Altenburg & Wymenga ECOLOGICAL CONSULTANTS

Ecological hotspots in the Upper Niger Basin and Inner Niger Delta

II. Existing data and information

A&W-report 2253b

Commissioned by

Wetlands INTERNATIONAL

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Photograph front page
Inner Niger Delta, photo: Leo Zwarts

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Content

Summary/Résumé

Summary

Framework and objectives
In 2015 the Dutch-funded BAMGIRE project was launched to support the IWRM-process in the Upper Niger Basin, in particular in Mali and Guinea. IWRM refers to Integrated Water Resources Management in which an integrated approach is taken, accounting for all sectors (economy, energy, environment, ecology, food) and balancing the water need and availability. In the framework of this project, an analysis of ecological hotspots in the Upper Niger Basin and Inner Niger Delta was performed.

The general objective of the hotspot analysis is the identification and mapping of the hotspots of ecosystem services and biodiversity. The study is focussing on two sub basins of the Niger River, in particular the Upper Niger Basin and Inner Niger Delta. A first report deals with the selection of methods and criteria which are suitable in this context and the preliminary identification of the ecological hotspots. The current report provides an overview of existing knowledge on biodiversity and ecosystems in both basins, knowledge gaps and data needs.

Upper Niger Basin
The Upper Niger Basin hosts an array of important areas with a high biodiversity and which are highly important for ecosystem services, in particular the riverine areas and forests. Apart from the general lack of data, we conclude that as far as information is available it concerns data from protected areas (PA's). These seem to be the sole areas where populations of vulnerable species are still present, reasons why most of these areas have been designated or proposed as protected area (Ramsar, Biosphere, National Parks). However, also outside these PAs endangered or endemic species can be present, in particular in large forest fragments and other habitats with low human pressure. For the species with a large home range these areas can serve as temporary habitat or corridor between key populations. For species with a small home range, these areas still can hold viable populations. However, as the natural habitats in the Upper Niger Basin are becoming more and more fragmented, the ecological connection between these areas is essential for viable populations. Riverine habitats often play a pivotal role as corridor between the larger areas.

Expect for specific site information, actual and spatial data on vulnerable bird and mammal species (endangered or endemic), other biodiversity and bird concentrations in the Upper Niger Basin is lacking, fragmented and/or far from complete. It will not be possible, nor is the goal, within the framework of the BAMGIRE program to fill this information gap. However, as far as vulnerable and endemic species are present in riverine habitats it is important to know in which parts of the catchment they are distributed. Therefore, we note a large gap in knowledge concerning biodiversity data, in particular on the level of tributary catchments. Data on aquatic and amphibian vulnerable species have high priority, next to species which reside in riverine habitats.

Inner Niger Delta
As shown in this report, the Inner Niger Delta is a ecological hotspot itself in many aspects. The area, which is an international important wetland in terms of the Ramsar Convention has no legal protection. It is a floodplain of global importance and in Mali is a major ecosystem, essential to the rural economy (fisheries, livestock raising, cereal production). In this report we

present the current knowledge on biodiversity, mainly based on field work in the period 2000-2012. More recent data from the area are not, or hardly available. Based on the current information, and the pressure on natural resources, it is noted that there is an urge for recent data, either collected via local field work or additionally through remote sensing.

Résumé

Cadre et objectifs
En 2015, le projet BAMGIRE, financé par les Pays-Bas, a été lancé pour soutenir le processus de gestion intégrée des ressources en eau dans le bassin supérieur du Niger, en particulier au Mali et en Guinée. La GIRE fait référence à la gestion intégrée des ressources en eau dans laquelle une approche intégrée est adoptée, tenant compte de tous les secteurs (économie, énergie, environnement, écologie, alimentation) et équilibrant les besoins et la disponibilité en eau. Dans le cadre de ce projet, une analyse des points chauds écologiques du bassin supérieur du Niger et du delta intérieur du Niger a été réalisée.

L'objectif général est l'identification et la cartographie des points chauds des services écosystémiques et de la biodiversité. L'étude se concentre sur deux sous-bassins du fleuve Niger, en particulier le bassin supérieur du Niger et le delta intérieur du Niger. Un premier rapport traite du choix des méthodes et des critères appropriés dans ce contexte et de l'identification préliminaire des points chauds de l'écologie. Le présent rapport donne un aperçu des connaissances existantes sur la biodiversité et les écosystèmes des deux bassins, des lacunes dans les connaissances et des besoins en données.

Haut bassin du Niger
Le bassin supérieur du Niger abrite un ensemble de zones importantes, riches en biodiversité et très importantes pour les services écosystémiques, en particulier les zones riveraines et les forêts. Outre le manque général de données, nous concluons que, dans la mesure où les informations sont disponibles, elles concernent les données des zones protégées (AP). Celles-ci semblent être les seules zones où des populations d'espèces vulnérables sont encore présentes, ce qui explique pourquoi la plupart de ces zones ont été désignées ou proposées comme zones protégées (Ramsar, Biosphère, Parcs nationaux). Cependant, en dehors de ces AP, des espèces en voie de disparition ou endémiques peuvent être présentes, en particulier dans de grands fragments de forêt et d'autres habitats à faible pression humaine. Pour les espèces ayant un vaste domaine vital, ces zones peuvent servir d'habitat temporaire ou de corridor entre les populations clés. Pour les espèces ayant un petit domaine vital, ces zones peuvent encore contenir des populations viables. Cependant, à mesure que les habitats naturels dans le bassin supérieur du Niger deviennent de plus en plus fragmentés, le lien écologique entre ces zones est essentiel pour des populations viables. Les habitats fluviaux jouent souvent un rôle pivot en tant que corridor entre les zones les plus vastes.

