific journals. In truth, the rich assemblage of information gathered together in this synthesis volume demonstrates the error of these assumptions. The perceived challenges of the past have become a mosaic of opportunities for the future.

The energy, knowledge and dedication of this book's 46 contributing authors has resulted in a comprehensive synopsis of the 'state of science' on the evolution and diversity of Angola's landscapes, flora, vegetation, all vertebrates, two iconic invertebrate taxa, and key ecosystems in both marine and terrestrial environments. What is immediately obvious from each chapter is the wealth of Angola's natural heritage, and how fragile it is to anthropogenic impacts and the vicissitudes of climate change. The vulnerability of the remnant forests of Angolan Escarpment and Afromontane ecosystems to these pressures places a tremendous responsibility on Angolans to study and protect these fingerprints of the past. Angola's universities, scientific organisations and government research institutions can lead the way to strengthening our understanding of the evolution, structure and functioning of these and the many other special habitats that make Angola unique in Africa in terms of the diversity of biomes and ecoregions found within its borders.

Each chapter of this volume reveals research and conservation opportunities relevant to the environment or taxon under discussion and presents compelling arguments for greater levels of investment in both research and conservation. Some needs are very specific, such as the importance of biodiversity surveys, vegetation maps and socio-economic assessments of the country's many protected areas as a basis to achieving their effective management and the delivery of long-term benefits to society. Other priorities are more broadly based, aimed at developing tools for wide-scale natural resource-use planning, such as a new and detailed vegetation map for the entire country, building on the results of the current forest inventory, and for a national biodiversity data portal. Yet others focus on selected taxa that can help, through modern genomic studies, to explain the processes of speciation that have led to the richness of the country's flora and fauna. All have a common purpose – to effectively inform decisions that will ensure increasingly sustainable development for all Angolans and for humanity at large.

## Towards a Biodiversity Conservation Research Strategy

Over 40 research topics are identified in the chapters of this volume. Such compilations of research opportunities need to be embraced within national strategies, matching needs with resources and priorities within a research agenda, while understanding the country's challenges. In recent decades, a first point of departure in the design of conservation science programmes has been the frameworks provided by international multilateral environmental conventions – most specifically the Convention on Biological Diversity to which Angola has been a signatory since 1998. The development of Angola's National Biodiversity Strategy and Action Plan (NBSAP) brought a logical structure to both policy and planning (GoA 2006, 2018). These strategies have been further developed through setting nationally relevant implementation goals such as those detailed in the Aichi Targets (CBD 2010). An early lesson learned in the implementation of such strategies was the fundamental importance of cooperative partnerships between multiple institutions. The global scarcity of taxonomists, for example, has meant that no single country has the capacity to study, understand and document all taxa and ecosystems. The strength of organisations such as IUCN, GBIF, IPBES, etc., is based on shared information and skills. The benefits of the recent surge of interest in Angola's biodiversity demonstrated by foreign universities, museums, non-governmental organisations and intergovernmental agreements have yet to be fully exploited. For this, a strategic approach, implemented opportunistically, is advantageous.

Building a programme of work for conservation science needs to be mobilised at several levels, often simultaneously, rather than sequentially. At a first level, biodiversity assessments are a priority. Biodiversity surveys, which provide both the building blocks of knowledge and unique training and capacity building opportunities, must maintain the positive momentum of the past decade. The preliminary checklists of species presented in this volume should be regularly updated and expanded to integrate these and other taxonomic groups through an electronic biodiversity data portal. Ideally, international institutions, in liaison with national hosts, should assist in the coordination and curation of checklists, atlases and field guide-books such as those already available for the reptiles and amphibians of Cangandala National Park (Ceríaco et al. 2016), the 'special birds' of Angola (Mills 2018) and the atlas of Angolan reptiles and amphibians (Marques et al. 2018). Checklists and the natural history collections on which they are based need integration within international databases such as those of GBIF and the Catalogue of Life. A direct outcome of this component of research is the development of taxonomic skills and of para-taxonomists in Angola.

Second, the socio-ecological systems within which research and conservation play out should not be neglected. Biodiversity does not exist in a vacuum – it has a human face that governs the success or failure of interventions. Biodiversity scien-

tists who ignore the human dimensions of research and conservation do so at their peril. This is especially true within and around formal protected areas, where studies are needed on the socio-economic drivers of change (from a subsistence to a cash-based economy in rural areas), and the impacts of the bushmeat trade, slash-and-burn agricultural practices, charcoal production and nomadic pastoralism, on biodiversity conservation across the country. Such studies should also draw on local indigenous knowledge in developing management plans and research projects. At a regional scale, the assessment of the role of ecosystem services for sustainable living in rural and urban environments provides information essential to long-term development planning, ideally guided by a new and detailed vegetation map of Angola. The interdependence of basic research, biodiversity assessments and applied studies is obvious.

