

Ecological hotspots and land use patterns in the Upper Niger Basin, Guinea



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E. Klop M. Sikkema M. Diawara A. Gado Cover photograph: Mafou River, Photo: Erik Klop

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Summary / Résumé

Summary

Framework and objectives

The BAMGIRE project (2015-2019), run by Wetlands International Mali, aims to support and coach the implementation of Integrated Water Resources Management in the Upper Niger Basin. BAMGIRE encompasses the support of the political process and provides the science-based background and content to the process. One of the key components of the BAMGIRE project is an assessment of ecological hotspots within the two sub-basins of the Niger River. Very little is known on the ecological hotspots of the upstream areas in Guinea, the source area of the Niger River. This report presents information on the ecology, land use and biodiversity, based on a two-week field visit to eastern Guinea in February 2018, and on available literature on the ecology and land use in the area.

Habitats

The natural habitat in these parts of the Upper Niger Basin is moist woodland savanna, with a transition to the dry Sudan savanna in the northeast (Siguiri area) and to the humid forest zone in the far south. The northern parts of the basin consist of open savanna and dry farmbush, i.e. regrowth on abandoned or fallow agricultural fields. Large-scale agriculture – mainly rice irrigation– is mostly restricted to the alluvial plains bordering the Niger River and its tributaries. Along water courses gallery forest is found and in the southern zone of the basin closed-canopy forest. This habitat is now extremely rare.

Ecological hotspots

The site with probably the highest biodiversity value in the Upper Niger Basin is Mafou Forest, which is one of the core areas of the Haut Niger National Park. Mafou Forest might represent one of the last remnants of this habitat in the wider region, providing habitat to species such as the critically endangered West African Chimpanzee (*Pan troglodytes verus*). We have no information on the exact status, threats or degradation of the forest, nor do we know the status of the other core area of the park, Kouya Forest. However, given the uniqueness and high biodiversity value of intact dry forest, the conservation of these habitats is paramount importance.

Many parts of Haut Niger N.P., including the buffer zones and Amana classified forest, consist of degraded woodland savanna with an impoverished fauna. The field visits show high levels of human activity, including hunting, logging, savanna burning, fishing, gold mining, cattle grazing, slash-and-burn agriculture, beekeeping, collection of grass and firewood, etc. Several large mammals have already been extirpated from the area, including African savanna elephant and (most likely) Lion. Given the lack of staff and resources, effective conservation and protected area management in Guinea is a major challenge.

Wetlands in this part of the Niger River Basin are confined to the river valleys and some small permanent wetlands. These places provide important habitat for both resident and migrant species of waterbirds. Gallery forest is found throughout the region along rivers. In the northern parts this is often no more than a thin strip of a few trees bordering the water, but in the southern sections some well-developed gallery forests are present. These patches of gallery forest provide important habitat to several forest species in a matrix of open savanna and agricultural fields, and host a relatively high biodiversity.

Ecosystem services

Agricultural activities are the dominant form of land use. The Niger River and its tributaries provide however several other ecosystem services to the local people. Some of these services refer to small-scale and local activities, such as the collection of fruits and honey, whereas other services have turned into more industrialized economic activities that can have severe impacts on the local environment. Some prominent ecosystem services include Shea butter (from the fruits of *Vitellaria paradoxa*), beekeeping, logging and firewood, sand extraction from the riverbed, clay for brick

Résumé

Cadre et objectifs

Le projet BAMGIRE (2015-2019), géré par Wetlands International Mali, vise à soutenir et à accompagner la mise en œuvre de la Gestion Intégrée des Ressources en Eau dans le Haut Bassin du Niger. BAMGIRE englobe le soutien du processus politique et fournit le contexte et le contenu scientifique du processus. L'une des composantes clés du projet BAMGIRE est une évaluation des points chauds écologiques dans les deux sous-bassins du fleuve Niger. On sait très peu de choses sur les points chauds écologiques des zones en amont en Guinée, la zone source du fleuve Niger. Ce rapport présente des informations sur l'écologie, l'utilisation des terres et la biodiversité, basées sur une visite de terrain de deux semaines en Guinée orientale en février 2018, et sur la littérature disponible sur l'écologie et l'utilisation des terres dans la région.

Habitats

L'habitat naturel dans ces parties du haut bassin du Niger est une savane boisée humide, avec une transition vers la savane sèche du Soudan au nord-est (région de Siguiri) et vers la zone forestière humide à l'extrême sud. Les parties septentrionales du bassin sont constituées de savane ouverte et de broussailles sèches, c'est-à-dire de repousses sur des champs agricoles abandonnés ou en jachère. L'agriculture à grande échelle - principalement l'irrigation du riz est surtout limitée aux plaines alluviales qui bordent le fleuve Niger et ses affluents. Le long des cours d'eau, on trouve des forêts galeries et dans la zone sud du bassin, des forêts à couvert fermé. Cet habitat est aujourd'hui extrêmement rare.

Les points chauds de l'écologie

Le site ayant probablement la plus grande valeur de biodiversité dans le Haut Bassin du Niger est la forêt de Mafou, qui est l'une des zones centrales du Parc National du Haut Niger. La forêt de Mafou pourrait représenter l'un des derniers vestiges de cet habitat dans la région au sens large, fournissant un habitat à des espèces telles que le chimpanzé d'Afrique de l'Ouest (Pan troglodytes verus), une espèce en danger critique d'extinction. Nous n'avons aucune information sur le statut exact, les menaces ou la dégradation de la forêt, ni sur le statut de l'autre zone centrale du parc, la forêt de Kouya. Cependant, étant donné le caractère unique et la grande valeur de biodiversité de la forêt sèche intacte, la conservation de ces habitats est d'une importance capitale.

De nombreuses parties du P.N. du Haut Niger, y compris les zones tampons et la forêt classée d'Amana, sont constituées d'une savane boisée dégradée avec une faune appauvrie. Les visites sur le terrain montrent des niveaux élevés d'activité humaine, notamment la chasse, l'exploitation forestière, le brûlage de la savane, la pêche, l'extraction de l'or, le pâturage du bétail, l'agriculture sur brûlis, l'apiculture, la collecte d'herbe et de bois de chauffage, etc. Plusieurs grands mammifères ont déjà disparu de la région, notamment l'éléphant de savane africain et (très probablement) le lion. Étant donné le manque de personnel et de ressources, la conservation et la gestion efficace des zones protégées en Guinée constituent un défi majeur.

Dans cette partie du bassin du fleuve Niger, les zones humides sont confinées aux vallées fluviales et à quelques petites zones humides permanentes. Ces endroits fournissent un habitat important pour les espèces d'oiseaux d'eau, tant résidents que migrateurs. On trouve des forêts-galeries dans toute la région le long des rivières. Dans les parties septentrionales, il ne s'agit souvent que d'une mince bande de quelques arbres bordant l'eau, mais dans les parties méridionales, on trouve quelques forêts galeries bien développées. Ces parcelles de

forêts galeries fournissent un habitat important à plusieurs espèces forestières dans une matrice de savane ouverte et de champs agricoles, et abritent une biodiversité relativement élevée.

Services écosystémiques

Les activités agricoles sont la forme dominante d'utilisation des terres. Le fleuve Niger et ses affluents fournissent cependant plusieurs autres services écosystémiques aux populations locales. Certains de ces services concernent des activités locales et à petite échelle, comme la collecte de fruits et de miel, tandis que d'autres services se sont transformés en activités économiques plus industrialisées qui peuvent avoir de graves répercussions sur l'environnement local. Parmi les principaux services écosystémiques, on peut citer le beurre de karité (provenant des fruits de Vitellaria paradoxa), l'apiculture, l'exploitation forestière et le bois de chauffage, l'extraction de sable dans le lit des rivières, l'argile pour la fabrication de briques

1 Introduction

1.1 Framework and background

The Niger River is the longest river in West Africa and provides water and resources to millions of people in the river basin. The water and the ecosystem services provided by the river are essential for sustaining the livelihoods of the local people, but also govern the general ecology of the area. However, the river catchment is subject to a plethora of threats, including some large-scale processes such as climate change and the realization of major hydrological infrastructure, as well impacts that operate on a smaller scale, including several forms of unsustainable resource extraction.

The BAMGIRE project (2015-2019), run by Wetlands International Mali, aims to support and coach the implementation of Integrated Water Resources Management in the Upper Niger Basin. BAMGIRE encompasses the support of the political process and provides the science-based background and content to the process. One of the key components of the BAMGIRE project is an **assessment of ecological hotspots** within the two sub-basins of the Niger River, i.e. the Upper Niger Basin and Inner Niger Delta. This assessment has the following objective:

"The general objective of the overall hotspot analysis as part of BAMGIRE is that by the end of the project period, the **hotspots of ecosystem services and biodiversity are identified and mapped**, and priorities are identified for protection and restoration."

More specifically, the BAMGIRE hotspot assessment aims to quantify the links between water availability on one hand and patterns in land use, biodiversity and ecosystem services on the other hand. Much research on these topics has been done in the Inner Niger Delta (IND) of Mali, and a separate report has been produced describing the results in detail (Wymenga *et al.* 2017). In contrast to the IND however, the upstream areas in Guinea – where the river originates – are little known.

1.2 Goals

The goal of this report is to present information on the ecology, land use and biodiversity of the Guinean part of the Upper Niger Basin. It is largely based on a two-week field visit to eastern Guinea in February 2018, and on the available literature on the ecology and land use in the area. It focuses specifically on the following topics:

- Identification and mapping of the main habitats, ecosystems and land use found in the Upper Niger Basin, in particular those related to the river;
- Identification of the main threats to ecological values in the area, such as logging, mining etc;
- Provide information on the biodiversity in the region and the status of protected areas, most importantly the Haut Niger National Park;
- Provide data on the hydrology of the main rivers in the area.

This information is visualized in maps and photographs where possible. A brief description of the outline of this report is provided below.



Figure 1.1 Overview of the Guinean part of the Upper Niger Basin, showing the main rivers and protected areas.

1.3 Outline of this report

A concise description of the field mission, including the itinerary and the location of the areas that were visited, is given in Chapter 2. In Chapter 3 a general description of the sub-basin is given, focusing on climate (rainfall) and the hydrological characteristic of the main rivers. An overview of the protected area system in this part of Guinea is given in Chapter 4. This chapter provided data on Haut Niger National Park, as well as Ramsar Sites and Classified Forests. Chapter 5 describes the main biodiversity of the sub-basin. It fosuses on mammals, but also provides information on the vegetation, birds, reptiles and fish in the area. Chapter 6 provides information on the main habitats and land use in the sub-basin. It covers both natural habitats as well as the different forms of agriculture found in the area. A brief overview of ecosystem services is given, based on the data collected during the field mission. The report concludes with a synthesis and a list of references. The daily log of the field mission is given in Appendix 1; a list of birds recorded during the field mission is given in Appendix 2.

2 Field mission

2.1 Field work

A field mission to the Upper Niger Basin in Guinea was carried out from 29 January until 9 February 2018 by a team of Wetlands International Mali (Abdouramane Gado and Mamadou Diawara) and Altenburg & Wymenga ecological consultants (Erik Klop and Marten Sikkema). The aim of this field mission was to collect data on land use, habitats, hydrology and ecosystem services in the Guinean part of the basin. More precisely, the field work focused on the following activities:

- Mapping habitats (both natural and cultivated), ecosystems and types of land use that are characteristic of the Upper Niger Basin.
- Ground truthing satellite map using GPS and georeferenced photos of habitats, agricultural fields and vegetation.
- Describing the relevant types of land use, including agriculture, NTFPs and other forms of resource extraction, and conducting informal interviews with local people.
- Identify the main threats, such as logging, mining, brick construction etc.
- Describe the biodiversity and main protected areas in the area, including the status of the Haut Niger National Park.
- Collect existing data on the hydrology of the main rivers and where possible carry out Eflow measurements like water velocity, vegetation on river banks, etc.

The itinerary of the field mission is given in the table below. The numbers in the last column correspond to the locations on the map (Figure 2.1). The results of the field mission have been reported in a mission report (Klop & Sikkema 2018). The main text from this report, including the daily log, is included in Appendix 1.

Date	Location	Activities	Number
			on map
29 January	Travel Ams – Bamako	Travel day	-
30 January	Travel Bamako – Kankan	Travel day, stopped at Niger River crossing	-
31 January	Kankan, Aliamounou	- Visit PCA-GIRE office to discuss planning and logistics	1, 2
	village	- Visit gouverneur Kankan	
		- Visit Aliamounou village for forest restoration site and	
		vegetable fields (WI project)	
01 February	Siguiri area	- Tinkisso River: gallery forest, habitat measurements	3, 4, 5
		- Faidherbia trees migratory birds census	
		- Visit a small temporal wetland	
02 February	Bakongokorro,	- Bakongokorro vegetable fields, discuss with local women 6	
	Bakongocissela, Kankan	- Bakongocissela wetland, discuss with village chief	
		- Visit gallery forest along N6	
		- Brick construction site near Kankan	
		- Sand excavation site near Kankan	
03 February	Fomi + Moussako dam	- Visit Moussako dam area, passed by Koumbankourou	9, 10
	areas	Classified Forest along the way	
		- Visit Fomi dam area, explored gallery forest	

Table 2.1 Itinerary of the field mission. For locations see figure 2.1.

04 February	PCA-GIRE office Kankan	 No field visit due to local elections Received hydrological data at PCA-GIRE office 	-
05 February	Kouroussa, Amana Forest	 Travel to Kouroussa and Diaragbela area Long drive through Amana Forest (Haut Niger NP), visited two sites along Niger River 	11
06 February	Serekoroba, bufferzone NP	 Bufferzone Haut Niger NP, visited artisanal gold mining site Serekoroba area at Mafou River, where done flow measurements Pirogue trip on Niger River near Diareguela 	12, 13
07 February	Sidokoro, park headquarters	 Long drive to park headquarters at Sidokoro, discussed biodiversity and threats with park rangers Short walk at strictly protected area in NP 	14
08 February	Kouroussa – Bamako	Travel day	-
09 February	Arrival Amsterdam	Travel day	-



Figure 2.1 Areas visited during the field mission in January - February 2018. See Appendix 1 for the daily log.

3 Description of the basin

3.1 General topography

The source of the Niger River is situated in the Guinean Highlands near the border with Sierra Leone, at an altitude of around 750 m a.s.l. To the northwest the Guinean Highlands extend into the Fouta Djalon mountains, which rise up to 1,500 m. To the southeast are the Kourandou and Simandou mountain ranges and Mt Nimba, the highest peak in Guinea. The altitude decreases as the Niger flows eastwards towards Mali. This section of the basin is mostly flat or slightly undulating, and is situated at an altitude between 200 and 400 m.

The soil types in this part of the basin predominantly belong to ferralitic soils and tropical ferruginous soils. Ferralitic soils are heavily weathered and leached soils that are generally rich in iron and bauxite (aluminium). These soils are mostly located in the humid forest zone, like the Upper Guinea forests, and the southern Guinea savanna zone with relatively high rainfall. Ferralitic soils are present in the Guinean Highlands. More to the north, the savanna zone is characterised by ferruginous soils. Fertility and organic matter content of these soils are generally low compared to the soils of the humid forest zone. These soils are generally suitable for growing annual crops like maize, millet etc.

3.2 Climate

Many aspects of the ecology, land use and livelihoods of the people in West Africa are directly or indirectly governed by rainfall, and the Upper Niger Basin is no exception. A characteristic feature of the West African climate is the steep rainfall gradient when going from north to south. Over a relatively short distance of less than 1,000 km, rainfall increases from <250 mm at the southern edge of the Sahara to >3,000 mm in the southern forest zone (fig. 3.1). The ecosystems along this gradient are often classified into bio-climatic zones (e.g. Keay 1959, Le Houérou 1989), with annual rainfall as long-term determinant of the potential vegetation.



Figure 3.1 Mean annual rainfall in West Africa. Source: CILLS 2016.

The Guinean part of the Niger River Basin covers a rainfall gradient from roughly 1,000–1,200 mm in the northeast at the border with Mali, to 1,800–2,000 mm in the southwest at the border with Sierra Leone. The mean annual rainfall at Siguiri in the period 1922–1995 is 1277 mm, in Kankan 1590 mm and in Kissidougou 2035 mm (figure 3.2; source: KNMI Climate Explorer). Rainfall is highly variable, however, and characterized by substantial fluctuations over the years.

The rains fall in a single wet season. In the northern parts of the basin, such as Siguiri, the rains start in April and last until October (figure 3.3). By far the wettest month here is August with over 300 mm of rain; only three months (July–September) receive over 200 mm of rain. Rainfall is very low from November up to March. The wet season is more prolonged in the southern parts such as Kissidougou, where the first rains fall in March and last until November. In these parts six months (May–October) receive over 200 mm of rain (figure 3.3).



Figure 3.2 Boxplots of annual rainfall in the southern part (Kissidougou), central part (Kankan) and northern part (Siguiri) of the Upper nlger Basin. Source: KNMI Climate Explorer.



Figure 3.3 Rainfall patterns for Siguiri, Kankan and Kissidougou. Error bars show the standard deviation around the mean precipitation value. Source: KNMI Climate Explorer.

3.3 Hydrology

The Niger River (4,180 km) is the longest river in West Africa and the third longest on the African continent. From its source in the highlands of Guinea, the river passes through Mali, Niger and Nigeria where it flows into the Gulf of Guinea in the Atlantic Ocean. The river drains a catchment area of over 2 million km² and provides water to more than 100 million people.