Le pluspart des données réelles et spatiales sur les espèces d'oiseaux et de mammifères vulnérables (en voie de disparition ou endémiques), sur la biodiversité et sur les concentrations d'oiseaux dans le bassin du Haut Niger, sont fragmentées et / ou loin d'être complètes. Il serait difficile de combler ce gap en matière d'information, dans le cadre du programme BAMGIRE. Cependant, dans la mesure où des espèces vulnérables et endémiques sont présentes dans les habitats riverains, il est important de savoir dans quelles parties du bassin elles sont réparties. Par conséquent, nous notons une grande lacune dans les connaissances sur les données de la biodiversité, en particulier sur le niveau des bassins versants des affluents. Les données sur les espèces aquatiques et les espèces d'amphibiens vulnérables ont une priorité élevée, à côté des espèces qui résident dans les habitats riverains.

Delta Intérieur du Niger
Comme indiqué dans ce rapport, le Delta Intérieur du Niger est un point chaud écologique à de nombreux égards. La zone, qui est une zone humide d'importance internationale au sens de la Convention de Ramsar, ne bénéficie d'aucune protection juridique. C'est une plaine inondable

d'importance mondiale et, au Mali, un écosystème majeur, essentiel à l'économie rurale (pêche, élevage, production de céréales). Dans ce rapport, nous présentons les connaissances actuelles sur la biodiversité, principalement basées sur des travaux de terrain menés au cours de la période 2000-2012. Des données plus récentes sur la région ne sont pas ou difficilement disponibles. Sur la base des informations actuelles et de la pression exercée sur les ressources naturelles, il a été constaté que les données récentes étaient recherchées, soit par le biais de travaux sur le terrain locaux, soit par la télédétection.

1 Introduction

1.1 Ecological Hotspot Analysis

In the framework of the BAMGIRE project (2015-2019), run by WI Mali, a coherent approach is needed 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. The BAMGIRE project is organised in different modules. The assessment and mapping of ecological hotspots is a priority module within the BAMGIRE project. In the Terms of References for the Ecological Hotspot Analysis the objectives are formulated as:

General objective
The general objective of the overall hotspot analysis as part of BAMGIRE (2015-2019) 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.*

The study is focussing on two sub-basins of the Niger River, in particular the Upper Niger Basin and Inner Niger Delta (Fig. 1.1). Given the availability of data and information, the approach of the two basins is as follows:

- For the Inner Niger Delta the analysis and mapping will have a relatively high resolution
- For the Upper Basin the analysis and mapping will have a relatively low resolution

Approach
The hotspot analysis will go through different steps, starting with the selection of methods and criteria which are suitable in this context and the preliminary identification of the ecological hotspots in the Inner Niger Delta (high resolution) and the rest of the Upper Niger Basin (low resolution). This latter is based on an inventory of existing knowledge on biodiversity and ecosystems in both basins; this inventory is dealt with in a separate report. Based on this step it is possible to identify gaps in knowledge and information. Where data and information are lacking, new data are collected, notably in Guinea, and in the Inner Niger Delta, as far as the security situation is allowing field studies.

The next step will be the description and data collection, to gather insight in the quality of the ecological hotspots, the threats (local, regional, global) and the relationship with the water management in the Upper Niger Basin. Final step will be prioritizing of the ecological hotspots for which conservation and restoration measures have to be formulated and implemented. These will be worked out in another module: community based management and adaptations plans for ecological hotspots in the Upper Niger Basin.

The approach leads to the following products (situation end 2017):

I. Methods and preliminary assessment (this report);
II. Inventory of existing data and information (Wymenga *et al*. 2017);
III. Field study ecological hotspots Niger Basin in Guinea (Klop et al. In prep.).
IV. Other outputs to be defined (e.g. monitoring of ecological indicators).