Third, there is no questioning the paramount importance of strengthening the capacity of young Angolan researchers and of research institutions. These actions should be framed within a collaborative and mutually beneficial strategy. International collaboration is already assisting in this, but needs further support. Scholarships, internships and mentoring programmes are fundamental, but field experience is critical for young biodiversity researchers, and the promotion of bush camps for student training in protected areas and biodiversity hotspots is a highly effective mechanism for inspiring the new generation. The establishment of a virtual network of Angolan conservation professionals using social media such as the *Angola Ambiente* Facebook site is a highly effective initiative. Angolan institutions also need strengthening and closer cooperation across government departments, and the integration of their research results through a formal information portal, is a key opportunity.

## Research Opportunities from Genes to Landscapes

While the above three pillars form the foundations of a nascent biodiversity conservation research agenda, with an emphasis on immediate and practical needs, there are many fascinating questions relating to the functioning of Angola's diverse ecosystems that challenge the minds of biologists as they explore the country. The research strategy should be reinforced by studies on the evolutionary and ecological processes that account for Angola's biodiversity. An understanding of the evolution of Angola's biota will be strengthened by the development of modern phylogenies of key taxonomic groups, as proposed in many to the chapters of this volume. An understanding of the evolution of species assemblages and of individual species is of great value to guiding conservation measures, as already demonstrated by the Angolan studies of Vaz da Silva (2015) and Vaz Pinto (2018). Advanced molecular technologies allow new insights into many patterns revealed by basic surveys and assessments. The population genetics and hybridisation of Angola's two elephant

species needs urgent study before the last remnants of Forest Elephant are driven to extinction. Similarly, iconic plants such as the baobab *Adansonia digitata* that in Angola manifests as widely divergent phenotypes, from dwarf baobabs in Namibe to the obese giants of Cunene and the slender columns of Cuanza-Norte, merit studies on their genetic diversity, ecology and traditional uses. Angola's once vast populations of *Welwitschia mirabilis* await research on their population dynamics and potential resilience to overgrazing by cattle in Iona National Park. The bizarre patterns of 'fairy circles' of the Namib, 'fairy forests' of the Lundas and Moxico, of dwarf succulents along the desert margins of Benguela, and the ecological role of fog along the entire coast, are all ecological puzzles that need elucidation.

Many of these topics might at first sight appear of little more than academic interest, but every element of applied science and technology rests on the fundamentals of curiosity-driven enquiry. The baseline compilation of checklists leads to the identification of patterns of endemism and rarity, to be understood through phylogeographic studies across the country. From such studies, increasingly robust scenarios of evolutionary processes may be built. It is these phenomena of the patterns in nature, their ecological functioning and the interactions that drive large-scale environmental dynamics that will ultimately guide sustainable landuse management and inform responses to the impacts of climate change. It is at the level of landscapes and seascapes that the nation's economy and progress is built, and such wide-horizon visioning, underpinned by fundamental research, is needed for the sustainable development agendas of the twenty-first century.

At a landscape scale, an early priority should be to update the vegetation map of Angola to give a more balanced and objective delineation of the country's major vegetation units, for landuse planning and conservation purposes. This can best be achieved with the input of a multi-national team of workers, using modern remote sensing technologies for vegetation classification, mapping and monitoring. Vegetation classification and mapping skills take many years, even decades to develop, and the close collaboration, even leadership, of foreign experts would be valuable. An improved vegetation map will help expedite assessments of ecosystem conservation status, landuse potential, research priorities and opportunities, and help develop a predictive understanding of ecosystem structure and function.

At ecosystem scale, the importance of securing the effective management of protected areas, large and small, terrestrial and marine, is a *sine qua non* to the future of Angola's biodiversity. The biological and cultural importance of relatively small protected areas, such as Ilhéu dos Pássaros, and future protected areas such as Mount Moco, Namba, Cumbira, Tundavala and the rainforests of Cuanza-Norte, Uíge and Zaire, and of turtle nesting grounds along the coast, should not be overlooked during the pursuit of mega-parks that might excite the public and motivate politicians. Targeted studies of the existing protected areas and of the key biodiversity hotspots identified by the Ministry of Environment in successive strategies (GoA 2006, 2011, 2018) should be given priority, as these protected areas and hotspots most probably hold more than 80% of Angola's floral and faunal diversity in less than 15% of the

country's land area. As training grounds for young biologists and conservation scientists, protected areas have no equal. Furthermore, identifying and rigorously protecting near-pristine zones within otherwise threatened protected areas such as Quiçama, Luando, Iona and Mupa, and of the country's extensive coastline, should be an integral part of any protected areas strategy. The marine environment is especially sensitive to the impacts of human activities and science-based marine spatial planning is essential if long-term conflicts between humans and the marine environment are to be avoided. The importance of a focus on the biodiversity hotspots and on the existing protected areas of Angola – the repositories of the country's natural wealth – is self-evident.

## Conclusions

These outlines are of necessity simplistic and preliminary. Each of the chapters in this book identifies research questions that can be addressed by an emerging generation of Angolan biodiversity scientists and conservation professionals. The challenges are exciting and demanding – offering multiple opportunities for intellectual stimulation, knowledge generation and international collaboration. Angola is truly alive with research and conservation opportunities. The country is still blessed with vast areas of rich wilderness and unique habitats, and has the opportunity to stimulate scientists, conservationists and the general public to participate in programmes of research and effective biodiversity conservation management. As this synthesis volume demonstrates, the limits are boundless. *Carpe diem!*

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