CHAPTER 4

ENDEMISM AND NATURE CONSERVATION

CHAPTER OUTLINE

4.1 WHAT IS ENDEMISM?

In Chapter 2 we discussed how different parts of the globe support different numbers of species. For instance, there are more species in the tropics than at higher latitudes. Chapters 2 and 3 also discussed how different species are not equally widely distributed: some are found very widely, while others are very localised. In this chapter, we want to look at this issue more closely, particularly with reference to how it affects conservation planning.

If a species is only found naturally in one particular place or specific geographical area, it is said to be **endemic** to that place or area. If that place or area also supports many other species which have equally restricted distributions, then it is said to be an **area of endemism**, because it is rich in endemic species.

In theory, endemism can be considered at any scale. For instance, ostriches and African elephants are endemic to Africa, because they are not found on any other continent. However, most conservationists prefer to restrict the use of the term endemism to describe species restricted to smaller areas than continents. It then becomes a very useful concept for planning conservation areas: areas rich in endemics will be more important for conservation than areas that lack endemics, since the loss of an area rich in endemics may be irreplaceable if those species are really found nowhere else. What we are saying, then, is that not all areas are equally important for conservation, even if they are equally species-rich. In addition to species-richness, conservationists should also value the **level of endemism** amongst the species present.

Endemism is one extreme of a continuum. If a species is found in lots of places across a wide geographic range, it is said to be **widespread**. Most species are relatively widespread. Thus Uganda shares many of its species with neighbouring countries, and a fair proportion of them are also found as far afield as South Africa or Cameroon. It shares far fewer species with countries of other continents. For instance, Africa and South America share just two tropical forest tree species, *Ceiba pentandra* and *Symphonia gabonensis*, while Africa shares only a handful of tropical forest tree species with Asia, for example *Antiaris toxicaria*, *Tamarindus indica*, and *Oncoba spinosa*. The extreme form of "widespreadness", and at the opposite end of the continuum from endemism, is **ubiquitousness**. Humans are an obvious example of a ubiquitous species, since we are now residents of every continent and many oceanic islands too.

4.2 ZONES OF ENDEMISM

The widest scale at which the term endemism has any practical significance is at the level of ***phytochoria***, or zones of plant endemism (White, 1983). Under this system, Africa is seen to be comprised of nine main zones of plant endemism (Figure 4.1). Within any one of these zones is a pool of plant species from which all the plant communities are derived. The boundaries of these zones correspond roughly to the boundaries of the main vegetation types in Africa (see Section 5.4.1). By definition, at least a third of all plant species within a zone are not found in any other zone. Thus most species of plants in Mali, in the West African part of the Sudanian zone of plant endemism, also occur in Sudan, in the East African part of the same zone.