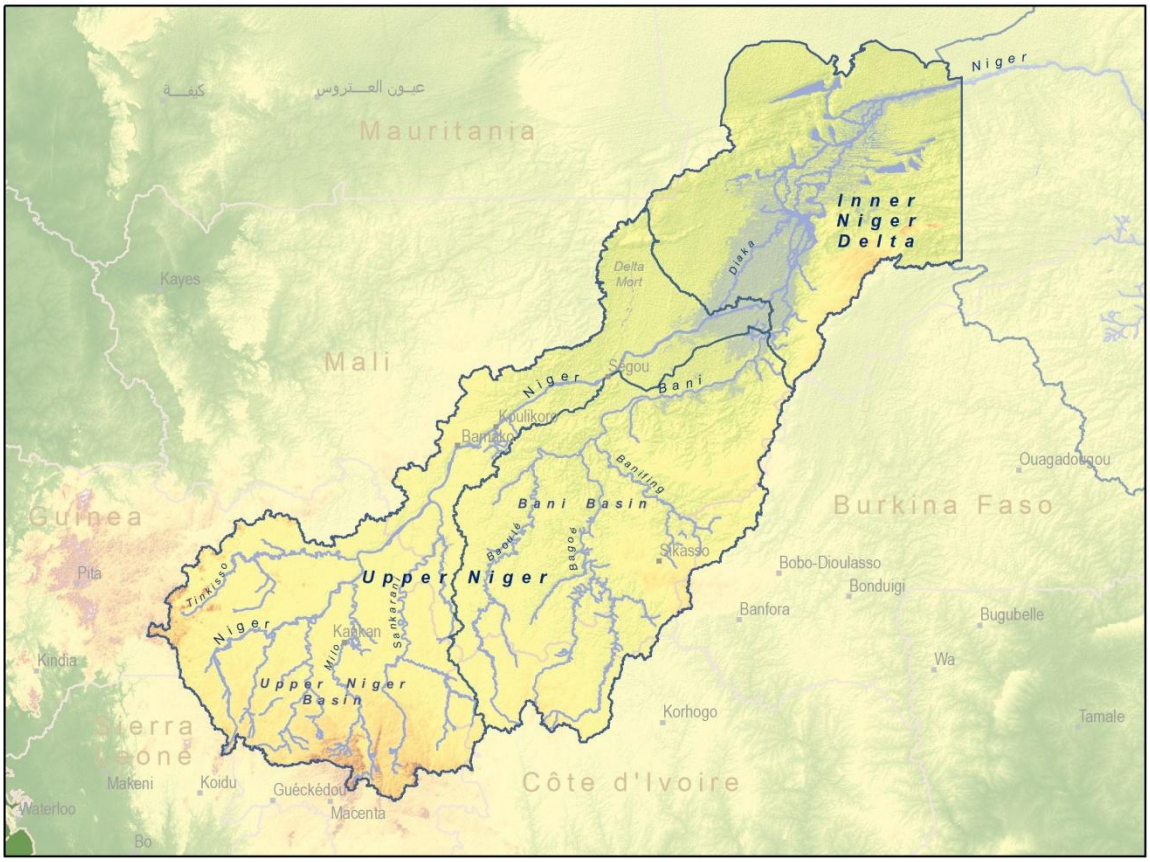


Figure 1.1. Outline of the study area, representing the Upper Niger Basin (shaded green) and the Inner Niger Delta (maximum flooded area in blue). The white line delineates the borders between the catchments of the Niger River en the Bani. The study area does not include areas downstream of Taoussa in the north.

1.2 Objectives and outline of this report

The first step in the process of Ecological Hotspot identification and mapping in the Upper Niger Basin and Inner Niger Delta, in particular the development of an approach and method and a preliminary assessment, has been reported in hotspot report I: Wymenga *et al*. (2017). It builds upon the work which has been done previously by other studies, either on a basin level (Brugiere & Kormos 2009, Marie *et al.* 2007, Orange *et al.* 2002, Thieme *et al.* 2006, Zwarts *et al.* 2005, 2009), the level of the Inner Niger Delta (Quensiere 1994, van der Kamp *et al.* 2005, Wymenga *et al.* 2002, Zwarts *et al.* 2009), or in the framework of an international assessment of important areas for biodiversity (Fishpool & Evans 2001, Birdlife International 2014, IUCN 2016).

The basic information, used by Wymenga et al. (2017) for the preliminary assessment, is given in this report. The objective for the work reported here is the collection of necessary and available information on ecological hotspots in the IND and the Upper Niger Basin. The data and information collected is stored in a GIS-database; in this report a summary of knowledge and information is given. It must be stressed, that this inventory of existing knowledge is not targeted to include all studies on biodiversity but rather focuses on data and spatial information suitable for the ecological hotspot mapping.

Outline of the report

In the next two chapters we summarise the information which is available for the Upper Niger Basin (Chapter 2) and Inner Niger Delta (Chapter 3). Following the criteria for ecological hotspots developed (Wymenga *et al*. 2017), we give an overview of existing data and describe in short terms the ecological information. This refers in particular tot protected areas (system of protection, spatial data), the identification and distribution of endangered ecosystems and habitats (in short ecology, spatial data), and vulnerable and endangered species according to the system of the red lists of the IUCN (http://www.iucnredlist.org/static/categories_criteria_3_1).

When available, other information – important for the region – on concentrations of water birds, wetlands and breeding colonies of birds was added. For all of these themes we assessed availability and quality. As will be apparent from the start, from the Upper Niger Basin adequate information is lacking, while from the IND, relatively speaking, high level information is available, on a high spatial resolution.

In Chapter 4 we summarise the state of knowledge, the need for additional and actualisation of the data, not only to delineate ecological hotspots but also to use this information to prioritise ecological hotspot for which conservation and restoration measures have to be worked out.

The Niger River in Guinea (Milo tributary) in the Upper Niger basin in January. In the upper reaches of the river, the river banks are often vegetated with gallery forest. Photograph A&W.

2 Upper Niger Basin

2.1 Protected areas

Both in Mali and Guinea a network of protected areas is established, covering important areas for nature conservation, and legally regulating hunting and the use of natural resources. The formal and legal protection of natural resources and its fauna dates from colonial times, when much emphasis was put on the protection of classified forests (*forest classées*). Where the legal protection focused initially on classified forests and the regulation of hunting, the protection of biodiversity – mainly large mammals and birds – was stimulated much by the International Convention of Flora and Fauna in Africa in London in 1933. From then on, national parks and other protected areas were proposed and assigned, however still based on very little knowledge and data.

In Mali and Guinea the legal system and assignment of areas has been given a growing attention since the 1990s, but up till present does not cover all individual sites with a high biodiversity (Guinea: Brugiere & Kormos 2009). In this Section, we briefly sketch the legal system of protected areas in Mali and Guinea, including the Inner Niger Delta.