The Niger and most of its main tributaries rise in the Guinean Highlands at the border with Sierra Leone. Next to the Niger proper there are five major tributaries, the Tinkisso, Niandan, Milo and Sankarani in Guinea and the Bani in Mali (figure 3.4). The most northerly branch, the Tinkisso, originates in the Fouta-Djalon mountains. The trends in mean discharges over the year for the Niger and some of its main tributaries are shown in figure 3.5.



Figure 3.4 The Niger River and its main tributaries in Guinea, also showing the hydrological stations for which the data are provided in figure 3.5.

The source of the **Niger** is roughly 60 km west of Kissidougou near the border with Sierra Leone. For the first 100 km or so, it is no more than a small, heavily meandering stream that winds itself through a landscape of hills, agricultural fields and forest patches. Narrow strips of gallery forest border the river at both sides. At Faranah the mean maximum discharge is around 175 m³/s at the end of September (figure 3.5). This drops to a minimum discharge of less than 3 m³/s in April. Around 200 km from the source the Niger is joined by the Balé and changes direction to the northeast. In the Haut Niger National Park the Niger is joined by the Mafou. At Kouroussa, nearly 400 km from the source, the maximum discharge has increased to a mean value of over 740 m³/s at the end of September. Further downstream the river is joined by the Niandan, Milo and Tinkisso tributaries. The maximum discharge east of Siguiri increases to an average value of 2,300 m³/s at the Dialakoro gauging station. A further 25 km downstream the Niger flows into Mali, roughly 600 km from its source.

The **Niandan** originates west of Kissidougou at the border with Sierra Leone. It runs in a southnorth direction and 365 km downstream from the source it joins the Niger River near the village of Babila, roughly 20 km east of Kouroussa. The mean maximum discharge during the wet season is 750 m³/s in September, which drops during the dry season to a minimum of 25 m³/s in April (Ferry *et al.* 2015, figure 3.5). It is the Niandan where the planned Moussako dam (10.316N, 9.754W) or Fomi dam (10.512N, 9.721W) will be situated.

The **Milo** flows east of the Niandan through the town of Kankan and joins the Niger near the village of Sansando. The mean maximum discharge during the wet season is over 600 m^3 /s in September. The mean minimum discharge measures less than 20 m^3 /s at the end of the dry season.

The major tributary of the Niger in eastern Guinea is the **Sankarani**, which straddles the border between Guinea and Mali for some distance before flowing into Mali, where a main reservoir at the Sélingué dam is situated. The Sélingué dam was constructed in 1982 with the main goal of hydropower production, although it is also used for irrigation purposes. The maximum storage volume of the reservoir is 2.2 km³. The maximum discharge of the Sankarani (average 900 m³/s) is reached in September.

In contrast to the other main tributaries of the Niger that are described here, the **Tinkisso** does not originate in the southern highlands but in the Fouta Djalon to the west of the Upper Niger Basin. It joins the Niger at Siguiri.



Figure 3.5 Discharges (m3/s) for various hydrological stations in the Niger, Niandan, Milo and Sankarani Rivers. Source: Direction Régionale Hydraulique, Kankan. The black line shows the mean discharge, the grey shaded areas show the 95% confidence interval around the mean. Outliers, i.e. years with unlikely low discharge values, have been omitted before analysis.



Figure 3.6 Variation in discharges in the Niger River at Kouroussa. Dry years: 1976-1985, wet years: 1950-1969, recent years: 2000-present. Source: Direction Régionale Hydraulique, Kankan. The years 1989, 2012 and 2013 have been removed from the dataset because of unlikely low values.

The variation in discharges in the Niger at the Kouroussa station between dry and wet years is shown in figure 3.6. Dry years refer to the mean discharge in the period 1976–1985, whereas wet years refer to the period 1950–1969. In addition, the mean discharges in recent years (2000–2014) are also shown. This figure clearly shows the substantial increase in maximum discharge in the Niger River during relatively wet periods such as the the 1950s and 1960s. Not only is the peak discharge higher, the time period with elevated discharges in the wet season lasts longer: in wet years a given discharge is reached around 20 days earlier compared to dry years, and it can take up to 30 days longer before the discharge drops again to a given level in the dry season. The higher discharges in wet years remain until far into the dry season. Only very late in the dry season, from March until May, are the discharges in dry and wet years comparable.

Data on water levels measured at Kouroussa are available from 1970 onwards. Obviously, there is a direct relation between discharge and water level. Figure 3.7 shows a scatterplot with a polynomial model fitted through the data. With a goodness-of-fit of 99.9% the fit of the model is extremely good, so the regression equation can be used to calculate the missing water level values (i.e. before 1970). The resulting estimates are plotted as a blue line in figure 3.8.



Figure 3.7 Scatterplot showing the relation between discharges and water levels at Kouroussa. Outliers have been removed (the years 1989, 2012, 2013).



Figure 3.8 Maximum discharges and water levels at Kouroussa between 1923 - 2014. Years for which no data are available are not shown, so the horizontal axis is not fully chronological. The red line shows the measured water levels, the blue line the estimated water levels based on the regression model shown in figure 3.6.



Figure 3.9 Water levels measured at various hydrological stations in the Niger, Niandan, Milo and Sankarani Rivers. Source: Direction Régionale Hydraulique, Kankan. Outliers have been removed.



Figure 3.10 Relation between total annual rainfall and maximum discharge at Kankan (Milo River) between 1938–1995. The grey shaded area shows the 95% confidence interval around the values predicted by the regression equation.

Discharges and water levels in the Niger River and its tributaries are ultimately dependent on rainfall. When looking at the data from Kankan between 1938–1995, the correlation between annual rainfall and maximum water level is 0.62 and is statistically significant (p<0.01). However, there is much noise in this relation and the explanatory power of the regression curve is below 40%, as shown in figure 3.10. This is due to the effects of rainfall, groundwater levels and incoming tributaries further upstream, for which no data are available.

4 Protected areas

4.1 Introduction

The background, organisation and system of protected areas in Guinea is described by Brugiere & Kormos (2009) and on the website (<u>www.eaux-forest.gouv.gn</u>) of the *Direction National des Eaux et Forêts* (DNEF). This Direction was charged with the management of the protected area network in Guinea until 2003. In 2004 this responsibility has been transferred to CENAGAP, the '*Centre National de Gestion des Aires Protégées*'. This Institute is placed under responsibility of the *Ministère de l'Agriculture, d'Elevage, de l'Environnement et des Eaux et Forêts* (Brugiere & Kormos 2009). The information below is primarily based on IUCN (2008) and Brugiere & Kormos (2009)

Like in many West African countries, the protected area network in Guinea has its roots in colonial legislation aiming to secure wood resources and the protection of water catchments. In the period 1885–1958, a total of 147 Classified Forests (*forêts classées*) were created, covering 11,550 km². Although the primary goal was to protect forestry resources, no hunting was allowed in these forests. The first national parks were also created in the colonial period, at the beginning of the 20th century. In 1990 the '*Code de protection de la faune sauvage et réglementation de la chasse*' was adopted, and from 1997 onwards embedded in the legal system. This code distinguishes five categories of protected areas: National Park, Strict Nature Reserve, Managed Nature Reserve, Faunal Sanctuary and Game Hunting Reserve.

In 1985 the classified forest of Badiar Nord was transformed into Badiar National Park, which is contiguous with Niokolo-Koba N.P. in Senegal. In 1997 the Haut Niger N.P. was established, with in its centre the Mafou and Kouya classified forests. Besides these two national parks, the protected area network in Guinea currently consists of one strict nature reserve (Mt Nimba) and two faunal reserves (Kankan and Blanche Island). In total these areas cover 2.9% of the land territory, making it one of the smallest protected area networks in West Africa (Brugiere & Kormos 2009). The four national parks that were gazetted in the 1920s and 1930s are currently considered to be non-existent (Boké, Koumbia, Dinguiraye) or have been downgraded to the status of faunal reserve (Kankan).

In addition to the abovementioned protected areas, Guinea designated one world heritage site, four biosphere reserves and 16 Ramsar sites. It is not clear how these Ramsar sites are embedded in a legal protection framework. In 2006 a vulture sanctuary was meant to be created in the Fouta Djallon mountans, but the current status is unknown.

4.2 Protected areas in the Upper Niger Basin

Within the Upper Niger Basin, several protected areas are found (figure 4.1). The structure is complex because of e.g. unclear boundaries, changes in protection status, or spatial overlap between some of the categories. The areas are as follows:

1. Haut Niger National Park, which is the largest of the two national parks in Guinea. It covers a part of the catchment of the Niger, Mafou and Niandan Rivers. The park is comprised of a complex of different areas each with its own protection status.

- 2. Kankan Faunal Reserve, located to the southeast of Kankan. This reserve was originally gazetted as a national park, but is no longer regarded as such (although it has never been officially degazetted; see Brugiere & Kormos 2009).
- 3. A total of 19 classified forests are found within the borders of the UNB, including Mafou and Koya Forests that are strictly protected parts of Haut Niger N.P.
- 4. The Haut Niger Biosphere Reserve, which covers the Mafou sector of the national park. The Kouya sector is not part of the Biosphere Reserve.
- 5. Six sites that are regarded as Wetlands of International Importance (Ramsar sites), which in total cover a large part of the Upper Niger Basin.



Figure 4.1 Overview of the various protected areas in the Upper Niger Basin in Guinea.

4.3 Parc National du Haut Niger

In January 1997 the Parc National du Haut Niger (Upper Niger National Park) was established, which is by far the largest of the two national parks in Guinea. The park consists of two contiguous parts (figure 4.2): the Mafou sector in the northwest and the Kouya sector in the southeast. Both sectors consist of a strictly protected core area surrounded by a large buffer zone. The bufferzone of the Mafou sector is further subdivided into an 'inner' and 'outer' bufferzone. Both the Mafou and Kouya core areas were originally designated as classified forest. In addition, two classified forests (Amana and Tamba) are located inside the Mafou sector. The Nono and Koumban-Kourou classified forests are contiguous with the park but are not part of it. The entire Mafou sector is also designated as a Biosphere Reserve. All these different parts of the park have different goals, park rules, and a concomitant different status concerning the level of protection. In addition, some boundaries of the Kouya sector are not clearly defined, and the official surface areas (reported by e.g. IUCN 2008, Saïdou & Djellouli 2011) differ substantially from the areas calculated in GIS based on the available maps of the park (see table 4.1). All these ambiguities make the park structure rather obscure.



Figure 4.2 Haut Niger National Park and its buffer zones.

Core areas

The two strictly protected core areas (*Zone Intégralement Protégée*) are Mafou Forest and Kouya Forest, both of which were originally designated as classified forests. These core areas aim to protect biodiversity and activities like hunting, logging, mining, NTFP collection etc. are not allowed. However, fishing is allowed in the main watercourses. Mafou Forest is bounded by the Niger River in the north and the Mafou River in the east.

Classified forests

Besides the core areas of Mafou Forest and Kouya Forest there are two additional classified forests (*fôrets classées*) located inside the Mafou sector of the park, i.e. Tamba and Amana Forest. In contrast to the core areas, some sustainable natural resource extraction is allowed in these forests. North of the Mafou sector is Nono classified forest, which is contiguous with the park but not part of it. Likewise, Koumban-Kourou classified forest borders the Kouya sector but is not formally part of the park.

Buffer zones

A substantial part of the park consists of buffer zones surrounding the core areas. Two different buffer zones have been defined in the Mafou section of the park (figure 4.2). The inner buffer zone allows the sustainable use of resources such as wood and NTFPs by the local villagers, whereas the outer zone also allows agricultural activities and other activities that are in line with the objectives of the park. Hunting in the buffer zones is allowed between October 1st and June 30th, except in an area of 245 km² north of Mafou Forest where hunting is not allowed at all. The exact boundaries of this area are not known. The exact borders of the bufferzone in the Kouya sector have never been formally approved. This bufferzone was established in September 1997 as an extension of 6,000 km² to the parts of the park that were gazetted earlier that year. However, as clearly shown in figure 4.2 and table 4.1, the currently available data indicate an area that is only half the size.

Area	Official	GIS
Mafou Forest core area	554	613
Inner buffer zone	3,641	3,027
Outer buffer zone	2,275	2,470
Total buffer zone	5,960	5,497
Amana Forest	198	165
Tamba Forest	160	147
Total Mafou sector	6,828	6,422
Kouya Forest core area	674	571
Buffer zone Kouya sector	6,000	2,996
Total Kouya sector	6,674	3,567
Total National Park	13,502	9,989

Table 4.1 Area in km2 of the different parts of Haut Niger N.P., based upon the official data (taken from IUCN 2008, Saïdou & Djellouli 2011) compared to the areas calculated in GIS, based on the map shown in figure 4.2.



Figure 4.3 Headquarters of Haut Niger National Park, located south of Mafou Forest.

The field visits to Haut Niger N.P. and its buffer zones indicated high levels of human activity in the buffer zones and Amana Forest, including hunting, logging, savanna burning (to create grass regrowth for cattle), fishing, gold mining, cattle grazing, slash-and-burn agriculture, beekeeping, collection of grass and firewood, etc. In Amana Forest several cut-down trees were found, including *Daniellia oliveri, Khaya senegalensis* and *Bombax sp.*, and many stumps of trees that have been cut down earlier. In addition, chainsaws were heard at several locations. Just outside the eastern border of the Mafou sector of the park, a major gold mining site is located. Washing the clay is done in a patch of gallery forest inside the borders of the park, which is formally illegal but no action is taken. During the field visits, no wild mammals like duikers or primates were observed in the park, indicating high hunting pressure. Indeed, several hunters were encountered each day.

In contrast to the highly degraded landscape in the buffer zones, the habitat around the park headquarters south of Mafou Forest appeared to be a unique patch of mature dry forest. This might be one of the last remnants of this habitat in the region. Given the uniqueness and high biodiversity value, the importance for conservation is paramount. This could also be an interesting site for ecotourism, but there is very little to accommodate visitors; basic facilities like proper accommodation, food or drinking water are all lacking.

Unfortunately, the observations described above fit into a wider pattern. Effective conservation and protected area management in Guinea, including the Haut Niger N.P., is extremely difficult due to lack of staff and resources. Henschel *et al.* (2014) formulate the problem as follows:

"In Haut Niger, which has 15 patrol staff, assessors noted that in practice, agents do no or very few patrols due to a lack of resources and motivation; as a result poaching and illegal logging is widespread. Brugière (2012) notes that existing protected areas in Guinea are essentially

paper-parks, i.e. they have no staff, management plan or operating budget. Consequently, even in the largest formally gazetted protected area in Guinea, the Kankan Faunal Reserve, c. 20,000 people live within the area, poaching pressure is high, and antelope population densities are extremely low."

4.4 Biosphere reserves

According to UNESCO Biosphere reserves are: "areas comprising terrestrial, marine and coastal ecosystems. Each reserve promotes solutions reconciling the conservation of biodiversity with its sustainable use. Biosphere reserves are 'Science for Sustainability support sites' – special places for testing interdisciplinary approaches to understanding and managing changes and interactions between social and ecological systems, including conflict prevention and management of biodiversity" (http://www.unesco.org). Biosphere reserves have three zones with complementary functions: core areas, buffer zones and a transition area. The core area comprises a strictly protected ecosystem that contributes to the conservation of landscapes, ecosystems, species and genetic variation. The <u>buffer zone</u> surrounds or adjoins the core areas, and is used for activities compatible with sound ecological practices that can reinforce scientific research, monitoring, training and education. The <u>transition area</u> is the part of the reserve where the greatest activity is allowed, fostering economic and human development that is socio-culturally and ecologically sustainable.

The Haut Niger Biosphere Reserve ($6,470 \text{ km}^2$) was declared in 2002 around Mafou Forest, which forms the core area of the reserve (figure 4.2). Besides this core area (554 km^2), the reserve consists of a bufferzone of $3,641 \text{ km}^2$ and a transition zone of $2,275 \text{ km}^2$. As shown in table 4.1, the officially reported surface areas of these zones do not perfectly match the surface areas shown on the map. The zonation of the Biosphere Reserve and its functions are similar to that of the Mafou sector of the park. The Kouya sector is not part of the Biosphere Reserve.

4.5 Ramsar sites

The Convention on Wetlands, usually called the Ramsar Convention, is an intergovernmental treaty aiming at the conservation and wise use of wetlands and their resources. The sites covered by the treaty are regarded as Wetlands of International Importance. Guinea currently has 16 sites designated as Ramsar Sites, of which six are located within the Upper Niger Basin (see figure 4.4).

Below a concise summary is given of each Ramsar site (texts are adapted from <u>https://www.ramsar.org/wetland/guinea</u>). More information on the biodiversity, vegetation and land use patterns can be found in chapter 5.

 Niger-Tinkisso. This site covers an extensive area of river and freshwater ponds and marshes around the Tinkisso river and the Niger as far as the frontier with Mali, centering upon Siguiri. The Western Giant (or Derby's) Eland, thought to be extinct in Guinea, has been rediscovered within the site but remains threatened, and appreciable number of both waterbirds and molluscs are reported. Water quality is generally good but might be affected by gold mining and pesticide runoff from cotton culture.