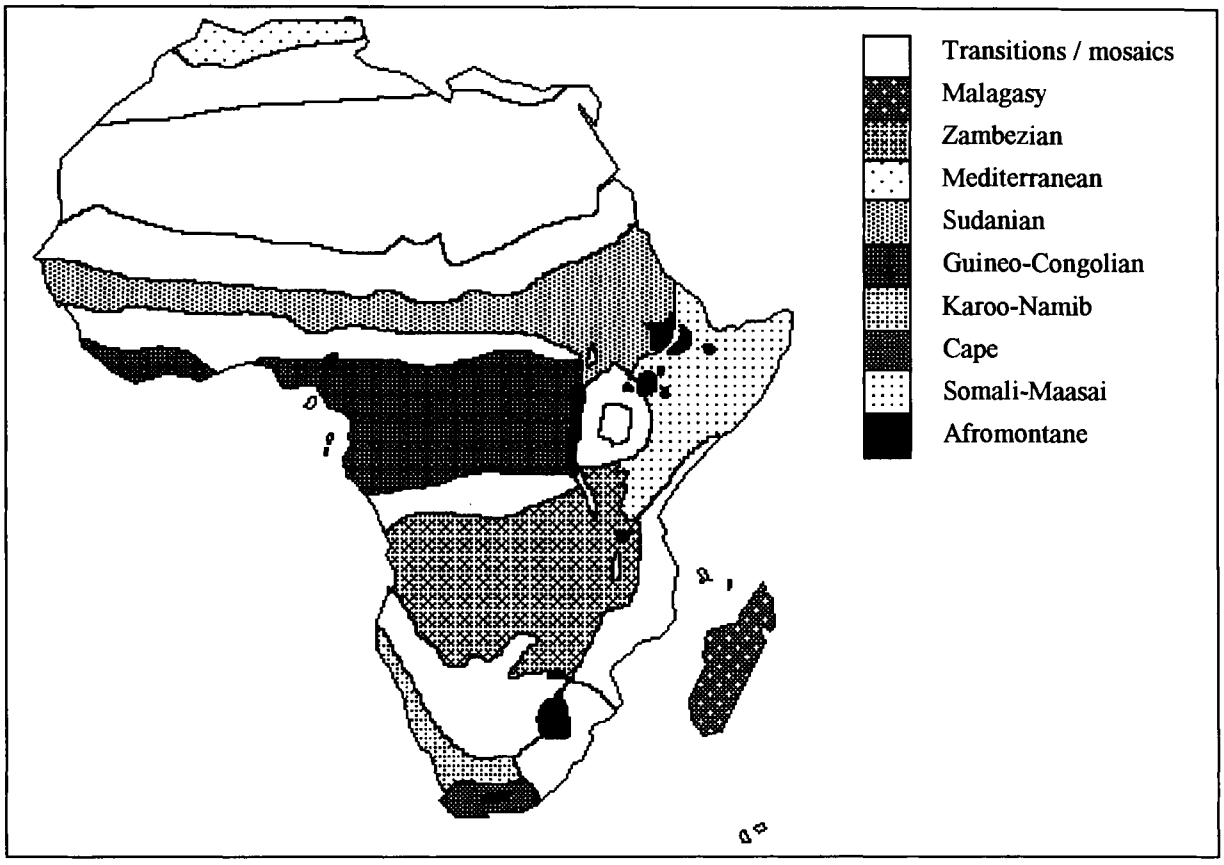

Figure 4.1. The main zones of plant endemism in Africa (shaded areas), plus transitions and mosaics (unshaded). After White (1983).

On the other hand, the plants of Mali are very different from those of, say, Sierra Leone, because they fall within different zones of plant endemism even though they are geographically quite close. Furthermore, the plant species of Mali differ greatly from those of, say, Namibia, even though parts of Namibia have a similar climate and an apparently similar vegetation cover to Mali.

These zones are fairly distinct, but there is some overlap between them. As Figure 4.1 shows, many parts of Africa consist of "transition zones" between two or more zones, containing species characteristic of each zone. In transitions, such as the Sahel, plant endemism is very low. In the Sahel's case, it is probably 0.1% (Hamilton, 1993). Uganda is unusual in that much of it is covered by a 'mosaic', called the *Lake Victoria Regional Mosaic*, which is where three main zones merge; it also has parts of the country covered by four true zones and a transition (Figure 4.2).

This is one reason why Uganda is particularly rich in plant species (4000-5000 species), because it has elements of many distinct zones of endemism within its borders. Despite this, Uganda has relatively few *nationally* endemic plants, something in the order of 0.6% (30 species), because most are shared with one or more of its neighbours which lie in the same zone or zones. Zaire's national level of plant endemism, on the other hand, is about 30%, because most of Zaire falls within one zone. But Niger, Guinea Bissau, Togo and Burkina Faso, all of which lie in transition zones, are each thought to have 0% plant endemism (WCMC, 1992).