System of protected areas **in Mali**
The current system of protected areas (PAs) in Mali, along with its efficiency in terms of protection, is described in 2008 by the IUCN (UICN/BRAO 2008). Although the IUCN-report dates from 9 years back, this report still presents a reliable state of affairs. The information in this Section therefore is mainly based on the IUCN assessment and additional information in a project description, made available in the framework of a PNUD-FEM program, entitled '*Extension et renforcement du système d'AP du Mali*' (PNUD 2010). For a detailed description of the legal system of the protection of areas, ecosystems and species, see UICN/BRAO 2008).

Management of protected areas
The protection and management of National Parks and other PAs in Mali is the responsibility of the *Ministère de l'Environnement et de l'Assainissement* and is executed by the *Direction Nationale de la Conservation de la Nature* (DNCN). Recently the name of the DNCN has been changed in the *Direction National des Eaux et Forêts* (DNEF), which formalises that the activities of the DNEF primarily concentrate on the management of the national forests and wood resources. The "*Division de la conservation de la faune et de ses habitats*" is in charge of the management of PAs. It is expected that this Division will be reorganised into a "*Division de la gestion des aires de conservation de la faune*" (PNUD 2010).

The operational (field) management within the DNEF is organised through regional Services:
- 9 *Directions Régionales des Eaux et Forêts* (DREF);
- 49 *Services de Conservation de la Nature* (SCN), network on the level of cercles and cantons;
- 236 *Antennes de la Conservation de la Nature* (ACN), network on commune level.

The management of the Biosphere Reserve Boucle du Baoulé is carried out by a specific service, related to the DNCN, called '*l'Opération aménagement du Parc National de la Boucle du Baoulé'* (OPNBB). The '*Réserve partielle de faune pour les éléphants'* in Gourma, related to the Projet '*Conservation et Valorisation de la Biodiversité du Gourma et des Eléphants'* (PCVBG – E) is managed by *l'Unité de Gestion du Projet* (UGP), contracted by la Cellule de Mise en Œuvre (CMO) in Douentza.

Entrance of the Biosphere Reserve Boucle du Baoulé. Source: http://www.safariants.com/tours/view/451

System of protected areas

In the past decades the system of protected areas in Mali developed into a network which covers most of the areas with a high biological interest (presence of specific fauna) or representative ecosystems. Although the biodiversity in Mali is under high pressure the protected areas still hold important populations of fauna which are representative for the region. Within the system of PAs different categories can be distinguished.

Mali had designated some international outstanding areas, based on international conventions (UNESCO, Ramsar). 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 international categories (Biosphere Reserve, Ramsar Site, World Heritage site) are not part of the national legislation in Mali. However, the core areas of Biosphere areas mostly consist of National Parks or otherwise legally protected reserves or classified forests.

Designated areas of International importance:

- **Réserve de Biosphère** de la Boucle de Baoulé situated in the Upper Niger Basin. The Biosphere Reserve is classified in 1982 and covers a large part of the ex-Parc National de la Boucle du Baoulé. In 2001 the delineation of the Reserve has been changed, creating three separated reserves with corridors: le bloc de Kongosambougou in the

north, le bloc de Fina in the southeast and Badinko in the southwest. These reserves constitute also (parts of) former National Parks and reserves de faune.

- **Réserve de Biosphère** Bafing – Falémeé – proposed. This proposed Biosphere Reserve is situated in the Senegal Basin and forms in the future a transboundary reserve, constituting of several existing National Parks (Wongo, Kouroufing), (Partial) Faunal Reserves, Game Hunting Reserves and the Faunal Sanctuary (Sanctuaire de chimpanzés). Given its location in the Senegal Basin this important area for biodiversity is not treated further in this report.
- **Ramsar area** – In 2001 the Malian government designated The Inner Niger Delta as a site of International Importance for Water birds under the Ramsar Convention. With a total surface area of 4.119.500 ha it is one of the largest (6th) Ramsar Sites in the world. The designation of the IND as Ramsar Site is not legally backed by a protection status, which means in practice that the IND is not protected, with exception of the specific areas which fall under the legal system of PAs (see below).
- **Ramsar area Lac Wegnia** – Next to the IND three other sites have been designated. Lac Magui (permanent lake) and Sourou plaines (floodplains) are not part of the catchment of the Niger. Lac Wegnia is a permanent fresh water lake north of Bamako
- The Falaises de Bandiagara (Pays Dogon) are classified as **World Heritage Site.** There are two more sites in Mali, but these are designated for cultural purposes only.

Since 1995 the legalisation of PAs in Mali was revised, resulting in seven official categories of PAs (Table 2). Mali holds currently (IUCN/BRAO 2008) a network of 23 PAs and one planned reserve (Tamesna in the north). The Biosphere reserves form a cluster of existing PAs, extended with buffer zones and transition zones. Table 2.1 gives an overview of the PAs, their surface area and date of establishment. We briefly mention the different categories and relevant PAs :

- **National Parks.** There are two National Parks, Wongo and Kouroufing Wongo, which are part of the Biosphere Reserve Boucle de Baoulé (see above). Also the former National Park of Boucle de Baoulé is part of the Biosphere Reserve;
- **Faunal Reserve –** Réserves de faune. Mali recognises five Faunal Reserves : Nema Wula, Mande Wula, Niénendougou, Talikourou and Kéniébaoulé). Néma Wula and Mandé Wula are part of the proposed Biosphere Reserve of Bafing-Falémé in the Senegal Basin;
- **Partial Faunal Reserve**. There are three Partial Faunal Reserves: Ansongo-Ménaka, Gourma and Siankadougou. Gourma is the Elephant Reserve. The distinction between a Faunal or Partial Faunal Reserve is not always clear in the available information;
- **Faunal Sanctuary**. Mali holds one Faunal Sanctuary, namely le sanctuaire de chimpanzés. It is located within the proposed Biosphere Reserve of Bafing-Falémé and are situated in the Senegal Basin;
- **Game Hunting Reserves** - zones d'intérêt cynégétique (ZIC). Six zones have been designated as Game Hunting Reserves : Tidermène-Alata, Inekar, Nienendougou, Banzana, Flawa and Azaoud also called Salam.