- Niger–Niandan–Milo. This site consists of a very large flat expanse of permanent and seasonal rivers and freshwater ponds and marshes, which makes up a critical section of the Niger Basin. Part of the site lies within the Upper Niger National Park. It is extremely important for its hydrological functions and for its fish biodiversity, with more than 200 species noted. The Site is also host to a large number of waterbirds. Extensive farming with excessive deforestation and burning have led to soil denudation, acceleration of erosion, the destruction of vegetation and scarcity of wildlife resources.
- Tinkisso. The Tinkisso Ramsar Site covers over 12,000 square kilometres of the upper reaches of the Tinkisso River, which flows from the highlands near Dabola and Dinguiraye downstream toward the plains near Siguiri. Extensive farming, prohibited fishing practices, and gold panning are major threats to this site. The African fan palm (*Borassus aethiopum*) has been over-exploited, particularly for making palm wine, and might disappear unless steps are taken. A range of legislative texts have been adopted to strengthen measures to protect natural resources.
- Sankarani–Fié. The Site, within the basin of the Sankarani River, is located in the east of the country next to the border with Côte d'Ivoire. It is characterized by savanna and dry forest, and major floodplains along the length of the river. This stretch of the river is an important fish spawning ground because the current is calm, deep and well protected by gallery forests. Hippopotamuses have become numerous within the site because of water retained by the Sélingué dam. However, agriculture, burning, exploitation of gold and prohibited fishing practices have all contributed to the destruction of vegetation cover and an increasing scarcity of wildlife.
- Niger Source. Covering the headwaters of the river Niger from its source near the frontier with Sierra Leone northward to Bandéya, the site is marked by savanna and forest vegetation with marked dry and rainy flood seasons. A very important site, since the basin of the entire Niger River depends upon the quality and quantity of its flow, it also supports an impressive biodiversity, including the threatened endemic freshwater catfish *Arius gigas* and a number of migratory waterbirds. Subterranean circulation of water in parts of the site aids in groundwater recharge and merits further study. Traditional fishing, grazing, and agriculture are practiced within the site.
- Niger-Mafou. A very large area of permanent and seasonal rivers and freshwater marshes, with irrigated and seasonally flooded agricultural land, located between and around the rivers Niger and Mafou. Large areas of primary dry forest support a high level of biodiversity, and the area has been little altered by human intervention. The threatened endemic fish *Arius gigas* is supported, and a number of waterbirds visit the site annually. Moreover, the site is situated in a migratory corridor for large mammals between Guinea and neighboring states, with abundant water resources for them throughout the year. Water quality is good, but increases in cotton-growing and the use of pesticides may offer a threat. Traditional fishing is economically important, as is agriculture and grazing, but losses due to clearing and deforestation are not negligible, and the use of explosives in fishing is diminishing fish stocks.



Figure 4.4 Ramsar sites in the Upper Niger Basin.

4.6 Classified forests

During the colonial era, a total of 147 classified forests (*forêts classées*) were created in the years between 1885 and 1958, with the primary aim to secure forestry resources (mainly wood and water). The website of the *Direction National des Eaux et Forêts* (<u>www.eaux-forest.gouv.gn</u>) currently lists 138 classified forests that are scattered throughout Guinea.

The Upper Niger Basin has a modest number of classified forests, although some forests are quite large. In total, 19 classified forests are found partly or entirely inside the UNB covering a total area of over 3,000 km² (table 4.2). The three main forests in this part of the basin are Mafou Forest and Kouya Forest, which are also the core areas of Haut Niger N.P., and Kourani-Oulete-Dienne south of Kankan. Note that the area sizes calculated in GIS are different from the areas reported by the website of the *Direction National des Eaux et Forêts*, in some cases quite significantly. No classified forests are located in the area between Kankan and the border with Mali (figure 4.1).

No.	Classified Forest	DNEF area (km ²)	GIS area (km²)
1	Mafou Forest (core area Haut Niger NP)	524	613
2	Kouya Forest (core area Haut Niger NP)	674	571
3	Fello-Selouma	40	46
4	Balayan-Souroumba	250	225
5	Sincery-Ourssa	140	35
6	Nono	56	54
7	Chutes de Tinkisso	11	17
8	Souarele	20	32
9	Baro	80	80
10	Amana	198	165
11	Lefarani	19	27
12	Koumban-Kourou	40	51
13	Kourani-Oulete-Dienne	590	829
14	Yardo	41	55
15	Tamba	150	147
16	Bambaya	3	4
17	Pic de Tibe	61	62
18	Milo	136	102
19	Guirila	81	112
	Total area (km ²)	3,114	3,225

Table 4.2 List of the various Classified Forests in the Upper Niger Basin. Areas in km² based upon the official data (taken from the website of DNEF) and those calculated in GIS.

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5 Biodiversity

5.1 Vegetation

The Upper Niger Basin is largely situated within the Guinea savanna zone and as such the potential vegetation in large parts of the basin would be moist woodland savanna. However, the structure of the vegetation is strongly affected by human impacts such as agriculture, wood cutting, burning and cattle grazing, all of which open up the landscape. As a result, the vegetation in the northern parts of the basin (Siguiri area) is more akin to the dry Sudan zone of southern Mali. The vegetation of this area is characterized by open, degraded woodland savannas and dry farmbush (abandoned or fallow agricultural fields). Typical tree species include *Parkia biglobosa, Vitellaria paradoxa* (of which the fruits are used to produce shea butter), *Bombax costatum* (Red kapok tree), *Combretum spp.*, some very large *Ceiba pentandra* (silk cotton tree), and the ubiquitous Mango.

More to the south in the direction of Kankan, the vegetation gets thicker. This part of the basin consists mainly of heavily degraded woodland savanna interspersed with agricultural fields. Typical trees of this zone are *Afzelia africana* (common), *Isoberlinia doka, Daniellia oliveri* (locally very common), *Cassia ataxacantha, Pterocarpus erinaceus* and *Khaya senegalensis*. Along water courses gallery forest is found; in the northern parts this is often no more than a thin strip of a few trees (*Ficus, Uapaca*) bordering the water, but in the southern sections some well-developed gallery forests are present which provide important habitat for several forest species.

The much wetter southern zones of the basin receive sufficient rainfall to support closedcanopy forest, but this habitat is now very rare and is probably restricted to the Mafou core area of the Haut Niger National Park. A high diversity of trees is found here, including *Anthonotha crassifolia*, *Cassia sieberiana*, *Vitex madiensis*, *Lannea velutina*, *Sterculia tragacantha* and *Detarium microcarpum*. The far southern part of the basin touches the wet forest zone, and remnants of mature forest may remain in some areas. The Niger River and its main tributaries Niandan, Milo and Sankarani originate in this zone.

Major wetlands are absent from this part of the Niger Basin, although during the wet season many temporal wetlands may occur in the lower lying parts. One apparently permanent wetland behind the village of Bakongocissela was visited during the field mission. Around 70–80% of the water was covered by Water lily, with smaller areas of Water primrose (*Ludwigia grandiflora*) and Bladderwort (*Utricularia sp.*). Around a fifth of the wetland consisted of small islands covered by sedges.

5.2 Mammals

As in many parts of West Africa, most large mammals in Guinea have disappeared from nonprotected land due to uncontrolled hunting and habitat degradation. During the field work in early 2018, no large mammals were observed at all, although footprints of Hippopotamus were found at the Tinkisso River south of Siguiri.

Detailed surveys of the mammal fauna of the Haut Niger N.P. have been carried out between 1995 and 1997 based on field observations, tracks and signs, carcasses on bushmeat markets, rodent traps and mistnetting bats (Ziegler *et al.* 2002). These surveys recorded 94 species of

mammals, including several possible or unconfirmed species. During the field work in February 2018, surprisingly no common West African species like Vervet monkey, Patas monkey, Redflanked duiker, Bush duiker etc. were observed in the park. These species are generally common and widespread throughout their range, including in disturbed habitats. The absence of any observations might be coincidence but may also be due to high hunting pressure in the buffer zones and Amana classified forest. Every day around 5–10 hunters were encountered on the trails and roads in these areas.

Primates

A large number of primate species occurs in West Africa, although the highest diversity is found in the humid forest zone. From a taxonomic point of view, the West African primates can be divided into the following families:

- Old world monkeys (family Cercopithecidae). This large and diverse family is native to Africa and Asia and contains familiar species such as baboons, Green monkey, Patas monkey and many of the West African forest species.
- Apes (family Hominidae). In this part of West Africa this family is represented only by Chimpanzee.
- Galagos (family Galagonidae). Galagos are small nocturnal primates that are sometimes called Bushbabies. Two or three species occur in the region.
- Potto and lorises (family Lorisidae). The Potto is the only species from this family that occurs in West Africa. Sometimes the Galagonidae and Lorisidae are lumped in the family Loridae.

Within the Upper Niger Basin, several species of Old world monkeys are found (table 5.1). This includes a few threatened species, as well as several more widespread primate species that occur in the savannas (Guinea/Olive baboon, Green monkey, Patas monkey) or forests (Sooty mangabey, Campbell's monkey, Lesser spot-nosed monkey) in or close to the UNB.

The African baboons (genus Papio) have tradionally been considered to be a single species (Papio hamadryas) with several subspecies that occur in various parts of the continent, but most recent taxonomic sources recognize five different species (e.g. Groves 2001, Grubb et al. 2003, Duff & Lawson 2004, Zinner et al. 2009, Mittermeier et al. 2013). Based on the latter view, there are two species of baboons that occur in Guinea. The Guinea baboon (Papio papio) has a relatively small range from western Mali and central Guinea to the coast. This species is listed as Near-threatened on the IUCN Red List. The second species, the Olive baboon (P. anubis) has an extremely large range and occurs from eastern Guinea and Sierra Leone to East Africa. This species occurs throughout nearly the entire Niger Basin. However, it is unclear whether the baboons in the westernmost part of the Upper Niger Basin belong to P. anubis or P. papio. The distribution maps of the IUCN indicate that only Olive baboon occurs in the UNB, but one of the sample locations of Guinea baboon in the study of Zinner et al. (2009) comes from the Bakaria area just south of Faranah. Based on their map (figure 1 in Zinner et al. 2009) of the geographical distribution of baboon species, Haut Niger N.P. falls within the range of Guinea baboon. The reddish coloration of the captive baboon at the headquarters of the park (figure 5.1) also seems to point to Guinea baboon rather than Olive baboon.

Similar to the baboons, the Vervet monkey is either considered a single species or as a set of different species that occur in savannas throughout the African continent (see Grubb *et al.* 2003 and Mittermeier *et al.* 2013 for a review). The western (sub)species that occurs in the UNB is called Green monkey or *singe vert* which occurs from Senegal to Ghana. Depending on the taxonomic point of view, it is classified as either a subspecies of Vervet (or Grivet) monkey
(*Cercopithecus aethiops sabaeus*) or elevated to species rank (*C. sabaeus*). In addition, the species is variously placed in the genus Cercopithecus or Chlorocebus (see Grubb *et al.* 2003, Groves 2005, Mittermeier *et al.* 2013). Either way, it is widely distributed throughout the West African savanna zone where it is often common. It occurs throughout the entire UNB, including the Haut Niger N.P. (Ziegler *et al.* 2002) although it was not recorded here during the field mission in 2018. A captive animal was present at the headquarters of the park.



Figure 5.1 Captive baboon at the headquarters of Haut Niger National Park.

A close relative of the previous species is the Patas monkey (*Erythrocebus patas*) or *singe rouge*. This species has an extremely large range, spanning 6000 km from the coast of Senegal east to Ethiopia and Kenya. Patas monkeys are terrestrial and commonly occur in open grasslands and savannas throughout West Africa. It occurs in Haut Niger N.P. where a few confiscated individuals are present at the park headquarters.

In the southern parts of the Upper Niger Basin, some other primate species may be found that are confined to humid forest or gallery forest along rivers. Sooty mangabey (*Cercocebus atys*) is a semi-terrestrial forest species that also occurs in farmbush and secondary forests in western and southern Guinea. Campbell's monkey (*Cercopithecus campbelli*) and Lesser spotnosed monkey (*C. petaurista*) have a similar geographic distribution. The former species occurs in gallery forest along the Kogon River in NW Guinea (pers. obs.) and may occur in similar habitat in the UNB. These three species are currently not threatened.

The range of the Western pied colobus (or King colobus, *Colobus polykomos*) stretches along the West African coast from southern Senegal to the Sassandra River in Côte d'Ivoire. The species prefers dense rainforests and gallery forests, but is sometimes found in secondary

forests as well. Within the UNB, the species range covers the most southern part, around the origins of the Niger, Niandan, Mafou, Milo and Sankarani. The IUCN Red List Status (2016-3) is Vulnerable. The Upper Guinea red colobus (*Piliocolobus badius*) is listed as Endangered; it is restricted to the forest zone and might just occur within the limits of the UNB near the border with Sierra Leone.

Chimpanzees are widely distributed in the highlands of Guinea, and occur in several areas including Haut Niger N.P. The West African subspecies of Chimpanzee (*Pan troglodytes verus*) is listed as Critically endangered by the IUCN. Chimpanzees are mostly a forest species, but have adapted to secondary forest, farmbush, dense woodland savanna and gallery forest (Davies 1987, Fimbel 1994b, Grubb *et al.* 1998). High densities occur in Mafou Forest, one of the core areas in Haut Niger National Park, making the park a key area for the conservation of this species (Fleury-Brugiere & Brugiere 2010). This is particularly true for the forest habitats in the park, such as gallery forests, where the highest densities are found.

Two or three species of galago occur in this part of West Africa. The most common is Senegal (or Lesser) galago (Galago senegalensis), a widespread species that occurs in savannas and open woodland from Senegal to Tanzania. It has been recorded in the Haut Niger N.P. (Ziegler et al. 2002) and is probably found throughout the Upper Niger Basin. In more forested habitats, one or two species of dwarf galago may be found. Demidoff's galago (G. demidoff) is a widespread and common species throughout the forest zone of West and Central Africa, where it is found at forest edges and dense secondary growth. The southern parts of the UNB fall within the distribution range of this species. Thomas' galago (G. thomasi) is very similar and often considered conspecific. The status of G. thomasi in West Africa is unclear because of confusion with G. demidoff. Both species may or may not occur sympatrically in West Africa. Ziegler et al. (2002) list Thomas' galago for Haut Niger N.P. based on 17 specimens found on the market at Mansiramoribaya. According to Ziegler and colleagues, the species occurs in wet and densely forested depressions within the park. They continue "The animals resemble Galagoides thomasi, a forest species known from Cameroon eastwards to Uganda (Nash et al., 1989) but are bright ochre-orange on the underside and have longer tails". It is unclear whether these animals refer to Demidoff's galago or Thomas' galago. Another prosimian species, West African potto (Perodicticus potto) may occur in the forests of the southern parts of the UNB. This is a secretive and nocturnal species that (unlike galagos) does not vocalize loudly, hence its presence in an area is very difficult to confirm. No information on the exact distribution of West African potto in these parts of Guinea is available.

English name	Scientific name	Habitat	IUCN	Occurrence in UNB
Guinea baboon	Papio papio	Savanna, woodland	NT	Uncertain. Baboons in Haut Niger NP
				possibly refer to this species.
Olive baboon	Papio anubis	Savanna, woodland	LC	Eastern Guinea, Mali
Green monkey	Cercopithecus sabaeus	Savanna, woodland	LC	Throughout UNB
Campbell's monkey	Cercopithecus campbelli	Forest, farmbush, gallery	LC	Uncertain, possibly in south
		forest		
Lesser spot-nosed monkey	Cercopithecus petaurista	Forest, farmbush, gallery	LC	Uncertain, possibly in south
		forest		
Patas monkey	Erythrocebus patas	Grassland, open	LC	Throughout UNB
		savanna		
Sooty mangabey	Cercocebus atys	Forest, farmbush	NT	Uncertain, possibly in south

Table 5.1 Primates in the Upper Niger Basin.

Western pied colobus	Colobus polykomos	Forest, gallery forest	VU	Uncertain, possibly in south
Upper Guinea red colobus	Piliocolobus badius	Forest	EN	Uncertain, possibly in south
Chimpanzee	Pan troglodytes verus	Forest, woodland		
Senegal galago	Galago senegalensis	Savanna, woodland	LC	Throughout UNB
Demidoff's galago	Galago demidoff	Forest edge	LC	Either this or the next species occurs in
		-		Haut Niger NP.
Thomas' galago	Galago thomasi	Forest	LC	See above.
West African potto	Perodicticus potto	Forest	LC	Uncertain, possibly in south

Ungulates

Nearly 40 species of ungulates are known to occur in West Africa, from the diminutive Royal antelope (2 kg) to giants like the African savanna elephant (4000 kg). The highest species diversity of grazers is found in the humid savanna zone, whereas most browsers and frugivores are found in the wet forest zone (Klop & Prins 2008). In Guinea around 27–29 species of ungulates occur, depending on one's taxonomic point of view. In addition, the exact distribution limits of some species are inadequately known. The far majority of these ungulate species are in the family Boviday which includes various antelope species and African buffalo.

Around 20 species of ungulates occur within the limits of the Upper Niger Basin (table 5.2). This includes 3 species of pigs (Warthog, Red river hog and Giant forest hog), Hippopotamus, African buffalo and 15 species of antelopes. Most of these species are currently not threatened and listed as 'least concern' on the IUCN Red List. One exception is the West African subspecies of the Giant eland (*Tragelaphus derbianus*), which has a population of less than 200 individuals and is considered to be Critically Endangered. It occurs mainly in Niokola-Koba N.P. in south-eastern Senegal, but it may occasionally occur within the UNB limits near the Tinkisso river in northern Guinea. The eastern subspecies is listed as vulnerable and occurs in the woodland savannas of northern Cameroon and the Central African Republic.