Although these zones were based on plant endemism, they have relevance for animal endemism as well. Figure 4.3 shows the levels of endemism amongst mammals and birds, as well as plants, in the seven zones of mainland sub-Saharan Africa. In all cases, endemism is higher amongst plants than amongst birds or mammals. This may be because they are more easily isolated by physical or environmental barriers than are animals, because animals tend to be more mobile. Since speciation tends to follow isolation, plants tend to speciate into localised endemic forms more readily than do animals.

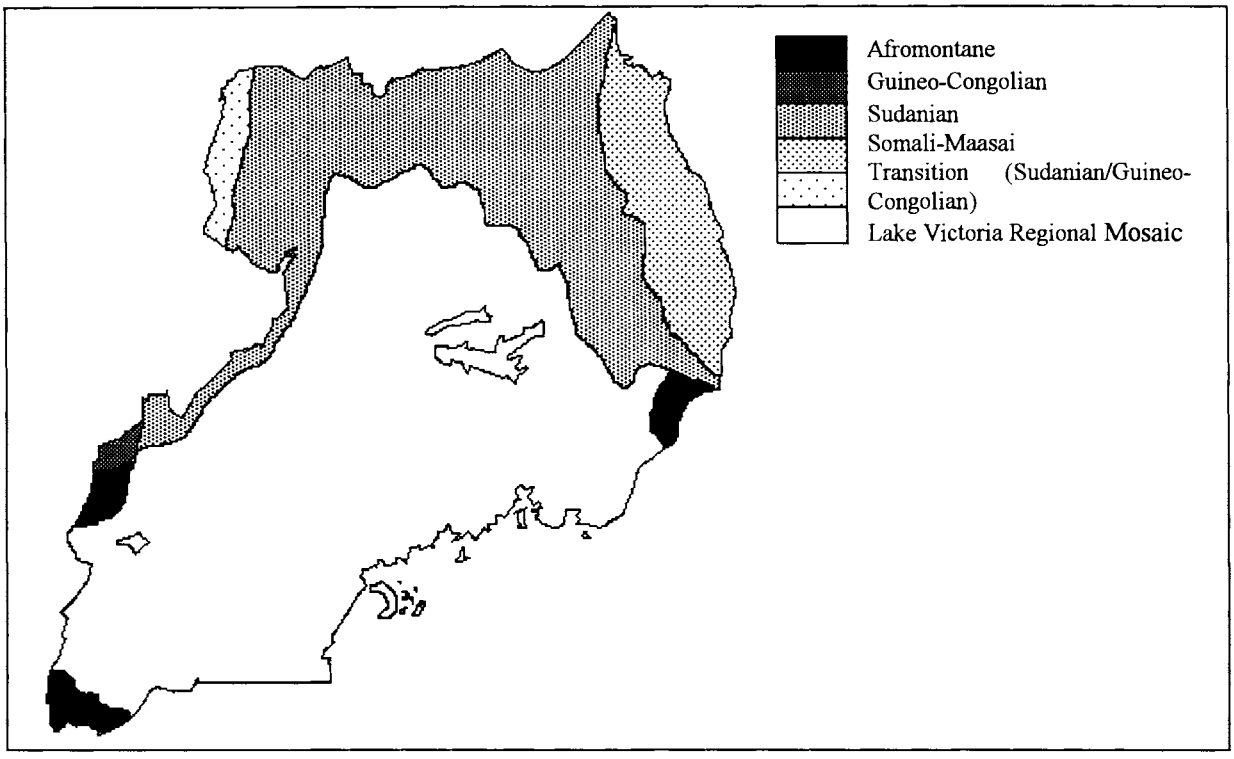

Figure 4.2. An enlargement of White's (1983) map, covering Uganda and showing the Lake Victoria Regional Mosaic.