In addition to these PAs a system of classified forests (*forêts classées*) already exists in Mali since the beginning of the 20th century. The main objective is to manage and regulate the procurement of wood resources as well as (over)grazing of the forest sites. In the Malian part of the Upper Niger Basin a limited number of classified forests are found.

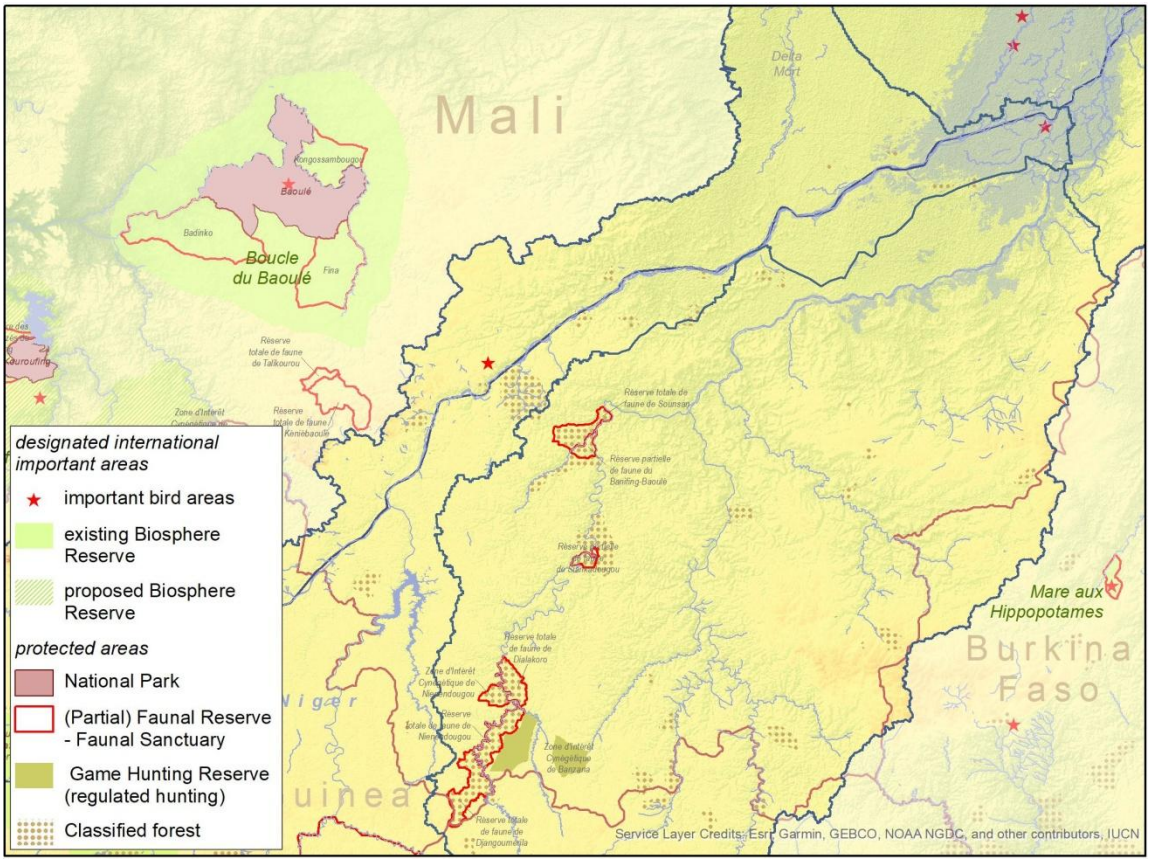


Fig 2.1. Protected areas and designated international important areas in the Malian part of the Upper Niger Basin. Note that also important bird areas are indicated, which do not have a formal status.

System of protected areas in Guinea

The background, organisation and system of protected areas in Guinea is described by Brugiere & Kormos (2009) and on the website (www.eaux-forest.gouv.gn) of the Direction National des Eaux et Forêts (DNEF). This Direction is charged with the management of the PA network in Guinea. Additional information is available through an IUCN assessment of the effectiveness of the PA network by in 2008 (IUCN 2008), as well as from specific project reports (mentioned where appropriate).

Management of protected areas

The protection and management of PAs in Guinea is covered by the Ministère de l'Environnement and was carried out, till 2003, by the *Direction Nationale des Eaux et Forêts* (DNEF). The predecessor of this Direction dates from the 1930s and was primarily focussed on forests and wood resources (classified forests). Today, the main mission of the Direction is the sustainable management of national forests resources and fauna. In 2004 the responsibility for the protection of the PA network 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).

System of protected areas

Based on the network of classified state forests (1885-1958), the protection of ecosystems, natural resources and biodiversity in Guinea was given a growing attention in the second half of

Table 2.1. List of protected areas in Mali based on the list in IUCN/BRAO (2008) and additional information. Rf = Réserve de Faune, RPF = Réserve partielle de faune.