Hippopotamus (*Hippopotamus amphibius*) is listed as 'vulnerable' on the IUCN Red List. It occurs in most of the large rivers in Guinea, including the Niger, Kogon, Tinkisso and Niandan (Brugière *et al.* 2006). During the field work in February 2018, footprints of hippo were found on the banks of the Tinkisso River near its confluence with the Niger. In 2001 river censuses were carried out in the Haut Niger National Park by Brugière *et al.* (2006). They surveyed the Niger and Mafou Rivers within the park boundaries in both the dry and wet season. A total of 93 hippos in 28 groups were counted in the dry season, mostly in the section of the Niger River bordering Mafou Forest. In the wet season, 77 hippos in 23 groups were found, mostly along the Mafou River in the southeast of the park (Brugière *et al.* 2006). These results indicate a population in 2001 of at least 100 individuals in Haut Niger N.P. There are no permanent hippo populations in other protected areas in Guinea, and it is unknown what the total population size is in Guinea.

Various species of antelopes occur in the Upper Niger Basin, including some widespread species like Bushbuck, Hartebeest, Kob etc. However, most large mammals have become very rare outside protected areas and are now largely restricted to Haut Niger N.P. In particular large and sensitive species like Roan and Hartebeest are vulnerable to disturbance and hunting pressure and have been eradicated from many non-protected areas. Although the distribution maps published by the IUCN indicate a wide distribution throughout the region, in reality the ranges of many species have become severely fragmented.

Haut Niger N.P. is home to 14 species of ungulates (Ziegler *et al.* 2002). This includes the three West African pig species and Hippopotamus (see above), African buffalo and a selection of antelopes. Four species of duiker are reported to occur of which two are widespread savanna species (Red-flanked and Bush duiker). The two other species (Maxwell's and Yellow-backed duiker) are more characteristic of the humid forest zone where they are found inside mature forest and along its edges and in dense farmbush. Curiously, Oribi (*Ourebia ourebi*) has not been reported by Ziegler and colleagues, while this is a very common and widespread species of the West African woodland savannas.

In the far south of the Upper Niger Basin, possibly a few additional ungulate species may occur in locations with dense forest. These are e.g. Royal antelope and several duiker species, such as Bay duiker, Black duiker and possibly even Ogilby's duiker. All of these species are very hard to observe and are easily missed during surveys.

African elephant (*Loxodonta africana*) no longer occurs in Haut Niger N.P. (Ziegler *et al.* 2002). Elephant populations in West Africa have become severely fragmented, and sizeable populations remain only in a few protected areas such as the W–Arly–Pendjari complex shared by Benin, Niger and Burkina Faso (Thouless *et al.* 2016). In Guinea both (sub)species of African elephant used to occur, i.e. the Savanna elephant (*L. a. africana*) and Forest elephant (*L. a. cyclotis*), which are often elevated to full species rank (Grubb *et al.* 2000, Roca *et al.* 2001).

At present, only a few elephants still occur in Guinea. A very small population of Savanna elephants used to occur, at least seasonally, in northwest Guinea between the Kogon River and the border with Guinea-Bissau (Brugière *et al.* 2006). It is unknown whether this population still exists (Thouless *et al.* 2016). Only one population of Forest elephant still occurs in southern Guinea, where an estimated 60–200 elephants occur in Ziama Nature Reserve, located near the border with Liberia (Thouless *et al.* 2016). This area falls outside the UNB. The only other elephant population near the Niger River basin in Guinea and Mali is in the Gourma area, east of the Inner Niger Delta.

English name	Scientific name	Habitat	IUCN	Occurrence in UNB
Red River Hog	Potamochoerus porcus	Forest, gallery forest	LC	Haut Niger NP
Giant Forest Hog	Hylochoerus meinertzhageni	Forest	LC	Haut Niger NP
Warthog	Phacochoerus africanus	Savanna	LC	Throughout UNB
Hippopotamus	Hippopotamus amphibius	Rivers in savanna	VU	Major rivers throughout UNB
Oribi	Ourebia ourebi	Savanna	LC	Throughout UNB? Not recorded in Haut Niger NP
Royal Antelope	Neotragus pygmaeus	Forest	LC	Uncertain, possibly in south
African Buffalo	Syncerus caffer	Savanna, forest	LC	Haut Niger NP. Also surrounding areas?
Bushbuck	Tragelaphus scriptus	Woodland, forest	LC	Throughout UNB
Giant Eland (Derby's Eland)	Taurotragus derbianus	Savanna	VU	Uncertain, possibly occasional in northwest
Bohor Reedbuck	Redunca redunca	Savanna	LC	Throughout UNB? Not recorded in Haut Niger NP
Waterbuck	Kobus ellipsiprymnus	Savanna, floodplains	LC	Throughout UNB

Table 5.2 Ungulates in the Upper Niger Basin.

Kob	Kobus kob	Savanna, floodplains	LC	Throughout UNB?
Roan Antelope	Hippotragus equinus	Savanna	LC	Haut Niger NP
Hartebeest	Alcelaphus bucelaphus	Savanna	LC	Haut Niger NP
Bay Duiker	Cephalophus dorsalis	Forest	NT	Uncertain, possibly in south
Maxwell's Duiker	Cephalophus maxwellii	Forest	LC	Haut Niger NP
Black Duiker	Cephalophus niger	Forest	LC	Uncertain, possibly in south
Red-flanked Duiker	Cephalophus rufilatus	Woodland savanna	LC	Throughout UNB
Yellow-backed Duiker	Cephalophus silvicultor	Forest	NT	Haut Niger NP. Also surrounding areas?
Common Duiker	Sylvicapra grimmia	Woodland savanna	LC	Throughout UNB

Carnivores

A wide range of mammalian carnivores occur in West Africa. The majority of the roughly 40 species belong to the so-called small carnivores, which include African palm civet, Genets and civets, Mongooses, and Otters, weasels and badgers (families Nandiniidae, Viverriidae, Herpestidae and Mustelidae). The highest species richness of small carnivores is found in the humid forest zone (Do Linh San *et al.* 2013), including southern Guinea but outside the Upper Niger Basin. However, the ranges of some forest species may just overlap with the UNB. Many of these species are poorly known and the taxonomy and distribution patterns are often unclear. In contrast, many larger carnivores, i.e. Cats, Hyenas and Dogs (families Felidae, Hyaenidae and Canidae) have been studied in detail and are well-known.

The African palm civet (*Nandinia binotata*) has a very wide distribution and occurs in forest and humid woodland savannas from Senegal to Zimbabwe. This is an arboreal and omnivorous species often associated with oil palms, the fruits of which make up a significant part of its diet (Kingdon 1997). It is generally common throughout its range and listed as Least concern on the IUCN Red List. African palm civet occurs in Haut Niger N.P. (Ziegler *et al.* 2002), but is probably absent from other parts of the Upper Niger Basin because of its habitat preferences.

The Common (or Small-spotted) genet (*Genetta genetta*) occurs throughout the African continent, where it is commonly found in dry savannas. It is probably widespread throughout the Upper Niger Basin. Two other widespread species are Pardine genet (*G. pardina*) and Haussa genet (*G. thierryi*), both of which occur in a variety of habitats throughout Guinea and western Mali. The former species is listed for the Haut Niger N.P. (Ziegler *et al.* 2002). The forest species Bourlon's genet (*G. bourloni*) and Johnston's genet (*G. johnstoni*) may occur in the far southern parts of the Upper Niger Basin. Also within the family Viverridae is African civet (*Civecttitis civetta*), which is widespread and common in wooded and forested areas throughout West Africa. It occurs in Haut Niger N.P. (Ziegler *et al.* 2002) and probably in many other areas of the UNB.

Several species of Mongooses (family Herpestidae) occur in these parts of West Africa, including widespread species like Common slender (*Herpestes sanguineus*), Egyptian (*H. ichneumon*), Marsh (*Atilax paludinosus*), Gambian (*Mungos gambianus*), Banded (*M. mungo*) and White-tailed mongoose (*Ichneumia albicauda*). All of these species except Banded mongoose have been recorded in Haut Niger N.P. (Ziegler *et al.* 2002). Long-nosed (or Common) cusimanse (*Crossarchus obscurus*) is found in humid forests and may occur in the far south of the UNB.

Two species of otter occur in Guinea, i.e. African clawless otter (*Aonyx capensis*) and Spottednecked otter (*Lutra maculicollis*). The former species occurs in both freshwater and marine waters, whereas the latter species is only found in freshwater habitats. Both species are listed for Haut Niger N.P. (Ziegler *et al.* 2002). The Saharan striped weasel (*Ictonyx libycus*) occurs outside the UNB in arid habitats, and its range overlaps with the Niger Basin in Mali. It does not occur in Guinea. The African striped polecat (or Zorilla, *Ictonyx striatus*) is found in savannas throughout the continent, including eastern Guinea and southern Mali. Its status within the UNB is unknown. Honeybadger (*Mellivora capensis*) has an extremely wide distribution throughout Africa, where it is found in a variety of habitats including forest, savanna and semi-desert. It is listed for Haut Niger N.P. (Ziegler *et al.* 2002).

Several species of the cat family (Felidae) occur in West Africa. Sand cat (*F. margarita*) is a small species confined to the Sahara desert and Sahel, and it may occur in the Niger Basin in central Mali. It does not occur in Guinea or the Upper Niger Basin. Wild cat (*F. silvestris*) occurs throughout the African continent in a variety of habitats. Based on 'reliable reports' it was listed for Haut Niger N.P. by Ziegler *et al.* (2002). Serval (*F. serval*) occurs in savannas throughout West Africa including the UNB, but this species was not recorded in Haut Niger N.P. by Ziegler *et al.* (2002). The closely related Caracal (*Caracal caracal*) occurs in dry habitats largely outside Guinea and the UNB, although it is listed for Haut Niger N.P. (Ziegler *et al.* 2002) which suggests possible confusion with Serval. The secretive Golden cat (*F. aurata*) is also listed for Haut Niger. This is essentially a forest species that may just occur in the far southern parts of the UNB. Leopard (*Panthera pardus*) has a very large distribution range and occurs in a variety of habitats, from semi-desert to dense forest. Although it has been extirpated from many parts of West Africa, it still occurs in several protected areas including Haut Niger N.P. (Ziegler *et al.* 2002, Jacobson *et al.* 2016). No data on population size are available.

The future for both Cheetah (*Acinonyx jubatus*) and Lion (*Panthera leo*) in West Africa looks bleak. The North African cheetah still occurs in the Sahara desert in Algeria and northern Mali, and in the transboundary W–Arly–Pendjari (WAP) complex shared by Benin, Niger and Burkina Faso (Durant *et al.* 2017). This subspecies is listed as Critically Endangered by the IUCN, and it no longer occurs in Guinea. In the entire region Lion populations have collapsed, most likely due to large-scale conversion of habitat to agricultural land outside protected areas (Bauer & Nowell 2004). The West African population of Lion is considered to be Critically Endangered by the IUCN. No more than 400 Lions may remain in all of West Africa, occupying 1% of their historic range. Lions are still found in three protected areas in West Africa: by far the largest population occurs in the WAP complex, and much smaller numbers occur in Niokola–Koba N.P. in Senegal and Kainji Lake in Nigeria (Henschel *et al.* 2014). In Guinea, the continued presence of Lions in Haut Niger N.P. and Kankan Faunal Reserve, both within the Upper Niger Basin, is uncertain. As Henschel *et al.* (2014) state: "given the lack of physical evidence for over a decade and the poor management scores of those two PAs, we believe any remaining populations would be relict and close to extinction".

Striped hyena (*Hyaena hyaena*) occurs in arid habitats in north and east Africa. In Mali it probably occurs within the Sahelian parts of the Niger Basin, but it is not found in the more humid habitats in the Guinean parts of the basin. Spotted hyena (*Crocuta crocuta*) is found throughout the African savanna zones, and has been listed for Haut Niger N.P. (Ziegler *et al.* 2002). Several species of dogs (Canidae) occur in West Africa. The three species of foxes (Pale fox, Rüppel's fox and Fennec) are confined to desert or semi-desert habitats and do not occur in Guinea or the UNB. Side-striped jackal (*Canis adustus*) is a widespread savanna species that occurs in Guinea; it is also listed for Haut Niger N.P. (Ziegler *et al.* 2002). Its close relative the Golden jackal (*C. aureus*) does not occur in Guinea, but probably occurs

throughout the more arid parts of the Niger Basin. The African wild dog (*Lycaon pictus*) has disappeared from most of West Africa and is in imminent danger of extinction in the region (Bruguière *et al.* 2015). Niokola-Koba N.P. in Senegal is the last remaining area where this species can still be found in West Africa, but its numbers have declined severely.

English name	Scientific name	Habitat	IUCN	Occurrence in UNB
African palm civet	Nandinia binotata	Forest	LC	Haut Niger NP
Bourlon's genet	Genetta bourloni	Forest	VU	Uncertain, possibly in south
Common genet	Genetta genetta	Savanna	LC	Probably throughout
Johnston's genet	Genetta johnstoni	Forest	NT	Uncertain, possibly in south
Pardine genet	Genetta pardina	Forest, wooded habitats	LC	Haut Niger NP
Haussa genet	Genetta thierryi	Forest, wooded habitats	LC	Probably throughout
African civet	Civecttitis civetta	Various wooded habitats	LC	Haut Niger NP. Also surrounding areas?
Wild cat	Felis silvestris	Savanna	LC	Haut Niger NP
Serval	Felis serval	Savanna	LC	Caracal in Haut Niger confused with this species?
African golden cat	Felis aurata	Forest	VU	Haut Niger NP
Leopard	Panthera pardus	Various habitats	VU	Haut Niger NP
Lion	Panthera leo	Savanna	VU	Probably extinct
Common slender mongoose	Herpestes sanguineus	Forest, savanna	LC	Haut Niger NP
Egyptian mongoose	Herpestes ichneumon	Forest, savanna	LC	Haut Niger NP
Marsh mongoose	Atilax paludinosus	Riparian habitats	LC	Haut Niger NP
Gambian mongoose	Mungos gambianus	Forest, savanna	LC	Haut Niger NP
Banded mongoose	Mungos mungo	Savanna	LC	Likely in savanna areas
White-tailed mongoose	lchneumia albicauda	Savanna	LC	Haut Niger NP
Spotted hyena	Crocuta crocuta	Savanna	LC	Haut Niger NP
Side-striped jackal	Canis adustus	Savanna	LC	Haut Niger NP. Also surrounding areas?
Spotted-necked otter	Lutra maculicollis	Freshwater habitats	NT	Haut Niger NP
African clawless otter	Aonyx capensis	Freshwater + marine habitats	NT	Haut Niger NP
Honey badger	Mellivora capensis	Various habitats	LC	Haut Niger NP

Table 5.3 Carnivores in the Upper Niger Basin.

Bats

A large colony of several thousands of Straw-coloured fruit bats (*Eidolon helvum*) was present in a mango tree in the compound of the PCA-GIRE office in Kankan. This species is common and widely distributed throughout the savanna zones of Africa. Curiously it often occurs in very disturbed areas with lots of noise and disturbance, like town centers. A second species of fruit bat, the Gambian epauletted fruit bat (*Epomophorus gambianus*) was observed in Kouroussa.

5.3 Birds

Over 600 bird species are found in Guinea, including nearly 200 migratory species. Guinea has no endemic bird species, but a few restricted-range species do occur (e.g. Turati's boubou, Sierra Leone prinia). The avifauna of the Upper Niger Basin is characteristic of the West African savannas and forests and includes many species that are common and widespread in suitable habitats throughout the region. During the field work in February 2018, 95 species of birds were observed in the various areas of the Upper Niger Basin. A complete list is given in Appendix 2. Most of these species are common and widespread. The most interesting species that was encountered was Lesser Jacana, a small relative of the much larger and widespread African Jacana. This species was recorded and photographed at two sites along the Niger and Milo Rivers, which are the first documented records of this species in Guinea. To our knowledge, only one other published record exists of this species in Guinea, near the capital Conakry in 2005 (Guédon 2005). There are several seemingly isolated records of Lesser Jacana from northern Sierra Leone, NW Côte d'Ivoire and SW Mali (Borrow & Demey 2014). This suggests that the species might occur throughout this part of western Africa, at least seasonally. Further downstream the Niger River, the species is not uncommon in the Inner Niger Delta in central Mali (Van der Kamp et al. 2005, Girard et al. 2009). The status of Lesser Jacana in Guinea is unknown; during our visit we encountered only few other suitable wetlands in this part of the basin. However, our visit was in the middle of the dry season, and many temporal wetlands had probably dried out.

Haut Niger N.P.

Detailed bird surveys in Haut Niger N.P. have been carried out in the 1990s by Nikolaus (2000), recording roughly 300 species in different areas of the park. A summary of his findings is given in Box 5.1. During the field visits in February 2018, 55 species of birds were recorded within the park, including four species (Spur-winged lapwing, *Vanellus spinosus*; Red-chested swallow, *Hirundo lucida*; Eurasian oriole, *Oriolus oriolus*; Beautiful sunbird, *Cinnyris pulchellus*) that were not recorded by Nikolaus (2000).

Box 5.1: Birds of Haut Niger National Park. Source: Nikolaus (2000).

The text below is adapted from Gerhard Nikolaus (2000): The birds of the Parc National du Haut Niger, Guinea. Malimbus 22: 1–22.