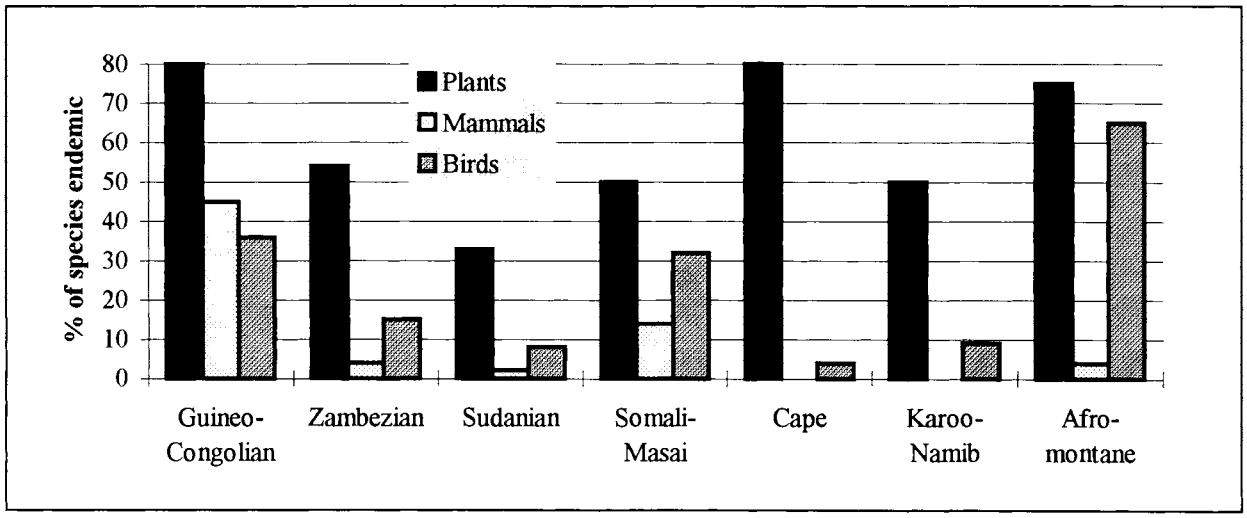

Figure 4.3. Levels of endemism in the seven zones of plant endemism of sub-Saharan Africa. After Stuart and Adams (1990).

4.3 ISLANDS OF ENDEMISM AND REFUGIA

4.3.1 Islands and centres of endemism in Africa

Although most of the zones of endemism described above form continuous blocks, note that the Afromontane zone does not. It occurs as isolated "islands" of high ground within other zones. The use of the term "island" is appropriate, because for the species that live there, the surrounding land is just as inhospitable, and just as much a barrier to dispersal and colonisation, as a true ocean would be. Most of these islands are found in East and Central Africa (such as the Rwenzori, Elgon and Virungas in Uganda) but others occur in Southern

Africa and to a lesser extent in West Africa. These areas have remarkably similar vegetation, but because they are isolated many of the species present may be unique to each "island", even if they are very closely related.

Island ecosystems are particularly important for endemic species. Because of their isolation from other similar areas, the species that live there have often evolved into distinct sub-species or species, making such areas particularly important for conservation. Although mountains with their Afromontane vegetation provide a classic example of areas with high endemism and high conservation value, they are not the only example. The major lakes of Africa can also be considered 'islands' surrounded by 'oceans' of dry land, and, as expected, the more isolated ones are rich in endemic species. For example, 99% of the cichlid fishes native to Lake Victoria are endemic to the lake, while of the 350 or so species of freshwater fishes found in Lakes Albert, Edward, George and Victoria, about 270 are found nowhere else (Huntley, 1988). A very full and readable account of this subject is given by Kingdon (1990).

Endemism in birds has been relatively well studied. They tend not to occur in isolation: often, where one endemic species occurs, other endemic species will also be found. We know, for instance, that about 26% of all the world's bird species are confined to less than 5% of the land area; 20% of them are confined to just 2% of the land area (Bibby et al., 1992). Most of these so-called *endemic bird areas* lie in the tropics, particularly along the equator. What this means for conservation of birds is that one of the best ways is to concentrate efforts on the areas that make up this small percentage. As we will see below, Uganda has an important role to play in this. Since the term endemism is somewhat vague, Bibby et al. (1992) have used the term *restricted range* to get around the problem of definition. In their analysis, a restricted range bird species is one whose global range does not exceed 50,000 km^2. Figure 4.4 lists the main centres of bird endemism in Africa, based on the numbers of restricted-range bird species present (Stuart and Adams, 1990).