Name	Statut	Lieu	ha	Référence
Reserve de la Biosphere transfrontalière du Bafing Famélé (332 639 ha, en cours de création)				
Kouroufing	Parc national	Bafouablé	55 770	Loi n° 02 - 003 du 16-1- 2002
Wango	Parc national	Bafouablé	53 599	Loi n° 02 - 002 du 16-1- 2002
S. de chimpanzés	Sanctuaire de faune	Bafouablé	67 200	Décret n° 02- 199- PRM du 22-4- 2002
Flawa	Zone d'intérêt cynégétique	Bafouablé	73 940	Arrt n° 04-2764/ MEA-SG du 30/12/2004
Mande Wula	Réserve de faune	Kayes	39 050	Décret n° 10-091/P-RM du 15/02/2010
Nema Wula	Réserve de faune	Kayes	44 730	Décret n° 10-092/P-RM du 15/02/2010
Gadougou	Zone d'intérêt cynégétique			
Réserve de la Biosphére de la Boucle du Baoulé (533.037 ha incluant zone de tampon et zone de transition)				
Badinko	Réserve de biosphère (secteur)	Kayes/Koulikoro	137 772	Loi n° 063 du 0/07/2001
Fina	Réserve de biosphère (secteur)	Kayes/Koulikoro	108 668	Loi n° 063 du 0/07/2001
Kongossambougou	Réserve de biosphère (secteur)	Kayes/Koulikoro	76 858	Loi n° 063 du 0/07/2001
Zones adjacentes à la Réserve de la Biosphére de la Boucle du Baoulé				
Talikourou	Réserve de faune	Kita	13 900	Arrt. n° 8111/SEF du 14/11/1953
Kéniébaoulé	Réserve de faune	Bko/Koulikoro	67 500	Arrt n° 2948/SEF du 15/04/1954
Autre réserve et zones d'intérêt cynégétique				
Siankadougou	Réserve partielle de faune - RPF	Bougouni	6 000	Arrêté général
Niénendougou	Réserve de faune	Bougouni	40 640	Décret n° 099/PG-RM du 23/02/2001
Niénendougou	Zone d'intérêt cynégétique	Bougouni	50 422	Arrt n° 04-2762/MEA-SG du 30/12/2004
Banzana	Zone d'intérêt cynégétique	Bougouni	44 402	Arrt n° 04-2765/MEA-SG du 30/12/2004
Sousan	Réserve de Faune	Sikasso	37 600	Arrt. n° 8531/SEF du 30/12/1954
Banifing - Baoulé	Réserve de Faune	Sikasso	13 000	Arrt. n° 8582 /SEF du 02/12/1954.
Gourma	RPF pour les éléphants	Douentza/Rharous	1 250 000	Loi n° 59-53/AL - RS du 30/12/1959
Azaouad NO /Salam	Zone d'intérêt cynégétique	Tombouctou	1 216 000	Arrt n° 06-2762/ MEA-SG du 19/01/2006
Ansongo Ménaka	RPF pour les girafes	Ans. / Ménaka	1 750 000	Arrt n° 883/SEF du 17/02/1950
Tidermène - Alata	Zone d'intérêt cynégétique	Ménaka	312 400	Arrt n° 04-1958/MEA-SG du 04/10/2004
Inékar	Zone d'intérêt cynégétique	Ménaka	180 625	Arrt n° 04-1959/MEA-SG du 04/10/2004
Tamesna	*RF pour les gazelles*	*Tin-Essako-Kidal*	*600000*	*Projet future*
Total sans Tamesna			5589476	

former century. The first National Parks were created in the beginning of the 20th century (Brugiere & Kormos 2009). In 1990 the '*Code de la protection de la faune et réglementation de la chasse*' was adopted (from 1997 onwards embedded in the legal system). This code distinguishes four categories of PAs in Guinea (Table 2.2). Already existing national parks (except for Kankan) have not been included and lack formal legal protection since.

On top of the PA network, Guinea ratified international conventions and designated several areas as international important areas for biodiversity and ecosystems (Biosphere Reserve, Ramsar Site, World Heritage site). In particular in the coastal zone several Ramsar Sites have

Table 2.2. Categories of protected areas in Mali and Guinea. After Brugiere & Kormos (2008).

Category	Mali	Guinea	IUCN Category	Main objective
National Park, *Parc National*	V	V	II	Protection and cons. of natural sites, landscape etc.
Strict Nature Reserve, *Réserve naturelle intégrale*	V	V	I	Guarantee free evolution of natural processes
Managed Nature reserve, *Réserve naturelle gérée*		V	IV	Conservation and management of fauna and its habitat
Faunal Reserve, *Reserve de Fauna*	V			Conservation and management of fauna and its habitat
Partial Faunal Reserve, *Reserve Partielle de Faune*	V			Conservation and management of fauna and its habitat
Faunal Sanctuary, *Sanctuaire de Faune*	V	V	IV	Conservation and management of fauna
Game Hunting Reserve, *Zone d'intérêt cynégétique*	V	V	VI	Sustainable exploitation of game species
Game Ranch	V			

have been designated (initiated by the IUCN in the 1990s), followed in the 2000s by Ramsar sites along the main rivers. It is not clear how these Ramsar sites are embedded in the legal system. Beyond the coastal zone, the PAs were based primarily on classified state forests.