Savanna woodland

The typical primary savanna woodland species for the park are: Beaudouin's Snake Eagle, Wahlberg's Eagle, Forbes's Plover, White-crowned Plover, Vinaceous Dove, Violet Tauraco, Wood Owl, Striped Kingfisher, Swallow-tailed Bee-eater, Blue-bellied Roller, Vieillot's Barbet, Fine-spotted Woodpecker, Rufous-rumped Lark, Grey-rumped Swallow, White-breasted Cuckoo Shrike, Green-backed Eremomela, Red-winged Warbler, Pallid Flycatcher, Blackcap Babbler, White-winged Black Tit, Violetbacked Sunbird, African Golden Oriole, Yellow-billed Shrike, White Helmet Shrike, Purple Glossy Starling, Chestnut-crowned Sparrow-Weaver, Red-headed Weaver, Yellow-winged Pytilia, Cabanis's Bunting.

Bowals

Bowals (or bowé) are covered with short grass and have some similarities with short grass plains in the dry savanna. Birds that appear here in the dry season include Forbes's Plover, Denham's Bustard, Rufousrumped Lark, Sun Lark, Plain-backed Pipit, Yellow-winged Pytilia, Orange-cheeked Waxbill, Lavender Waxbill and Black-bellied Fire-Finch. Palaearctic migrants include Tree Pipit and Whinchat.

Box 5.1 continued:

Swamps

The most typical birds of swamps are Painted Snipe, African Jacana, Yellow-throated Longclaw, African Moustached Warbler, cisticolas, Red-winged Warbler, Yellow-mantled Whydah, Zebra Waxbill and Quail Fich. Palaearctic migrants typical for this habitat are Purple Heron, Little Egret, Snipe, Wood Sandpiper and Yellow Wagtail.

Bowl forests

Related to lowland forests, bowl forests are small forest patches in a depression and often include a small swamp, lake or spring. Large green trees, thick undergrowth and humid surface throughout the year are characteristic. The bird community here is very similar to primary lowland forest. Typical species are: Tambourine Dove, Little Greenbul, Grey-winged RobinChat, White-crowned Robin-Chat, Green Crombec, Red-faced Cisticola, Olive Sunbird, Square-tailed Drongo, White-cheeked Oliveback and Crimson Seedcracker.

River edge vegetation

Along the two big rivers Niger and Mafou is a small fringe which sometimes continues also along the larger tributaries. The green vegetation is often restricted to the river banks. As with bowl forest, they are green throughout the year and provide thick undergrowth. African species that favour this habitat include: Guinea Tauraco, Blue-breasted Kingfisher, Shining Blue Kingfisher, Giant Kingfisher, Buff-spotted Woodpecker, Yellow-throated Leaflove, Oriole Warbler, White-browed Forest Flycatcher, Cassin's Flycatcher and Brown Sunbird. There are also some Palaearctic migrants attracted by this habitat: Olivaceous Warbler, Sedge Warbler and Chiffchaff were only found here.

Rivers Niger and Mafou

These are large enough to attract a variety of waterbirds, including the Afrotropical Hamerkop, African Fish Eagle, Senegal Thick-knee, Egyptian Plover, Rock Pratincole, White-crowned Plover, African Skimmer and Pel's Fishing Owl. Purple Heron, Black Stork, Osprey, Greenshank, Green Sandpiper, Wood Sandpiper and Common Sandpiper are winter visitors from Europe. Most of the African species use the late dry season with a low water level and sandbanks for breeding; during the rainy season, when the water level is high, they seem to move down the river to Mali.

Farmland and farmbush

This man-made habitat is only found in the buffer zone, and consists of regrowth on abandoned or fallow agricultural fields. After a few years a habitat with low trees and bushes mixed with open patches attracts many birds, like Laughing Dove, Grey-backed Camaroptera, Western Black Flycatcher, Whistling Cisticola, Tawny-flanked Prinia, Red-billed Firefinch and Yellow-fronted Canary. Even though the species composition is different from primary woodland, these habitats seem to be a valuable addition to the Park. Among the migrants from Europe, Nightingale, Whinchat and Willow Warbler show a preference for this habitat.

Kouroussa region

The small part of the Park next to Kouroussa is quite different from the rest of the Park. Fairly intensive agriculture over the last few hundred years has influenced the vegetation. The trees are much smaller and the vegetation is much more open. The area was visited in January and March and the species recorded from the Kouroussa region are presented separately in the species list. Future research should establish how marked the difference really is. Typical species recorded only in the Kouroussa region are: White-backed Vulture, Bateleur, Black-shouldered Kite, Temminck's Courser, Bronze-winged Courser and Chestnut-backed Sparrow Lark.

5.4 Reptiles and amphibians

Data on the herpetofauna of the Upper Niger Basin in Guinea are rather limited. The only study in the region known (in Haut Niger National Park) has been recorded by Greenbaum & Carr (2005). They recorded 43 reptile and 23 amphibian species based on preserved specimens, photos, literature records and own findings. Most of the species found were snakes (20 species) with the family of the Culubridae alone representing 11 species. Other species groups were chelonian, lizard and crocodile species. The crocodile species mentioned by Greenbaum & Carr (2005), are the Slender-snouted crocodile (Crocodylus cataphractus) and the Western Nile crocodile (Crocodylus suchus). The former is a critically endangered species which is restricted to forested rivers in West and Central Africa. It may now be extinct in most parts of West Africa. The Western Nile crocodile has recently been split from the widespread Nile crocodile (Hekkala et al. 2011). It has been categorized by the IUCN as offering insufficient information for a proper assessment of conservation status to be made. It is currently unknown if the third crocodile species occurring in Guinea, the African dwarf crocodile (Osteolaemus tetraspis), also occurs within the park. Its usual habitat consists of densely shaded swamps and streams in closed-canopy rainforest. This species is listed as vulnerable according to the IUCN. Other threatened reptile species based on ratings by CITFS, IUCN Red List, and Global Amphibian Assessment in Haut Niger N.P. are the Slender chameleon (Chameleo gracillis), Savanna monitor (Varanus exanthematicus), Western hinge-back tortoise (Kinixys belliana nogeuyi) and Nile monitor (Varanus niloticus). The authors were only able to sample during a short period and they note that the data on reptiles in the Haut Niger N.P. are not complete and should therefore be considered as preliminary.

More data on reptiles in the Upper Niger Basin region are not available. Böhme *et al.* (2011) however, provided a survey of the reptile species found in the forest zone in the southeast of Guinea. The list is composed of 64 recorded reptile species (2 chelonian, 16 lizard and 45 snake species as well as one crocodile species). The southeastern region is a forested area with large areas of pristine and extensive tropical forest, whereas the Upper Niger Basin is much more degraded. Therefore, it is questionable to what extend the species composition is comparable to that of the Upper Niger Basin. The authors also provided a nation wide checklist which documents the occurrence of 128 reptilian species (7 chelonian, 30 lizard, 88 snake and three crocodile species).

A study on the snakes of Guinea was performed by Trape & Baldé (2014). They recorded 95 snake species in Guinea and compared the currently known snake population in Guinea (104 species) to that of other West-African countries.

5.5 Fish

Scientific literature on the composition of fish species in the various regions of Guinea is scarce, and there are no references known on fish species in the Upper Niger Basin. However, a complete and very useful overview of all the fish species that are present in Guinea, is given by Froese & Pauly (2018) in <u>www.fishbase.org</u>. The species that are most likely relevant for the UNB are the freshwater species in this database. There are 245 freshwater fish species included in the list, of which 38 are endemic. The list is composed of 34 different taxonomic fish families. The most common taxonomic families in the freshwater bodies in Guinea are:

- Cyprinidae or carps (46 species included)
- Mochokidae or catfishes (31 species included)

- Cichlidae or Cichlids (28 species included)
- Nothobranchiidae or African rivulines (22 species included)
- Mormyridae or elephantfish (21 species included)
- Alestidae or African tetras (13 species included)

All the other taxonomic families consist of less than 10 fish species.

Other studies on fish species composition in the proximity of the upper Niger basin are performed by Sanogo *et al.* (2015) and Lévêque *et al.* (1983). Their findings partly support the occurrence of the fish species described by Froese & Pauly (2018).

Sanogo and colleagues identified fish species in the River Bagoé (Mali) based on artisanal fisheries landings and experimental fishery. The most common fish species found on the total investigated river course belonged to the families of the Cyprinidae, Cichlidae and Mormyridae, which are also among the most common taxonomic families in Guinea according to Froese & Pauly (2018). The upstream part (which is most comparable to the situation of the UNB in terms of biogeography) however, is characterized by the fish species *Bagrus docmak* (Bagridae family), *Oreochromis aureus* (Cichlidae familiy), *Oreochromis niloticus* (Cichlidae familiy), *Auchenoglanis biscutatus* (Claroteidae family), *Chrysichthys nigrodigitatus* (Claroteidae family) and *Mormyrus rume* (Morymidae family). Only the species *B. docmak*, *O. niloticus*, *C. nigrodigitatus* and *M. rume* are present in Guinea, so it is questionable how similar the species composition of the Bagoé river is compared to the UNB.

Lévêque *et al.* (1983) composed a list of freshwater fishes in the coastal basins of Guinea and Guinea-Bissau, based on inventories by the authors and previously published works (literature and collections of musea). The most relevant Guinean regions in this study are the basins of the Kogon and Kounkoure river. The most commonly observed fish species in these regions belong to the taxonomic families of the Cyprinidae, Cichlidae and Mormyridae. This is in line with the findings of Froese & Pauly (2018).

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6 Habitats and land use

6.1 Climatic zones

The main determinant of the distribution of habitats and ecosystems in West Africa is rainfall. As described in chapter 3, the Guinean part of the Niger River Basin covers a rainfall gradient from roughly 1,000–1,200 mm in the northeast to 1,800–2,000 mm in the southwest. This steep rainfall gradient is reflected in the landscapes and vegetation of the basin. However, within the limits set by rainfall, the habitats at the local level are predominantly shaped by anthropogenic impacts like burning, wood cutting, agriculture and cattle grazing. The general impact of these activities is a loss of vegetation cover, rendering the landscape more open than what would be expected purely on the basis of rainfall alone.

Based on the rainfall gradient, the West African landscape is usually classified into bio-climatic zones (e.g. White 1983, Le Houérou 1989, Arbonnier 2004). The various existing classifications differ in level of detail and the exact boundaries, but the general patterns can be summarized as follows:

- Sahara (<150 mm). A vast desert with sand dunes, rocky areas and other arid habitats where vegetation is scarce or absent. Thorny scrubs such as *Leptadenia pyrotechnica* are among the few plants that can survive in this arid environment. In moist depressions *Acacia tortilis* and *Balaenites aegyptiaca* may be found.
- Sahel (150–500 mm). This zone consists of sparsely vegetated steppes, with scattered Acacia trees (in particular *A. tortilis* and *A. senegal*) and *Balaenites aegyptiaca*. A number of major wetlands occur in this zone, including the Inner Niger Delta, the Senegal Delta and Lake Chad, as well as many smaller temporary wetlands that dry out dyring the course of the dry season. Nomadic cattle grazing (transhumance) is an important livelihood in which the herders and cattle migrate between temporary grazing grounds (Le Houérou 1989). Agriculture is generally limited to moist depressions, river banks and floodplains.
- Sudan zone (500–900 mm). This zone consists primarily of dry savanna with a welldeveloped grass layer and higher tree cover than the Sahel zone. Agriculture occurs widely and many areas are a patchwork of 'natural' savannas and active or abandoned farmland. White acacia *Faidherbia albida*, Karité *Vitellaria paradoxa* and Néré *Parkia biglobosa* are characteristic tree species of this zone.
- Guinea zone (900–1,800 mm). This moist savanna zone receives sufficient rainfall to support closed-canopy woodlands ('dry forests'). It generally consists of wooded savannas with a well-developed grass layer and characteristic tree species such as *Afzelia africana* and *Isoberlinia doka* in the northern parts and *Daniellia oliveri* in the southern parts. Fire is used frequently to clear fields for agriculture or to generate nutritious regrowth for grazing cattle. Agriculture is the most important land use. The structure and ecology of the West African woodland savannas are very similar to the miombo woodlands of south-central Africa.
- Forest (>1,800 mm). Annual rainfall in this zone is very high and the natural climax vegetation consists of tropical forest, with a high species diversity of trees (mainly Leguminosae). Today, much of the primary forest has disappeared and large parts of



this zone consist of a densely wooded forest–savanna mosaic with scattered forest patches and farmbush (abandoned fields with dense secondary growth).

Figure 6.1 Bioclimatic zones of West Africa. Source: CILSS (2016).

6.2 Habitats

A description of the vegetation in the basin is provided in chapter 5.1, and only a concise summary is given here. The natural habitat in large parts of the Upper Niger Basin is moist woodland savanna, with a transition to the dry Sudan savanna in the northeast (Siguiri area) and to the humid forest zone in the far south. Human impacts such as agriculture, wood cutting, burning and cattle grazing have severely degraded the habitats throughout the UNB, and more or less intact natural habitats have become very rare.

The northern parts of the basin consist of open savanna and dry farmbush (abandoned or fallow agricultural fields). Tree species that are characteristic of this zone include *Parkia biglobosa*, *Vitellaria paradoxa, Bombax costatum* and *Combretum spp*. The southern parts of the basin consist primarily of heavily degraded woodland savanna interspersed with agricultural fields. Characteristic tree species include *Afzelia africana, Isoberlinia doka, Daniellia oliveri, Cassia ataxacantha, Pterocarpus erinaceus* and *Khaya senegalensis*. Along water courses gallery forest is found.

The far southern zones of the basin receive sufficient rainfall to support closed-canopy forest, but this habitat is now very rare and is probably restricted to the Mafou core area of the Haut Niger National Park. A high diversity of trees is found here. The far southern part of the basin touches the wet forest zone, and remnants of mature forest may remain in some areas.

Major wetlands are absent from this part of the Niger Basin, although during the wet season many temporal wetlands may occur in the lower lying parts. These wetlands are often small and dry out during the course of the dry season. However, some wetlands appear to hold water permanently, such as the small wetland near the village of Bakongocissela (20 km south of Siguiri). These places provide important habitat for both resident and migrant species of waterbirds.

The habitats of Haut Niger N.P. reflect those in the wider area, although the dry forest in the Mafou core area is a unique remnant of a habitat that has disappeared from most of the region. A description of the habitats in the park is given by the IUCN (2008; see Box 6.1).

Box 6.1. Habitats of Haut Niger N.P. Source: IUCN (2008).

Le parc est situé dans la zone de végétation soudano-guinéenne. Les savanes du parc sont caractérisées par un tapis herbacé où dominent les graminées. On distingue trois types de paysages:

- **Savane arborée** (50%) composée de Parkia biglobosa, Vitellaria paradoxa, Pterocarpus erinaceus, Erythrophleum guineensis, Lophira alata, Ceiba pentandra, Piliostigma thonningii, Bombax costatum, Daniellia oliveri, Combretum glutinosum, etc.
- Savane boisée (28%), caractérisée par la présence de grands arbres avec comme principales espèces : Daniellia oliveri, Khaya senegalensis, Afzelia africana, Terminalia spp., Parkia biglobosa, Hymenocardia acida, Lophira alata, Detarium senegalense, Annona senegalensis, Xylopia aethiopica, Ficus exasperata, Ceiba pentandra, etc.
- Savane herbeuse dans les bas-fonds et les plaines et sur les bowé (9%), formation à dominance de graminées Andropogon gayanus, A. amplectans, A. subamplectans, Imperata cylindrica, Pennisetum purpureum, Loudetia spp., Hyparrhenia spp. Il arrive parfois que l'on rencontre sporadiquement des arbustes comme Mitragyna inermis (dans les plaines) et Lannea microcarpum (sur les bowé).
- La principale formation forestière est la forêt claire (12%), une des dernières reliques importantes dans la région et qui justifie le classement originel du parc. Elle se compose souvent d'une strate d'arbres de savane résistants aux feux (Hymenocardia acida, Lannea spp., Crossopteryx febrifuga, etc.) mélangée avec des arbres sensibles aux feux (Albizia zygia, Phyllanthus discoideus, Sterculia tragacantha, etc).
- Les galeries forestières, formations végétales plus denses, sont localisées aux abords des cours d'eau (1%).

6.3 Land use

As described before, water availability is the main driver of the patterns in habitats and land use in the basin. In contrast to the more arid Sahelian parts of the Niger basin, the moist southern parts of the basin receive sufficient rainfall to support rainfed agriculture. However, large-scale agriculture – mainly rice farming – is mostly restricted to the alluvial plains bordering the Niger River and its tributaries. A little higher up the slopes, other crops are being cultivated that are either (partly) irrigated or rainfed, including cassava, maize, millet, fonio etc.

Rice farming

The cultivation of rice is the main large-scale agricultural activity in the area. Major ricefields are situated along the floodplains of the Niger River and its tributaries. This lowland rice is restricted to the vast alluvial plains along watercourses (see fig. 6.2). In higher areas, upland

rice is cultivated using a slash-and-burn system, first with upland rice, then yam, cassave, maize, until the fields are abandoned. In moist depressions, rain-fed riz de bas-fond is found.

Traditionally, a number of different systems of rice cultivation in West Africa are being distinguished, based on the hydrological conditions. The principal factors are the source of water (rainfed vs. river water) and how this water reaches the plants (active irrigation, natural flooding, controlled water retention etc). In reality these systems do not have hard boundaries but represent a continuum from submerged valley bottoms in the lowlands to purely rainfed rice in the uplands (Windmeijer & Andriesse 1993). In Guinea all types of rice cultivation occur, depending on the location. At the national level rainfed rice (*riz pluvial*) is by far the most important, occupying 65% of the rice area in Guinea (Ministry of Agriculture and Livestock 2009). Other cultivation systems include alluvial rice farming, mangrove rice, irrigated rice and floating riverine rice (Windmeijer & Andriesse 1993, Roux 1998). In general, the most important areas for rice cultivation are located in the southern half of the country, where rainfall is highest. The northern parts and the Fouta Djalon contribute far less to the national rice production.