The figure suggests that the Albertine Rift is the most important area for bird endemism in Africa. It comprises the largely mountainous country from Lake Albert in the North to southern Burundi in the south, either side of and within the western Rift Valley. The extreme west of Uganda is included, which is one reason why conservation of the forests of western Uganda is so important. For instance, no fewer than 26 of the 40 Albertine Rift endemic (restricted range) birds are recorded from here. Bibby et al. (1992) show that it is likely that such areas that are important for endemic birds will also be important for endemism amongst other groups of animals and plants.

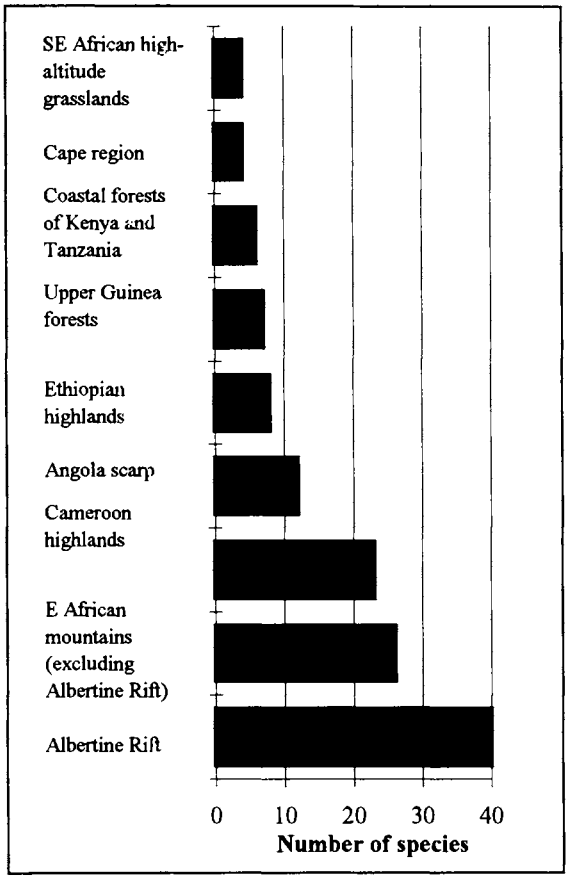

Figure 4.4. The major centres of bird endemism in Africa, based on the number of restricted range bird species found in each area. After Stuart and Adams (1990).

4.3.2 Endemism and refugia

In order to understand how areas such as the Albertine Rift have come to be so rich in endemic species, it is necessary to consider the history of climate in tropical Africa over the past two million years or so. As climate has changed, so too have vegetation zones. Temperatures may not have changed much, but rainfall patterns certainly have, and in fact they probably still are changing. This has meant that forests have been expanding and contracting according to the prevailing rainfall pattern. At certain times, forest could possibly have covered most of sub-Saharan Africa apart from the Horn of Africa and the Kalahari region (Knoch and Schulze, 1956). But at other times, forest would have shrunk to a fraction of its present area.

When this happened, once contiguous patches of forest could become isolated in a "sea" of savannah for thousands of years. During each period of isolation, some of the species thus isolated may become extinct because conditions are not quite right for their survival, or because the area of island is too small for them. But other species will adapt to the conditions, and if the isolation continues for long enough, then some of these may evolve into unique forms (species or sub-species), which are not found outside the island and which are therefore endemic to it.