In 1997 the Parc National du Haut Niger (PNHN) has been established, with in its centre the *Forêt de la Mafou* and the *Forêt Classée de la Kouya*. These areas are now indicated as *Zone Intégralement Protégée* (ZIP). In 2006 a Sanctuaire des Vautours was created in the Fouta Djallon massif, which is the latest formal protected area in Guinea (IUCN 2008). The PA network in Guinea (*Réseau guinéen d'aires protégées* - REGAP) is currently being formalised with all partners, as well as the Programme Cadre Décennal (2006–2015, information on website of DNEF) for the sustainable management of the network. A list of PAs is published on the website of the DNEF. PAs are divided in three main categories, linked to ecoregions or main habitat:

- Catégorie A. Aires protégées des écosystèmes terrestres
- Catégorie B. Aires protégées des écosystèmes côtiers, marins et insulaires
- Catégorie C. Aires protégées des écosystèmes d'eau douce

In this report, we do not elaborate on protected areas in Category B as these coastal areas are not part of the Upper Basin or near to it. Relevant PAs are (website DNEF, 9 November 2016) are listed below. In addition to these PAs a network of classified state forests (*forêts classées*) exists already since the beginning of the 20th century (Fig. 2.2). The main objective is to manage and regulate the procurement of wood resources as well as (over)grazing of the forest sites.

Catégorie A. Aires protégées des écosystèmes terrestres

1. Réserve de biosphère du Badiar : érigée en Parc national en 1985, puis en Réserve de biosphère en 2002 ; couvre 146 600 ha et englobe :
2. Réserve de biosphère du Haut Niger érigée en Parc national en 1997 puis en Réserve de biosphère en 2002, superficie 752 200 ha et comprenant :
3. Réserve de Biosphère du Ziama érigée en 1980 sur 112 300 ha (ex Forêt classée du Ziama créée en 1943)
4. Réserve naturelle intégrale des Monts Nimba créée en 1943, érigée en Réserve de biosphère en 1980 sur 13 000 ha puis en site du patrimoine mondial
5. Jardin zoologique de Dubréka érigé en 2006 sur 150 ha dans la forêt classée de Kakoulima

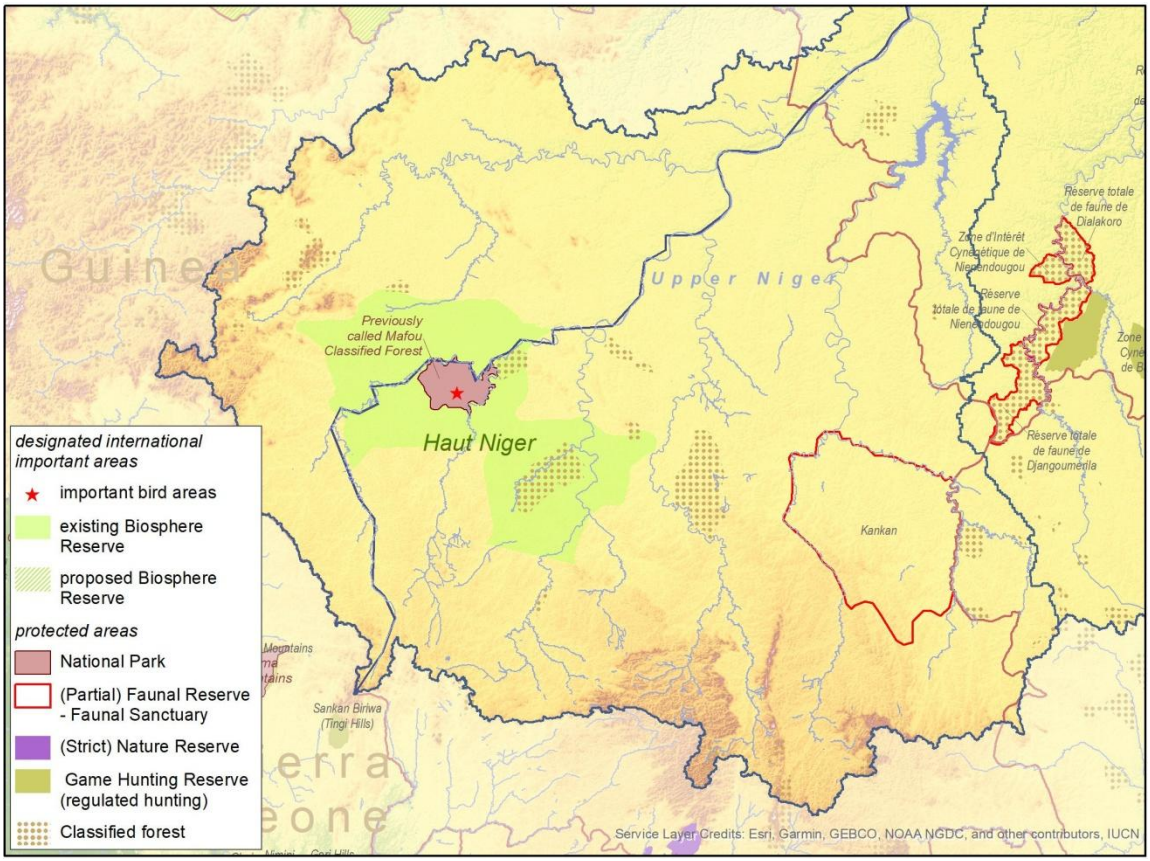


Fig. 2.2. Protected areas and designated international important areas in the Guinean part of the basin. Also important bird areas are indicated (in this case only one), which do not have a formal status.