In the Upper Niger Basin, the floodplains of the Niger and its tributaries are used for large-scale cultivation of rice (*système de culture de plaine alluviale*). Sowing the rice takes place between April and June at the beginning of the rainy season. It is usually done in two rounds after which the seeds are hoed into the soil. The first rains make the seeds germinate, but the main growth of the rice plants is due to the inundation of the floodplains by the river water. The fields are left alone during the flooding period, until the harvest which takes place in the dry season in the period between November–January. The floodplains are burned after the harvest to clear the fields of remaining vegetation biomass and to stimulate high-quality regrowth for grazing cattle.



Figure 6.2 Location of the main areas for rice cultivation in the northeastern part of the UNB (east of Siguiri), showing the concentration of rice in the alluvial plains bordering the river.



Figure 6.3 Rice field with post-fire regrowth following a burn.



Figure 6.4 Slash-and-burn agriculture.

The yields of alluvial rice farming in Haut Guinée are reported to be low. The study of Ly *et al.* (2001) mentions average yields of roughly 1.2–1.4 tons/ha, which translates into >720 kg cleaned rice. This is roughly equivalent to the rice consumption by 10–12 people in a year. The yield from floodplain rice is substantially lower than that in more intensively managed systems. Potential rice yields in irrigated systems in the Sahel can reach up to 10 tons/ha under optimal conditions (Dingkuhn & Sow 1997). However, actual yields are often substantially lower and strongly dependent on the growing season, water availability, and crop management practices (Haefele *et al.* 2001). The average rice yields from irrigated systems in the Inner Niger Delta (Mali) or the Middle Valley (Senegal and Mauritania) amount to roughly 4–6 tons/ha (Haefele *et al.* 2001, USAID 2009, Seck 2015). However, irrigated rice farming incurs high costs related to investments and irrigation schemes. Farmers on the floodplains have few if any overheads.

Other crops

Besides rice, several other crops are being grown in the area, most importantly maize, fonio, cassava and peanuts. In addition, cotton is grown as a cash crop. Cereal fields are scattered throughout the area and found on dry sandy soils, occupying the higher grounds that are not inundated.

<u>Maize</u> (*Zea mays*) is one of the most important crops that are cultivated in this region, and in terms of production it comes second after rice. In 1998 the production of maize in the region of Haute Guinée amounted to 27,000 tons, which is equivalent to 34% of the national production in Guinea (Diakite & Doumbouya 2000). The main zone for maize cultivation is in the dry northern areas around Siguiri and Kankan. Maize production is low in the southern, wetter parts near Faranah. <u>Cassava</u> (*Manihot esculenta*) is another important crop in these parts of Guinea, in particular in the poor rural areas. <u>Fonio</u> (*Digitaria exilis*) is one of the traditional crops in the dry savanna zone of West Africa, and is widely cultivated in Guinea (Cruz *et al.* 2007). Since fonio matures very rapidly, as early as two months after sowing, it can be harvested well before the harvest of other cereals like maize, millet or rice. It is therefore an important food source in a time of year when other cereals are not yet available. Fonio can tolerate drought conditions to some extent, and it can grow on poor, sandy soils that are unsuitable for other cereals. Fertilization is done by the N'dama cattle that graze on the fields during the long fallow period, usually 5–7 years (Ferry *et al.* 2015).

Vegetable farming

The production of vegetables takes is an important livelihood activity that takes place along the periphery of the floodplains, a little higher on the slope than the rice fields. A diversity of vegetables is being cultivated, in particular onions (figure 6.5), tomatoes, cabbage, aubergines, chili pepper, carrots and okra. The main season is the 'cold' season after the rains, from November to February, although some crops (e.g. chili pepper, okra, aubergine) are also cultivated in the hot summer months. Vegetable farming can also be alternated with crops like millet or peanuts.

The cultivation of vegetable crops is usually practiced at a fairly small scale, although the total area may be substantial. Similar patterns are seen in other parts of West Africa; for example, in the Senegal Middle Valley over 92% of all agricultural activities are done at fields smaller than 2.5 ha (Seck 2015). Irrigation is mostly done by hand, using water from wells or from the river. In case the wells dry out in the dry season, a diesel pump can be used in order to irrigate the fields with surface water.



Figure 6.5 Onion fields near Bakongo Cissela.

Cotton

Because of the association with colonialism and slavery, cotton farming was mostly abandoned after Guinea gained independence (Gerardeaux & Kourouma 1998). In the late 1980s and early 1990s, cotton production increased sharply due to several projects that were initiated. Within the Upper Niger Basin, cotton is farmed mostly in the dry areas north of Siguiri and east of Kankan (Diakite & Doumbouya 2000). Kankan is also home to a cotton factory. Cotton farming is virtually absent from the humid southern parts. The average yield amounts to roughly 1,200 kg/ha (Gerardeaux & Kourouma 1998).

Livestock

Besides agriculture, livestock farming comprises one of the most important economic activities in rural Guinea. Nationwide, total livestock numbers in 2008 were estimated at 4 million cattle, 1.4 million sheep and 1.7 million goats. Livestock farming is mostly aimed at meat production. Throughout the Upper Niger Basin, the characteristic N'dama cattle can be found grazing on floodplains and recently burned areas where post-fire regrowth provides nutritious forage. This might be one of the main reasons for the widspread burning practices, including in the bufferzone and classified forests of Haut Niger National Park. Sheep and goats are found in smaller numbers.

N'dama cattle (fig. 6.6) are a local breed that is said to have originated in the Fouta Djalon mountains of Guinea. It is well adapted to the local environment and relatively tolerant to bovine trypanosomosis, a disease spread by the tsetse fly. As mentioned above, the cattle are used for meat production. An abbatoir is located in Kankan, which discharges blood and intestines straight into the Milo River. Milk production by N'dama cattle is very low, with no more than a few liters per day.



Figure 6.6 N'dama cattle.

Fishing

Once a year, at the end of the month of May, the annual fishing festival takes place at several lakes or wetlands in the region, including Baro lake (Ferry *et al.* 2015) and the small wetland behind the village of Bakongo Cissela. No detailed information on fish harvests or species composition are available; according to the villagers of Bakongo Cissela, species that are caught most frequently include carp and catfish.

6.4 Ecosystem services

The benefits that people derive from ecosystems in the Upper NIger Basin can be classified as *ecosystem services* (Costanza *et al.* 1997, Levine & Chan 2011, EU 2014). Besides goods like biomass or drinking water, ecosystem services may also refer to more indirect benefits like flood protection, climate regulation, maintenance of biodiversity, etc. The concept of ecosystem services was brought into widespread use by the Millennium Ecosystem Assessment (MA), a global initiative set up in 1999 to assess how ecosystem change would affect human wellbeing. The MA defines ecosystem services as "the many different benefits that ecosystems provide to people". Despite the importance of these services to people, in the past many have been taken for granted, being viewed as free and infinite. However, it is now clear that the worldwide degradation of ecosystems is also reducing the services they can provide (MA 2005). The ecosystem services. Assessing and quantifying these services not only addresses the importance of protecting ecosystems, it can also provide decision makers with quantitative data on the value of doing so.

Ecosystem services are usually grouped in the following categories (see references above and figure 6.7):

- <u>Provisioning services</u> that relate to products obtained from ecosystems such as food, timber, water, fuel etc;
- <u>Regulating services</u> that relate to benefits obtained from the regulation of ecosystem processes, e.g. carbon storage, disease control, water purification, pollination etc;
- <u>Supporting services which</u> are necessary for the production of other ecosystem services. These include services such as nutrient recycling, primary production and soil formation. These services make it possible for the ecosystems to provide services such as food supply, flood regulation and water purification;
- <u>Cultural services</u> that relate to non-material benefits such as religious and spiritual values, tourism, aesthetic values etc.

Ser	vices	Comments and Examples	
Pro	visioning		
Food production of fish, wild game, fruits, and grains		production of fish, wild game, fruits, and grains	
Fres	sh water*	storage and retention of water for domestic, industrial, and agricultural use	
Fibe	er and fuel	production of logs, fuelwood, peat, fodder	
Bioc	chemical	extraction of medicines and other materials from biota	
Gen	etic materials	genes for resistance to plant pathogens, ornamental species, and so on	
Reg	gulating		
Climate regulation source of and sink for greenhouse gases; influence local and regional t precipitation, and other climatic processes		source of and sink for greenhouse gases; influence local and regional temperature, precipitation, and other climatic processes	
Wat	er regulation (hydrological flows)	groundwater recharge/discharge	
Wat	er purification and waste treatment	retention, recovery, and removal of excess nutrients and other pollutants	
Eros	sion regulation	retention of soils and sediments	
Nati	ural hazard regulation	flood control, storm protection	
Poli	ination	habitat for pollinators	
Cult	tural		
Spiritual and inspirational source of inspiration; many religions attach spiritual and religious values wetland ecosystems		source of inspiration; many religions attach spiritual and religious values to aspects o wetland ecosystems	
Rec	reational	opportunities for recreational activities	
Aest	thetic	many people find beauty or aesthetic value in aspects of wetland ecosystems	
Edu	cational	opportunities for formal and informal education and training	
Sup	oporting		
Soil	formation	sediment retention and accumulation of organic matter	
Nutr	Nutrient cycling storage, recycling, processing, and acquisition of nutrients		

ECOSYSTEM SERVICES PROVIDED BY OR DERIVED FROM WETLANDS

Figure 6.7 Categories of ecosystem services delivered by wetlands. Source: ecosystems and human well-being (from

MA 2005).

Here we provide a brief and anecdotal overview of a number of provisioning services found in the Upper Niger Basin in Guinea, based on the data collected during the field mission in February 2018. The most important provisioning services refer to the water itself (drinking, washing, irrigation) and the production of biomass (agriculture, fishing, livestock) that is generated by the water. Agricultural activities such as the farming of rice, vegetables and livestock have been described in the previous sections. In the sections below a number of additional services are described. Some of these services refer to small-scale and local activities, such as the collection of fruits and honey, whereas other services have turned into more industrialized economic activities that can have severe impacts on the local environment.

Shea butter

The fruits of the tree *Vitellaria paradoxa* are used for the production of shea butter or beurre de karité. Vitellaria trees are found throughout the basin, in particular the dry areas north of Siguiri. They are less common in the wet southern parts of the basin. In a community project near the village of Aliamounou, 3 kg of fruits were estimated to produce 1 kg of shea butter. The butter was used locally, but also sold on markets nearby at a price of GF 20,000 (roughly €2) per kg.

Mangos

The ubiquitous mango tree (*Mangifera indica*) is found commonly in villages, along roads and other cultivated areas. No data on fruit production or local use are available. In Côte d'Ivoire, the yield in mango orchards ranges from 10 ton/ha in poorly maintained orchards to 15–20 ton/ha in well-maintained orchards (Van den Broek *et al.* 2016).

Wild fruits

At the village of Serekoroba near the Mafou River, women had collected the fruits of *Detarium* from the other side of the river.

Honey

Beekeeping is mostly a small-scale activity that can provide food or revenue to the rural population. Beehives in trees were commonly encountered throughout the area. These were mostly the traditional hives from grasses and wood (figure 6.8), but also some modern wooden beehives. Besides the provisioning of honey, beekeeping provides a regulating service in the form of pollination of plants and crops.

Wood

Wood extraction for firewood (figure 6.10) and charcoal throughout the region is probably considerable, leading to the degradation of woodland savannas. In addition, many gallery forests along rivers have been cut down. In the buffer zones and the classified forests in and around Haut Niger National Park, some extraction of natural resources is allowed. This includes the use of wood and non-timber forest products (NTFPs) by the local villagers. In Amana Forest several cut-down trees were found (figure 6.11), including *Daniellia oliveri, Khaya senegalensis* and *Bombax sp.*, and many stumps of trees that have been cut down earlier. In addition, chainsaws were heard at several locations.

Sand

Close to Kankan there is a sand excavation site, where the sand is dug from the riverbed of the Milo River to use for construction material (concrete). The sand is collected manually, loaded in metal pirogues and brought ashore, where it is loaded in trucks. During our visit around 50 pirogues were present, each carrying an estimated 0.5 m³ of sand. The price of 10 m³ sand ranges from GF 500,000 (€50) in the dry season to GF 750,000 (€75) in the wet season. Besides coarse sand, a pile of finer sand was found with clay, indicating damage of the impermeable clay layer of the riverbed.

Clay

Near Kankan a major site for brick construction is located, where the clay from the riverbanks is used as well as the wood from the trees in the gallery forest (figures 6.12, 6.13). This seems to have a major impact on the local environment.

Gold

A major gold mining site of several hectares is found just outside the eastern border of Haut Niger National Park (figure 6.14). The mining itself is done by the men, whereas washing the clay is done by women down by the river inside the borders of the park (figure 6.15). This is formally illegal but no action is taken. According to the women they use no mercury, but the reseller in town may do so. The women are working independently, but if hired the wages are GF15,000 (€1.50) per day.

Bushmeat

Brochettes (skewers) with bushmeat from apparently Yellow-backed duiker were sold at the ferry that crosses the Niger River near Diaragbela, in the northern part of Haut Niger N.P. In the bufferzones of the park and in Amana classified forest, several hunters were encountered daily. The hunted animals included a Warthog, Giant pouched rat, and the leg of presumably a Bush duiker. When asked, other hunters told that they hunt monkeys, large birds, porcupine and Warthog. Hunting in the buffer zones is allowed between October 1st and June 30th, except in an area of 245 km² north of Mafou Forest where hunting is not allowed at all.



Figure 6.8 Traditional beehive in a tree.



Figure 6.9 Collection of grass.



Figure 6.10 Firewood.



Figure 6.11 Logging in Amana Forest.



Figure 6.12 Brick manufacturing site near Kankan.



Figure 6.13 Firewood used in the brick ovens.



Figure 6.14 Gold mining site along the eastern periphery of Haut Niger N.P.



Figure 6.15 Gold washing site in the gallery forest.

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7 Synthesis

Climate and habitats

The Guinean part of the Upper Niger Basin covers a rainfall gradient from roughly 1,000–1,200 mm in the northeast at the border with Mali, to 1,800–2,000 mm in the southwest at the border with Sierra Leone. Rainfall is highly variable, and characterized by substantial fluctuations over the years. The steep rainfall gradient is reflected in the landscapes and vegetation of the basin.

The natural habitat in these parts of the Upper Niger Basin is moist woodland savanna, with a transition to the dry Sudan savanna in the northeast (Siguiri area) and to the humid forest zone in the far south. Human impacts such as agriculture, wood cutting, burning and cattle grazing have severely degraded the habitats throughout the UNB, and more or less intact natural habitats have become very rare.

The northern parts of the basin consist of open savanna and dry farmbush, i.e. regrowth on abandoned or fallow agricultural fields. The more humid parts of the basin consist of a mosaic of wooded savanna, thickets and fields. Along water courses gallery forest is found. The southern zones of the basin receive sufficient rainfall to support closed-canopy forest, but this habitat is now extremely rare and is probably restricted to the Mafou core area of Haut Niger National Park. A high diversity of trees is found here. The far southern part of the basin touches the wet forest zone, and remnants of mature wet forest may remain in some areas.

Ecological hotspots

The site with probably the highest biodiversity value in the Upper Niger Basin is Mafou Forest, which is one of the core areas of the Haut Niger National Park. Although only a tiny part of the forest could be visited, the habitat around the park headquarters appeared to be a unique patch of mature dry forest. Mafou Forest might represent one of the last remnants of this habitat in the wider region, providing habitat to species such as the critically endangered West African Chimpanzee (*Pan troglodytes verus*). We have no information on the exact status, threats or degradation of the forest, nor do we know the status of the other core area of the park, Kouya Forest. However, given the uniqueness and high biodiversity value of intact dry forest, the importance for conservation of these habitats is paramount.

Many parts of Haut Niger N.P., including the buffer zones and Amana classified forest, consist of degraded woodland savanna with an impoverished fauna. The field visits to these parts of the park indicated high levels of human activity, including hunting, logging, savanna burning, fishing, gold mining, cattle grazing, slash-and-burn agriculture, beekeeping, collection of grass and firewood, etc. No wild mammals like duikers or primates were observed in the park, indicating high hunting pressure. Several large mammals have already been extirpated from the area, including African savanna elephant and (most likely) Lion. Given the lack of staff and resources, effective conservation and protected area management in Guinea is a major challenge.

Large wetlands are absent from this part of the Niger River Basin, although during the wet season many temporal wetlands may occur in the lower lying parts. These wetlands are often small and dry out during the course of the dry season. However, some wetlands appear to hold water permanently, such as the small wetland near the village of Bakongocissela (20 km south of Siguiri). These places provide important habitat for both resident and migrant species of waterbirds.

Gallery forest is found throughout the region along rivers. In the northern parts this is often no more than a thin strip of a few trees bordering the water, but in the southern sections some well-developed gallery forests are present. These patches of gallery forest provide important habitat to several forest species in a matrix of open savanna and agricultural fields.

Land use and ecosystem services

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Water availability is the main driver of the ecology and land use in the basin. In contrast to the more arid Sahelian parts of the Niger River Basin, much of the Guinean part of the basin receives sufficient rainfall to support rainfed agriculture. The cultivation of rice is the main large-scale agricultural activity in the area. Major ricefields are situated along the floodplains of the Niger River and its tributaries. This lowland rice is restricted to the vast alluvial plains along watercourses. In higher areas, upland rice is cultivated using a slash-and-burn system.