The major changes are summarised in the next chapter in Section 5.4.34. Particularly important is the fact that about 13,000 years ago, when the temperate zones of the world were experiencing the last (Pleistocene) "Ice Age", tropical Africa was so dry that forests shrank to small areas where rainfall remained particularly high. These areas are known as **Pleistocene refugia**, because they provided a refuge for the plants and animals dependent on the forests. Figure 4.5 shows the probable distribution of these refugia in Africa. A similar situation probably existed in South America, and possibly also in Asia.

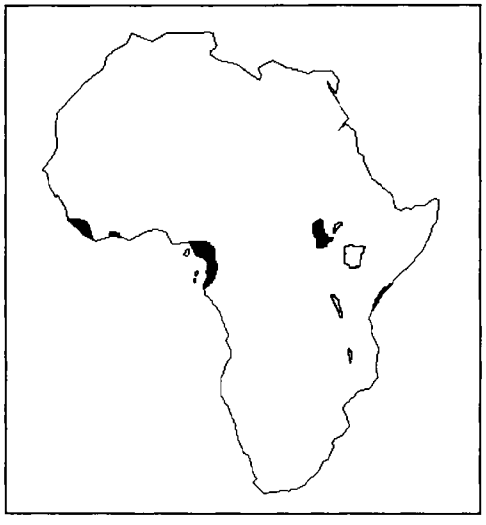

Figure 4.5. Probable distribution of the main tropical moist forest refugia in Africa during the driest period of the Pleistocene Ice Age, about 13,000 years ago. After Diamond and Hamilton (1981).

One of these refugia, known as the 'Central Refugium', extended from eastern Zaire into Rwanda and possibly just into western Uganda too. In other words it included parts of the Albertine Rift. Other parts of the Albertine Rift were above the tree-line anyway, as they are to this day (although vegetation belts were about 1000 m lower then), and supported isolated areas of Afromontane vegetation. Thus, it should not be surprising to find so many endemic species in the Albertine Rift to this day. Even though the forests have extended once again across much of central Africa, the area closest to the supposed refugium is still far richer in endemics, and in species generally. In fact, the forests of central Zaire, although seemingly in the heart of the great central African rainforests, support hardly any endemic bird species at all, and only about half the number of passerine bird species (songbirds) found in forests closest to the refugia (Diamond and Hamilton, 1981). Likewise, as shown in Figure 4.6, there is a strong gradient in forest tree species richness in the forests of Uganda as one moves away from the Albertine Rift, suggesting that some of the forests furthest away from the refugium have rather recent origins (Hamilton, 1974).

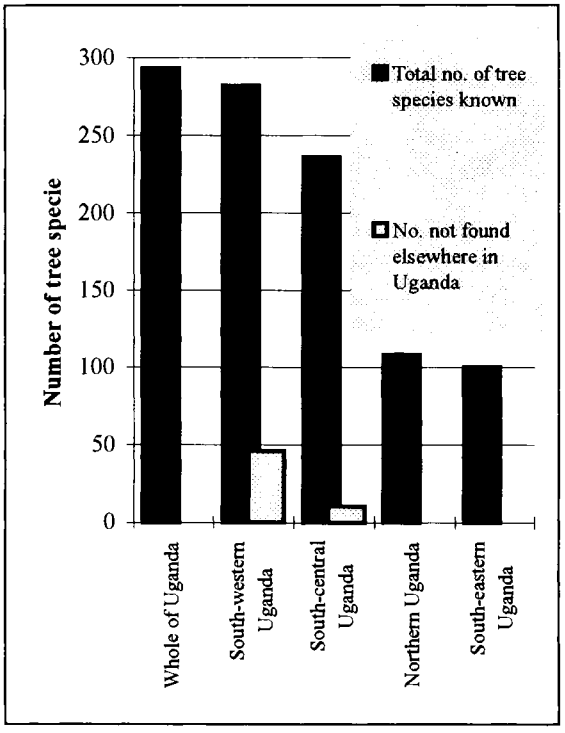

Figure 4.6. Variation in lowland forest tree diversity in different parts of Uganda. After Hamilton (1974).