Besides rice, several other crops are being grown in the area, most importantly vegetables, maize, fonio, cassava and peanuts. In addition, cotton is grown as a cash crop. Cereal fields are scattered throughout the area and found on dry sandy soils, occupying the higher grounds that are not inundated.

The production of vegetables takes is an important livelihood activity that takes place along the periphery of the floodplains, a little higher on the slope than the rice fields. A diversity of vegetables is being cultivated, in particular onions, tomatoes, cabbage, aubergines, chili pepper, carrots and okra. The cultivation of vegetable crops is usually practiced at a fairly small scale, although the total area may be substantial. Irrigation is mostly done by hand, using water from wells or from the river. In case the wells dry out in the dry season, a diesel pump is used in order to irrigate the fields with surface water.

In addition to the agricultural activities described above, the Niger River and its tributaries provide several ecosystem services to the local people. Some of these services refer to small-scale and local activities, such as the collection of fruits and honey, whereas other services have turned into more industrialized economic activities that can have severe impacts on the local environment. Some prominent ecosystem services include Shea butter (made from the fruits of the tree *Vitellaria paradoxa*), beekeeping, logging and firewood, sand extraction from the riverbed, clay for brick construction, gold mining, and bushmeat.

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Appendix 1. Field mission results

The data and information in this appendix has been published before in the field mission report of February 2018:

Klop, E. & M. Sikkema 2018. Mission report of the field visit to the Upper Niger Basin in Guinea, February 2018. A&W-notitie 2817-1-2018. Altenburg & Wymenga ecologisch onderzoek, Feanwâlden.

Habitats and land use

In the study area annual rainfall varies from roughly 1200 mm in the north to 1600 mm in the south. The terrain is largely flat or slightly undulating, although more prominent hills are found in the southwestern parts. Many areas have the typical hard laterite soils interspersed with more sandy areas and alluvial plains near the rivers. The northern parts of the area are characterized by open, degraded woodland savannas and farmbush (abandoned agricultural fields). Typical tree species include Parkia biglobosa, Vitellaria paradoxa (of which the fruits are used to produce shea butter or beurre de karité), Bombax costatum (Red kapok tree), Combretum spp., some very large Ceiba pentandra (silk cotton tree), and the ubiquitous Mango. More to the south, the vegetation gets thicker and at places forms a closed-canopy dry forest. Typical trees of these forests include Daniellia oliveri, Afzelia africana, Isoberlinia doka and several other species.

Along water courses gallery forest is found; in the northern parts often no more than a thin strip of a few trees (Ficus, Uapaca etc) but in the southern sections some well-developed gallery forests are present which provide important habitat for several forest species.

Throughout the area, there is agriculture, consisting mainly of:

- Rice farming, which is mostly done on the alluvial plains bordering the rivers. The rice is rain-fed and not dependent on irrigation, but the hard laterite soil in many areas prevent large-scale rice farming in the higher parts. However, some upland rice is being farmed in a few areas using a slash-and-burn system, first with upland rice, then yam, cassave, maize and finally the fields are abandoned. In moist depressions, rain-fed riz de bas-fond is found.
- Millet, maize and other dryland crops (fonio, peanuts etc). These fields are scattered throughout the area and found on dry sandy soils.
- Vegetable cultivation. Along the periphery of many rice fields and moist areas near the rivers or wetlands, vegetables are grown by the local women, including onions, okra, cassava and aubergine. Irrigation is mostly done by hand.
- Cash crops such as cotton. There is a cotton factory in Kankan.
- Cattle grazing. Throughout the area, the characteristic N'dama cattle are grazing on floodplains and recently burned areas where post-fire regrowth provides nutritious forage. This might be one of the main reasons for the widspread burning practices, including in the bufferzone and classified forests of the national park. Sheep and goats are found in smaller numbers.

Ecosystem services

The Niger River and its tributaries provide several important ecosystem services to the livelihoods of the local people. We recorded the most important provisioning services, including:

- Shea butter production from the fruits of Vitellaria paradoxa trees, which are found throughout the area (in particular north of Siguiri, less so in the southern parts).
- Brick construction. Near Kankan a major site for brick construction is located, where the clay from the riverbanks is used as well as the wood from the trees in the gallery forest. This seems to have a major impact on the local environment.
- Sand excavation, also close to Kankan where the sand is dug from the riverbed, brought ashore using pirogues and then collected and transported using more heavy machinery.
- Gold mining. A major site of several hectares is found just outside the eastern border of Haut Niger National Park.
- Apiculture. Throughout the area, we recorded beehives in trees. These are mostly the traditional hives from grasses and wood, but also some modern wooden beehives.
- Wood. In Amana Forest several cut-down trees were found, including Daniellia, Khaya and Bombax.

Biodiversity

At all sites visited, the main tree species and animal species were recorded. In general, numbers of birds, mammals and other vertebrates recorded were very low. In total around 100 species of birds were recorded. Few mammals were recorded, except some species in hunters bags (Giant pouched rat, Warthog and presumed Yellow-backed duiker meat), a Striped ground squirrel, and two species of bats (huge roost of Straw-coloured fruit bats at Kankan, and a few Epauletted bats at Kouroussa). In addition, tracks were recorded of Hippopotamus, antelope species (possibly Bushbuck), Red river hog or Warthog, and Marsh mongoose.

The vegetation in the northern parts was dominated by Vitellaria, Parkia, Bombax, Teak (Tectonia grandis), Mango and other tree species characteristic of these open degraded savannas and farmbush areas. More to the south and in Haut Niger National Park, other species were dominant including Daniellia oliveri, Afzelia africana and other species of the West African moist woodland savannas.

Eflow data

Field measurements of water flow were only done at the Mafou River near Serekoroba, where the velocity was too low to get a proper reading from the flow meter. River dimensions were measured at several locations. The directeur régional hydraulique, Mr Balla Traoré, kindly provided us with the data on river discharges and daily water levels measured at six hydrological stations in the Upper Niger Basin:

- 1. Dialakoro, data from 1954 2017
- 2. Kouroussa, data from 1970 2017
- 3. Baro, data from 1947 2014
- 4. Faranah, data from 1955 2010
- 5. Kankan, data from 1938 2015
- 6. Mandiana, data from 1954 2014

At the request of Chris Dickens and his team, lots of georeferenced photographs were taken of riverside vegetation, river banks, and terrestrial habitats. The GPS coordinates are stored in the Exif data of each photo. Locations of the photos can be viewed using e.g. Lightroom or Geosetter. The photos have been placed on Google Drive.
Daily log

Tuesday 30 January 2018

Morning car accident in Bamako. Visit Wetlands office, meet the staff and prepare for trip to Guinea. At 10 AM leave Bamako, arrive at border at noon. Lunch in Siguiri, stopped at bridge over Niger River at Niandankoro where water levels were very low. Many local women washing clothes in river. Arrive at Kankan 17:30. Dinner with WI staff at local restaurant.



Wednesday 31 January 2018

Leave hotel at 8:30 to PCA-Gire office in Kankan. Meet Mr Sacko, coordonnateur technique. Discuss planning and itinerary. Meet with directeur régional de l'environnement Souleymane Kourouma and directeur régional hydraulique Mr Balla Traoré. Look at major roost of Strawcoloued fruit bats in the Mango trees at the compound. To the gouverneur of Kankan to introduce ourselves. Back to PCA-Gire office. To village Aliamounou to see vegetable fields and reforestation site that is subject of a Wetlands project. Made a short walk into the forest and discuss status, biodiversity etc with local people. Back to PCAGire office and meet regional director Mr Sékou Diarra and the conservateur de la Réserve de la fauna de Kankan Mr Lanciné Faro.



- Communité des femmes established to do vegetable production. Received funds to construct a solar driven water pump. Main crops: tomatoes, cabbage, salad, onions, maize. Also banana trees along edge of fields.
- Many Vitellaria trees in the area, which are used for the procution of Beurre de karité.
 Production: 3 kg fruits give 1 kg butter. For local use, markets nearby and export. Price is GF 20,000 per kg.
- Main tree species: Vitellaria, Parkia, Bombax, Daniellia, Isoberlinia, Teak, cabbage tree, Piliostigma, Prosopis. Several Parkias and Vitellarias in flower.
- Burdning is widespread, resulting in post-fire regrowth for cattle grazing and maintaining open savanna landscape.
- Birds: Senegal eremomela in Bombax and Vitellaria, Peregrine, Red-necked buzzard, Bluespotted wood-dove, Black kite, Pied crow.
- Reforestation project: 60 ha started with ABN project 30 years ago. Now 10 ha added in 2016. The forest is not burned, no hunting, no wood harvesting etc. A few important species planted: Teak, Vitellaria, Gmelina in open spaces in forest.
- Mammals: nothing seen but according to local people there is Warthog, Patas, Bushbuck, Red-flanked duiker, no Yellow-backed duiker.
- The forest site has no formal protection status but is protected by the local community.
- Fine up to €50 for illegal activities.
- Villagers want to start apiculture for honey production.
- Rice production in Guinea mainly riz pluvial = riz seche. Rain dependent system, sown in wet season. One harvest per year.
- Other crops: maize, foni, cotton (factory in Kankan).

Thursday 01 February 2018

Visit to Siguiri area. First to the river near Tinkisso near confluence with Niger River, where we explored the gallery forest on the north bank. Tree species and bird species were recorded, and measurements taken of the river width, bridge height, max water levels and slope of the river banks. Cattle grazing on grassy river banks – on opposite side (south) also had Hippo tracks. Then lunch in Siguiri and travel to site with Faidherbia trees in millet fields. Carried out bird census counts in 3 Faidherbia trees, which held Melodious warbler, Bonelli's warbler and



Chiffchaff and others. Lastly we visited a small temporal wetland, where many waterbirds were present.

Main results:

- River width near bridge = 195 m, height bridge = around 12,5 m. Max water level = 5-6 m above present level. Water velocity very low.
- Mimosa pigra fields along grassy field where cattle grazes. Is exotic species?
- Gallery forest quite thin strip with Pterocarpus xantalnoides, Uapaca heudelotii/guineensis and other species. Pterocarpus bark used as medicine for cattle. Fruits dispersed by water.
- Birds present: Chiffchaff, Northern crombec, Beautiful sunbird, Yellow-crowned gonolek
- Around 100 Wattled lapwings on river bank, 5 Egyptian plovers, Red-chested swallow, Grasshopper buzzard, Greenshank
- Bridge was built in 2006, first there was a ferry
- The cows are N'dama cattle, characteristic of the Guinean highlands
- Women washing clothes in river. 8 adults and 10 children.
- Fish present in river, check species. Gill nets in river.
- On south bank, gallery forest only one tree wide. Check species, Uapaca again and Ficus sp?. Birds present: Red-billed firefinch, 2 Chiffchaff, Northern crombec, queleas, Little egret, Little swift
- Hippo tracks present on south bank. According to young boy they occur on both sides of the bridge.
- Old abandoned brick construction site, for which wood is needed from gallery forest.
- Laterite layer immediately above sandy river banks.
- Many Speckled pigeons between bridge pillars. Breeding?
- Black-headed heron flying over rice fields.
- We encountered two sites with Faidherbias along the tar road. 3 Faidherbias inventoried.
- Faidherbia site: millet fields with scattered Faidherbias, Vitellarias, Parkis, Baobab, Ficus spp. (old Ficus capensis → photo), Mango trees. Tree cover roughly 30%. Also lots of Moringa (check).

- Melodious warbler, Bonelli's warbler, Chiffchaff, sunbirds, Grey hornbill, Senegal parrot, Hooded vulture, Kites
- Vegetation along main road dominated by Vitellaria, Parkia, Combretums, Bombax, Isoberlinia, Baobab
- Very few birds encountered along the road.
- Five hunters on motorcycles seen on the way back
- Wetland visited close to road. Check dimensions.
- Many birds present: at least 42 Jacanas, 1 Lesser jacana (new record for Guinea?), 2
 White-faced whistling ducks, 12 Squacco herons, 6 Cattle egrets, 1 Great egret, 1 Little egret, 1 Marsh harrier, 1 Grasshopper buzzard, 1 Abyssinian roller, Green / Wood sandpiper, 3-4 Zitting cisticolas, 2 Wattled lapwings
- Pool fed by runoff water, falls dry in April and fills up again with rains. Connected to river floodplains to release water.
- Field of riz de bafond. From China.
- Much grass along edges of pool. Lots of water lily and Utricularia. Fruit of water lily apparently not eaten by local people.
- Fish present in pool.
- Other side of road recently burned. Snake skin found (cobra, check species).
- All the major fields along river = rice. Millet fields small and scattered.
- Vegetable fields small because of irrigation constraints, need to be watered two times a day.

Friday 02 February 2018

Visit to the village of Bakongokorro where visited the river and the vegetable fields. Discussed production and water use with the local women. Then to Bakongocissela to visit the wetland besides the village, where the village chief showed us around. Then visited a small part of gallery forest where the N6 crosses a dry river bed, but had to leave due to bees attack. Back to Kankan and break for prayer, in the afternoon to the brick construction site near the Milo River, and to the sand excavation site.



Bakongokorro:

- Wood cutting in gallery forest not allowed, use of bark and fruits for medicinal use is allowed
- Max water level 5-7 m higher than current level
- River width 130m
- Year-round fishing with standing nets
- 3 African skimmers on small sand bank, 1 Egyptian plover, 1 Cattle egret, 1 Little egret, 2 Wattled lapwings, Red-eyed dove, group of francolins in gallery forest, Common bulbul
- Water levels very low, less than 1m
- Vegetable fields with onions, okra, aubergine. Cultivation done by the local women.
- 2 to 4 wells per field. Depth around 4 5 m. Some dry.
- Motorpomp to irrigate when wells are dry
- In wet season cultivation of millet and peanuts on the same fields
- Major part of harvest is sold on markets, lesser part for own consumption
- A few km of fields along river; check satellite map.
- Boy with small catapult to chase away birds, not too serious

Wetland near Bakongocissela:

- Permanent water in the wetland, even in dry season.
- 20% scirpus islands, 70-80% water lily (not near edge), 5% Ludwigia grandiflora, Mimosa pigra 0-2,5% and Utricularia 1%
- Dimensions roughly 235m x 500m
- Fishing only allowed during festival in April, rest of the year not allowed
- Carp, Silure (catfish), Konkon, Fanah = main fish species. Especially carp and fanah.
- Vegetable fields mainly onions and aubergine. Irrigation with buckets, using water from wetland.
- Small plot (around 15 m2) of onions is worth GF 200,000
- 210 Whitefaced whistling ducks, 2 Marsh harrier, 1 Black-shouldered kite, tens of Squacco herons, many (100?) African jacanas, 1 Lesser jacana, 1 Grey heron, 1 Purple heron, 1 Yellow wagtail, 50? Cattle egrets, 1 Red-rumped swallow, 4 Spurwinged lapwings
- Long-tailed starling, Abyssinian roller, many Red-billed queleas in Mimosa bushes, Grey-headed sparrow, 2 Hooded vultures
- Grazing by cattle, 30-50 cows of N'dama cattle.
- Rice fields around wetland; check dimensions.
- Formerly there was a small woodland used as heronry, destroyed by droppings, now Mimosa bushes
- Field near village \rightarrow vegetables during wet season when other fields are flooded
- A few brick ovens nearby

Gallery forest near N6:

- No water in riverbed
- Mainly low gallery forest with lots of tangles, a few big trees, some Mimosa pigra. Used by cattle (tracks).
- Cut down Daniellia oliveri
- Beautiful sunbird, Grey-backed camaroptera, Senegal coucal, Lesser honeyguide, Blue-spotted wood-dove, Red-eyed dove, African paradise flycatcher, Snowy-crowned robin-chat, Green turaco

Brick construction site Kankan:

- Major brick production using clay from riverbed. Check dimensions. Ovens are built from the bricks themselves, using wood from Mango and Vitellaria. Possibly significant impact on river banks and gallery forest.
- Large-scale, several kilometers
- 11 Yellow wagtails, Wire-tailed swallow, Western reef egret, juvenile Green heron

Sand excavation site:

- Sand extracted from riverbed (coarse sand), loaded in metal pirogues and brought ashore, then loaded in trucks
- Used for construction (concrete)
- Pile of finer sand with clay from clay layer (impermeable)
- Revenu 10 m3 sand = GF 500,000 in dry season, GF 750,000 in wet season
- Roughly 50 pirogues with 0,5 m3 of sand

Saturday 03 February

First a very long bumpy drive to Moussako where the new dam will probably be built. Along the way we passed by the classified forest of Koumban-Kourou, but could not visit the forest itself due to time constraints. Habitat is dense woodland savanna on some low hills. In the afternoon via Kankan to the Fomi dam site.



Main results:

General area:

- Cultivation in the highlands: slash and burn pattern with first riz de montagne, then yam, manioc, maize and finally fallow/abandoned.
- Landscape mostly wooded savanna and farmbush, more densely wooded than Kankan area, with some patches of gallery forest and dry forest. Some small creeks with water, some dry.
- Trees: less Vitellaria, mainly Isoberlinia Daniellia vegetation
- Less human habitation in the area, fewer and smaller villages. Typical bush villages.

- Birds: Heuglin's wheatear, Bush petronias, many birds of prey. Higher bird densities compared to Kankan-Siguiri area?