4.4 ENDEMISM IN UGANDA

We have seen that Uganda is rich in species compared to its neighbours, and this is partly because the country sits at a meeting-point of several zones of endemism, as well as sitting on the edge of a major forest refugium and containing several isolated lakes and mountains. We have also seen that, despite this, there are relatively few nationally endemic species in Uganda, because most of the features that have high endemism straddle Uganda's borders. For instance, the main Afromontane areas in Uganda (the Virungas, Rwenzoris and Mount Elgon), and the main isolated lakes (Victoria, Edward and Albert) are all on international borders, while the main forests of western Uganda can be viewed as relict pieces of a forest refugium that also has fragments in neighbouring countries. Table 4.1 lists some of the species that are either nationally endemic, or endemic to small parts of Uganda and neighbouring countries. The list is confined to higher plants and vertebrates, because these are the groups that have been well studied. It is likely, though, that there are many more endemic species than appear in this table, particularly amongst the invertebrates.

Note that most of the species listed in the table are endemic to the Albertine Rift (or to the Rwenzoris, which lie within the Rift). This emphasises the great conservation importance of the parts of Uganda that lie within this area of endemism. The list of species from this area includes both montane and forest species: both are rich in endemics. It means that some of the most important forests for conservation in Uganda are those in and near the Albertine Rift, such as Bwindi, Echuya, Rwenzoris, Semliki, Kibale, Kasyoha-Kitomi, Kalinzu-Maramagambo, Itwara, Buhoma and Budongo, because these forests support species with very restricted global distributions for which every population is important in ensuring the species' survival.

4.5 SUMMARY

- Some species are restricted to relatively small natural ranges (restricted-range or endemic species), whereas others are widespread or ubiquitous
- Some areas are richer in restricted-range species (centres or zones of endemism) than others
- There are more centres of endemism near the equator than elsewhere
- Uganda is particularly rich in species partly because it lies at a meeting-point for several different zones of endemism, although most of its endemics are also shared with one or more neighbouring country
- Areas near to Pleistocene forest refugia, such as the forests of western Uganda, are likely to be richer in species, especially endemics, than areas further away
- Other natural "island" forests, such as those on the northern and eastern hills of Uganda, may also prove important for conservation of local endemics
- Given widespread instability in surrounding countries, the best chances of conserving many of the endemic species of East-Central Africa lie within Uganda

4.6 FURTHER READING

Bibby, C.J., Collar, N.J., Crosby, M.J., Heath, M.F., Imboden, C.H., Johnson, T.H., Long, A.J., Stattersfield, A.J. and Thirgood, S.J. 1992. *Putting biodiversity on the map: priority areas for global conservation.* International Council for Bird Preservation, Cambridge.

Kingdon, J. 1990. *Island Africa: the evolution of Africa's rare animals and plants.* Collins, London.

Stuart, S.N. and Adams, R.J. 1990. *Biodiversity in sub-Saharan Africa and its Islands.* IUCN, Gland.

WCMC. 1992. *Global biodiversity: status of the earth's living resources.* World Conservation Monitoring Centre/Chapman and Hall.

Table 4.1.
Some examples of species with a restricted range that occur in Uganda.
Mostly from IUCN (1988) and Kingdon (1973)