Moussako:

- Distance from gallery forest to gallery forest is 165m. Watercourse itself is 95-100 m wide.
- Trees: Mytragyna inermis + variety of others (the same as on other locations and some Ficus species).
- Gallery forest between 1 tree and 10-15 m. Used as public toilet.
- Chinese are currently busy with geological survey.
- Dam will be built between two hills. In case Moussako is built, no dam at Fomi.
- Land use is mostly rice cultivation, major ricefields in area. Also some fallow fields. Cows grazing.
- Water level low <1 m
- Birds: 6 Egyptian plovers, 2 Blue-bellied roller, 2 Grey hornbills, 2 Spur-winged lapwings, Tinkerbird (H), Blue-spotted wood-dove (H), Red-eyed dove, Common bulbul, oriole sp. (H), Pied crows, Grey-backed camaroptera, Yellow-throated leaf-love.

Fomi site:

- Distance from gallery forest to gallery forest is 145 m. Watercourse width = 88m. Height riverbank to water = 5m.
- Nice gallery forest roughly 15-20 m. Low trees of ca. 8 m. Behind gallery forest is a low rocky hillside.
- Birds: Red-bellied paradise flycatcher, Blue flycatcher, Yellow-crowned gonolek, Common wattle-eye, Green pigeon, Brown babbler, Northern puffback, Splendid sunbird, Village weaver, Bronze mannikin, Grey-backed camaroptera, Peregrine flying over. River birds: 2 Egyptian plover, 2 Pied crows, 5 Cattle egrets, 2-5 Barn swallows, Red-chested swallow, Grey heron, Osprey, Blue-spotted wood-dove (H), Tawnyflanked prinia (H)
- Lots of firewood and charcoal along the tar road to Kouroussa

Sunday 04 February

No field work possible because of local elections. In the afternoon to PCA-GIRE office to get data on river discharges and water levels at 6 stations. Thereafter to the water level scales, and the abbatoir which discharges blood and organic material directly into the river.

Main results:

- Data collection on hydrology, received data from Mr Traore.
- Visited site of water level poles. Very dirty place, much pollution and debris from the city in the water. Quite a sanitation issue.
- Abbatoir discharges blood and intestines in the river. Extreme lack of hygiene. Surprisingly no Hooded vultures present; result of the major population decline?
- Fishing is done directly below abbatoir. The meat is for Kankan, few cows a day.

Monday 05 February

Moved from Kankan to Kouroussa. First visited the prefecture, then checked in at hotel. Crossed the Niger River by ferry to Diaragbela. Most of the day spent in the Amana Forest in the northeastern section of the Haut Niger national park.



North bank Diaragbela:

- Major burned rice field, now grazed by cattle. Dry pool present. Burned recently, still smoking, and other fires still burning.
- Trees: Terminallia sp, Cassia siamea, Ficus capensis
- 70 cows grazing
- Birds: 75 Cattle egrets, 3-5 Grasshopper buzzards, 100? Pied crows, 20+ Yellow-billed kites, Lanner falcon, several Grey hornbills, 3 Hooded vultures, Blue-spotted wooddove, 2 Plain-backed pipits, 4 Senegal eremomela in flowering Pterocarpus erinaceus, Tawny eagle.

Niger River crossing:

- Bushmeat brochettes at the ferry from apparently Yellow-backed duiker
- 17 women washing at river
- At south bank, a few brick ovens have been constructed. Apparently the first in this area.
- Gallery forest roughly 20-25 m wide, including Pterocarpus xantalnoides. Height around 10-15 m high.
- 7 Egyptian plovers, 1 African skimmer, Hooded vulture, 2 Wattled lapwings, Hamerkop,
 13 Cattle egrets, Blue-breasted kingfisher, Red-chested swallow

Amana Forest:

- Crossed small gallery forest along dry stream, Shikra seen.
- Encountered a wetland holding water, with Intermediate egret, 8 Cattle egrets, 18
 Wattled lapwings, 5 Jacanas, 1 juvenile Marsh harrier, displaying Rufous-rumped lark, 1 Yellow wagtail, 45 cows grazing, Grey hornbill, Vinaceous dove, Red-necked buzzard
- Trees: Daniellia oliveri (commonly encountered), Afzelia africana (common), Cassia ataxacantha, Gardenia sp, Cassia sp, Pterocarpus erinaceus, Khaya senegalensis
- Several recently cut down trees encountered, including Bombax, Khaya. Also many stumps of earlier cut down trees. Chainsaw heard at various locations. Difficult to estimate logging intensity, but logging is certainly taking place. Is allowed in bufferzone.
- Active bush fires encountered, several locations recently burned, also in forest.
- Several rice fields, all located parallel to the river.

- Crossed mature gallery forest with high trees and lianas, Possibly flushed a duiker. Broad strip of forest, roughly 40-50m. Common wattle-eye, Paradise flycatcher (H)
- Grass field with Sun larks (2 adults with fledgling). Laterite layer with termite mounts, burned.
- Had to turn around because track ended for cars (motorcycles can continue).
- Area is densely wooded with high canopy cover. Some grass layer present, is burned. Dominant tree species see above. Almost no birds/animals seen during the day, but activity increased later in the day.
- Hunter on motorcycle.
- Marsh harrier male above rice field

Niger River site 1:

- Gallery forest roughly 30 m wide, well developed on both river banks.
- Tracks/signs of Warthog/Red river hog, Bushbuck (?) and cattle
- Feather of Guineafowl
- 4 Egyptian plovers, Wire-tailed swallow, 2 Wattled lapwings,
- Trees: Piliostigma thonigii (camelfoot) in dry forest next to gallery forest
- Large sandbanks in river

Niger River site 2:

- River gallery forest to gallery forest: 155m, water 80 m
- 7 boys were fishing. Old gill net on the sand bar
- Well developed gallery forest on both sides.
- 20 Wattled lapwings, 2 White-headed lapwings, 1 Little egret, 4 Egyptian plovers, 1 Common sandpiper
- Chainsaw nearby.
- Tracks of antelope sp. and cattle close to river

On the way back in bufferzone:

- Fork-tailed drongo, White helmetshrike (25), African hawk-eagle, Eurasian oriole, 7 White-backed vultures, 2 Cordonbleu, Black-shouldered kite
- Hunter on motorcycle, he told us that he hunts porcupine and warthog. Large birds are being trapped.

Tuesday 06 February

Visit to the bufferzone of the national park Haut Niger. Visited an artisanal gold mine and the washing facilities near a small forested river. Then on to village Serekoroba, where we did some flow measurements in the Mafou River. First we thought that this would be an undisturbed part of the park, but human presence was everywhere. We encountered one hunter with a Warthog, then six others during the day. On the way back we did a short pirogue trip on the Niger River.



- Near river crossing: Pin-tailed whydahs, Red-cheeked cordon-bleus, Red-billed firefinch, Bush petronias.
- Lots of gold mining activities along the border of the zone périferique. Pretty large scale (around 5 ha). Gold washing by the women down by the river inside the borders. This is formally illegal but no action is taken. According to the women, no mercury is used (this is questionable) but this is done by the reseller in town. Women are working independently but if hired the wages are GF15000 per day. Roughly 100 euro for 2-3 grams of gold?
- Along the main route to the south there is lots of disturbance, like agricultural fields, burning, logging, cattle grazing etc. One roadside vegetation cleared by bulldozer apparently.
- Striped ground squirrel seen crossing the road.
- Small road of 24 km to Serekoroba. Also lots of disturbance, slash-and-burn, beehives, fields, grass for roofs, etc. Human presence is dominant everywhere.
- Hunter showed us modern beehives and told us he hunts Warthog and monkeys.
- Serekoroba: visited the Mafou River, where we tried to do water velocity measurements. Velocity very slow, resulted in no reading by flow meter, so tried experiment with floating leaves.
- Apparently also fields on other side of Mafou River, up to the Niger. This is the Mafou Forest section of the NP.
- Water level low (knee-deep so roughly 60 cm), width 25 m of water, gallery to gallery 65m.
- Birds: 2 Egyptian plovers, White-headed lapwing, 2 Beautiful sunbirds, Common bulbul (H).
- Women had collected fruits of Detarium from other side of river.
- Visited another river site near the village. River width water 25m, gallery-gallery 110m, water very undeep (roughly 50 cm), Senegal thick-knee. Very wide sandbank.
- Upon asking which wild animals come to drink, they answered Bushbuck, Buffalo and Kob. The latter seems unlikely however.
- Back to Niger River, location of ferry. Wood in truck of Pterocarpus, apparently very good quality wood. Price GF75000 for one chunk of wood (roughly 2m x 30 cm x 30 cm). Price of a bed of Pterocarpus wood in Bamako = CFA615,000.

- Lots of oil floating on the river.
- Pirogue trip on Niger River. Only short trip (800m) on the water, then walked the sandbanks. Found tracks of Marsh mongoose. Apparently Hippos further upstream.
 Faro mentioned "Chien de riviere" as a mammal living there, bigger than Civet. Unclear what mammal he refers to.
- Birds: Western grey plantain-eater, 40 Bush petronias, White-headed lapwing, 2 Common sandpipers, Wattled lapwing, Cattle egrets, Egyptian plovers, Long-tailed cormorant, Red-eyed dove, 3 Senegal thick-knee, Tawny eagle, Green pigeon.
- A little higher up: tree filled with Starlings, Purple glossy and probably Bronze-tailed.
- Maliki received leg of Duiker from hunter, probably Bush duiker given the size and greyish colour.

Wednesday 07 February

Today we visited the strictly protected section of Haut Niger NP. Very long drive, but worth it: seems to be unique habitat (mature dry forest) in an otherwise open degraded savanna landscape. Some captive primates (Olive baboon, Vervet monkey, Patas monkeys) present. Discussed with two park rangers about status, threats, biodiversity, visitors etc. Unfortunately very limited visitor facilities and no trails.



Main results:

- The strictly protected area contains unique habitat not found in the surrounding areas (well developed forest without logging etc). This might be one of the last intact remnants of mature dry forest left in this part of Africa. However, levels of encroachment and threats hard to assess.
- Need to check satellite maps and IUCN delineation for borders of NP, classified forests and buffer zones. This is rather unclear. Check GPS points and georeferenced photos.
- In the areas surrounding the strictly protected area there is the usual human impacts: burning, logging, cattle grazing etc.
- In total 157 people employed by the park. Park area = 1,250,000 ha of which 5600 strictly protected (Mafou forest).

- Some species that occur in the park: Chimpanzee, Leopard, Yellow-backed duiker, Red-flanked duiker, Buffalo, Baboon. Questionable species include Lion, Kob, Roan etc.
- Some captured primates are held at the headquarters: 3-4 Baboons, 6 Patas monkeys and 1 Vervet monkey.
- Visitor facilities include accommodation and guided walks. No food or water available. Park fees GF500,000 pppd. Limited trails inside the park.
- Bridge over Mafou River: built in 1985 for cotton project. African fish eagle, Hamerkop, Osprey, Malachite kingfisher, Senegal coucal, Wire-tailed swallow. Water levels very low, nice gallery forest on both sides.
- On the way back, we encountered a group of women trying to reduce the water level in a pond in order to fish more efficiently.

Appendix 2 Birds recorded

The table below lists the 95 bird species that were observed in the Upper Niger Basin during the field work in February 2018. The taxonomy follows BirdLife International (2018).

Family	English name	Scientific name
Anatidae	White-faced Whistling-duck	Dendrocygna viduata
Columbidae	Speckled Pigeon	Columba guinea
Columbidae	Red-eyed Dove	Streptopelia semitorquata
Columbidae	Vinaceous Dove	Streptopelia vinacea
Columbidae	Laughing Dove	Spilopelia senegalensis
Columbidae	Blue-spotted Wood-dove	Turtur afer
Columbidae	African Green-pigeon	Treron calvus
Apodidae	Little Swift	Apus affinis
Cuculidae	Senegal Coucal	Centropus senegalensis
Rallidae	Black Crake	Zapornia flavirostra
Musophagidae	Western Plantain-eater	Crinifer piscator
Musophagidae	Green Turaco	Tauraco persa
Ardeidae	Green-backed Heron	Butorides striata
Ardeidae	Squacco Heron	Ardeola ralloides
Ardeidae	Cattle Egret	Bubulcus ibis
Ardeidae	Grey Heron	Ardea cinerea
Ardeidae	Purple Heron	Ardea purpurea
Ardeidae	Great White Egret	Ardea alba
Ardeidae	Yellow-billed Egret	Ardea brachyrhyncha
Ardeidae	Little Egret	Egretta garzetta
Ardeidae	Western Reef-egret	Egretta gularis
Scopidae	Hamerkop	Scopus umbretta
Phalacrocoracidae	Long-tailed Cormorant	Microcarbo africanus
Burhinidae	Senegal Thick-knee	Burhinus senegalensis
Pluvianidae	Egyptian Plover	Pluvianus aegyptius
Recurvirostridae	Black-winged Stilt	Himantopus himantopus
Charadriidae	Kentish Plover	Charadrius alexandrinus
Charadriidae	Spur-winged Lapwing	Vanellus spinosus
Charadriidae	White-headed Lapwing	Vanellus albiceps
Charadriidae	Wattled Lapwing	Vanellus senegallus
Jacanidae	African Jacana	Actophilornis africanus
Jacanidae	Lesser Jacana	Microparra capensis
Scolopacidae	Common Sandpiper	Actitis hypoleucos
Scolopacidae	Green Sandpiper	Tringa ochropus
Scolopacidae	Common Greenshank	Tringa nebularia
Scolopacidae	Wood Sandpiper	Tringa glareola

Laridae	African Skimmer	Rynchops flavirostris
Tytonidae	Common Barn-owl	Tyto alba
Pandionidae	Osprey	Pandion haliaetus
Accipitridae	Black-winged Kite	Elanus caeruleus
Accipitridae	African Harrier-hawk	Polyboroides typus
Accipitridae	Hooded Vulture	Necrosyrtes monachus
Accipitridae	White-backed Vulture	Gyps africanus
Accipitridae	Tawny Eagle	Aquila rapax
Accipitridae	African Hawk-eagle	Aquila spilogaster
Accipitridae	Western Marsh-harrier	Circus aeruginosus
Accipitridae	Shikra	Accipiter badius
Accipitridae	Black Kite	Milvus migrans
Accipitridae	Grasshopper Buzzard	Butastur rufipennis
Accipitridae	Red-necked Buzzard	Buteo auguralis
Bucerotidae	African Grey Hornbill	Lophoceros nasutus
Coraciidae	Purple Roller	Coracias naevius
Coraciidae	Abyssinian Roller	Coracias abyssinicus
Coraciidae	Blue-bellied Roller	Coracias cyanogaster
Alcedinidae	Malachite Kingfisher	Corythornis cristatus
Alcedinidae	Pied Kingfisher	Ceryle rudis
Alcedinidae	Blue-breasted Kingfisher	Halcyon malimbica
Falconidae	Lanner Falcon	Falco biarmicus
Falconidae	Peregrine Falcon	Falco peregrinus
Psittacidae	Senegal Parrot	Poicephalus senegalus
Oriolidae	Eurasian Golden Oriole	Oriolus oriolus
Vangidae	White-crested Helmet-shrike	Prionops plumatus
Platysteiridae	Brown-throated Wattle-eye	Platysteira cyanea
Malaconotidae	Northern Puffback	Dryoscopus gambensis
Dicruridae	Fork-tailed Drongo	Dicrurus adsimilis
Monarchidae	Red-bellied Paradise-flycatcher	Terpsiphone rufiventer
Corvidae	Piapiac	Ptilostomus afer
Corvidae	Pied Crow	Corvus albus
Stenostiridae	African Blue-flycatcher	Elminia longicauda
Alaudidae	Rufous-rumped Lark	Pinarocorys erythropygia
Alaudidae	Sun Lark	Galerida modesta
Macrosphenidae	Northern Crombec	Sylvietta brachyura
Cisticolidae	Senegal Eremomela	Eremomela pusilla
Cisticolidae	Zitting Cisticola	Cisticola juncidis
Hirundinidae	Wire-tailed Swallow	Hirundo smithii
Hirundinidae	Red-chested Swallow	Hirundo lucida
Pycnonotidae	Common Bulbul	Pycnonotus barbatus
Phylloscopidae	Western Bonelli's Warbler	Phylloscopus bonelli
Dhullocoopidoo	Common Chiffshoff	Phylloscopus collybita

Sturnidae	Long-tailed Glossy Starling	Lamprotornis caudatus
Sturnidae	Purple Starling	Lamprotornis purpureus
Muscicapidae	Snowy-crowned Robin-chat	Cossypha niveicapilla
Nectariniidae	Beautiful Sunbird	Cinnyris pulchellus
Nectariniidae	Splendid Sunbird	Cinnyris coccinigastrus
Nectariniidae	Variable Sunbird	Cinnyris venustus
Ploceidae	Red-headed Quelea	Quelea erythrops
Ploceidae	Village Weaver	Ploceus cucullatus
Estrildidae	Red-billed Firefinch	Lagonosticta senegala
Estrildidae	Red-cheeked Cordon-bleu	Uraeginthus bengalus
Estrildidae	Bronze Mannikin	Spermestes cucullata
Viduidae	Pin-tailed Whydah	Vidua macroura
Passeridae	Northern Grey-headed Sparrow	Passer griseus
Passeridae	Sahel Bush-sparrow	Gymnoris dentata
Motacillidae	Plain-backed Pipit	Anthus leucophrys
Motacillidae	Western Yellow Wagtail	Motacilla flava

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