Species	Global distrib.	Distribution in Uganda
Thunbergianthus rwenzoriensis (shrub)	Albertine Rift	Rwenzoris and Bwindi
Polystachia sp. (orchid)	Albertine Rift	Virungas
Cyathea camerooniana var. *ugandensis* (tree-fern)	Uganda	?
Cyathea dregei var. *burkei* (tree-fern)	Uganda	?
Euphorbia dichroa	Uganda	?
Euphorbia petraea	Uganda	?
Aloe mubendiensis	Uganda	?
Aloe schweinfurthii var. *labworiana*	Uganda	?
Aloe fororoana	Uganda	?
Aloe wilsonii	Uganda	?
Aloe wollastonii	Uganda	?
Senecio amblyphyllus	Albertine Rift	SW Uganda
Senecio elgonensis	Mount Elgon	Mount Elgon
Mus acholi (pygmy mouse)	NW Uganda	NW Uganda
Pelomys hopkinsi (creek rat)	Around L. Victoria	Around Lake Victoria
Pelomys isseli (creek rat)	Ssese Islands	Ssese Islands
Thamnomys venustus (mouse)	Albertine Rift	SW Uganda
Delanymys denti (Delany's mouse)	Albertine Rift	SW Uganda
Otomys denti (groove-toothed rat)	Albertine Rift	SW Uganda
Funisciurus carrutheri (Carruther's mountain squirrel)	Albertine Rift	Rwenzoris
Rhynchocycon cirnei stuhlmanni (elephant shrew)	Albertine Rift	SW Uganda
Dendrohyrax arboreus ruwenzorii (Rwenzori tree hyrax)	Rwenzoris	Rwenzoris
Procolobus badius tephrosceles (Uganda red colobus)	SW Uganda	SW Uganda
Cercopithecus mitis kandti (Golden monkey)	Albertine Rift	Mgahinga
Gorilla gorilla berengei (Mountain gorilla)	Albertine Rift	Bwindi and Mgahinga
Panthera pardus ruwenzorii (Rwenzori leopard)	Rwenzoris	Rwenzoris
Chamaeleo johnstoni (Three-horned chameleon)	Rwenzoris	Rwenzoris
Francolinus nobilis (Handsome francolin)	Albertine Rift	Rwenzori, Bwindi, Virunga
Francolinus nahani (Nahan's francolin)	Albertine Rift	W and SW Uganda
Halcyon badia (Chocolate-backed kingfisher)	Albertine Rift	W Uganda
Columba albinucha (White-naped pigeon)	Albertine Rift	Semliki and Kibale
Tauraco johnstoni (Rwenzori turaco)	Albertine Rift	SW Uganda
Tockus hartlaubi (Black dwarf hornbill)	Albertine Rift	Semliki
Turdus kibalensis (Kibale ground thrush)	Kibale Forest	Kibale Forest
Turdus oberlaenderi (Forest ground thrush)	Albertine Rift	SW Uganda
Cercotrichas leucosticta (Northern bearded scrub robin)	Albertine Rift	Semliki
Alethe poliophrys (Red-throated alethe)	Albertine Rift	Rwenzoris, Bwindi
Muscicapa lendu (Chapin's flycatcher)	Albertine Rift	W and SW Uganda
Pseudocalyptomena graueri (African green broadbill)	Albertine Rift	Bwindi
Graueria vittata (Grauer's warbler)	Albertine Rift	Bwindi
Sylvietta sp. (Lemon-bellied crombec	?Albertine Rift	Budongo
Hemitesia neumanni (Short-tailed warbler)	Albertine Rift	Bwindi
Apalis ruwenzori (Collared apalis)	Albertine Rift	Rwenzori, Kibale & Kigezi
Bradypterus graueri (Grauer's rush warbler)	Albertine Rift	Bwindi and Echuya
Melaenornis ardesiaca (Yellow-eyed black flycatcher)	Albertine Rift	Bwindi
Batis diops (Rwenzori batis)	Albertine Rift	Rwenzoris and Bwindi
Batis ituriensis (Ituri batis)	?Albertine Rift	Budongo
Nectarinia purpureiventris (Purple-breasted sunbird)	Albertine Rift	Rwenzoris, Bwindi , Kalinzu
Nectarinia regia (Regal sunbird)	Albertine Rift	Rwenzoris and Kigezi
Phyllastrephus lorenzi (Sassi's olive greenbul)	Albertine Rift	Semliki
Cryptospiza shelleyi (Shelley's crimson-wing)	Albertine Rift	Bwindi and Rwenzoris