4. Réserve naturelle intégrale des Monts Nimba créée en 1943, érigée en Réserve de biosphère en 1980 sur 13 000 ha puis en site du patrimoine mondial
5. Jardin zoologique de Dubréka érigé en 2006 sur 150 ha dans la forêt classée de Kakoulima
6. Réserve de faune de Kankan - Folonigbè, créée en 1926 sur 255 000 ha
7. Aire protégée transfrontalière Bafing – Falémé : Guinée – Mali démarrée en 2006 sur 2 666 000 ha (2/3 en Guinée soit 1 777 333 ha) et comprenant en Guinée
8. Aire protégée transfrontalière des Rio Cogon, Korubal et Nunez : démarrée en 2006 sur 1 700 000 ha (8 000 ha en Guinée)
9. Réserve naturelle de Kounoukan : forêt classée de Kamalaya érigée en 1994 sur 5 032 ha
10. Réserve naturelle de Forokonia (Forêt classée de la source du Niger en 1945 sur 4 770 ha)
11. Réserve naturelle de Pinséli classée en 1945 sur 13 000 ha
12. Réserve naturelle de Manden Woula – Warandogoba en 2006 sur 136 000 ha
13. Centre de conservation de chimpanzés de Somoria 1996 (Ce centre est compris dans le Parc N.H. Niger)
14. Rés. de faune de Bissikrima, en 2006 sur 25000 ha incluant les Forêts classées de Balayan -Souroumba de 1952 sur 25000 ha
15. Sanctuaire de faune de Fèllo Sélouma érigé en 2006 autour de la forêt classée de Fèllo Sélouma créée en 1955
16. Réserve spéciale de faune de Basse Guinée en 2006 sur 200 ha
17. Réserve spéciale de faune de Moyenne Guinée en 2006 sur 200 ha
18. Réserve spéciale de faune de Haute Guinée en 2006 sur 200 ha
19. Réserve spéciale de faune de Guinée Forestière en 2006 sur 200 ha
20. Réserve de faune de Gbinia et Banan en 2006 incluant :
21. Aire de conservation privée de Diwassi – Boula – Baranama à Kankan, concédée en 2003 sur 104 000 ha

Categorie c. Aires protégées des écosystèmes d'eau douce

22-28. Coastal Ramsar sites.

Categorie c. Aires protégées des écosystèmes d'eau douce

29. Site RAMSAR Niger – Tinkisso (Zone humide d'importance internationale), en 2002 sur 400 600 ha
30. Site RAMSAR Niger – Niandan – Milo, en 2002 sur 1 046 400 ha (incluant la forêt classée de Baro, la forêt classée de Kouya, la forêt classée de Kourani – Ouélété)
31. Site RAMSAR Niger – Mafou, en 2002 sur 1 015 450 ha, (incluant les forêts classées de la Mafou et de l'Amana)
32. Site RAMSAR Tinkisso, en 2002 sur 896 000 ha (incluant forêts classées du Mont Sincéry, de Balayan, de Nono, de Tamba)
33. Site RAMSAR Sankarani – Fié, en 2002 sur 1 015 200 ha (incluant en partie la Réserve de faune de Kankan)
34. Site RAMSAR Niger Source, en 2002 sur 180 400 ha inclue dans la forêt classée de Forokonia de 470 700 ha
35. Site RAMSAR Gambie – Koulountou (Zone humide d'importance internationale), en 2005 sur 281, 400 ha
36. Site RAMSAR Gambie – Oundou – Liti (Zone humide d'importance internationale), en 2005 sur 527,400 ha
37. Zone humide des Chutes de Kinkon en 2006 : forêt classée des chutes de Kinkon sur 320 ha
38. Zone humide des Grandes chutes, en 1944 sur 13 500 ha
39. Zone humide du Barrage de Garafiri érigée en 2006 (superficie à définir)
40. Zone humide des Chutes de Tinkisso : forêt classée de Tinkisso, en 1945 sur 1 100 ha

Sites divers : cas à évaluer aux ateliers de validation

41. Forêt classée du Mont Béro en 1952 sur 23 600 ha (inclue dans le complexe de gestion des Monts Nimba)
42. Forêt classée de Gban de 500 ha (inclue dans le complexe de gestion des Monts Nimba)
43. Forêt classée du Pic de Fon en 1953 sur 25 600 ha (inclue dans le complexe de gestion des Monts Nimba)
44. Forêt classée de Diécké en 1945 sur 64 000 ha
45. Forêt classée de Nyalama
46. Collines écologiques de Diécké
47. Jardins botaniques et arboretum

Relevant protected areas in Burkina Faso, Ivory Coast and Mauritania

Protected areas in the neighbouring countries can be important for the ecological hotspots in the Upper Niger Basin, especially as 'gene pool/reserve' and, on a seasonal level, through migration of mammals and birds. The legal system of PAs in Senegal, Mauritania, Ivory Coast and Burkina Faso is in essence comparable with that in Mali and Guinea, with a system of national Parks, reserves and classified forests. Apart from the important function of the PAs in these countries as refugium for biodiversity and gene pools, there are no known, direct relationships between the Upper Niger Basin with PAs in Senegal, Mauritania and Ivory Coast.

With respect to Burkina Faso, the Sahel Reserve, in the north of the country, south of Gao in Mali, is relevant for the protection of biodiversity and fauna which migrates from and to areas in the north in Mali, part of the IND. This is in particular relevant to birds and elephants. Elephants are roaming the savanna between the Sahel reserve, the mountains of Hombori and the *Reserve Partielle pour les elephants de Douentza/Rharous*.

Efficiency of PAs in protecting ecosystems and biodiversity

The existence of a network of PAs in itself is no guarantee for a proper protection of ecosystems and biodiversity. Initially and roughly until the 1950s protected areas in Mali and Guinea constituted classified forests. A significant part of these classified forest were essential for preserving parts of the original ecosystems and its faunal inhabitants (for example *Forêt classée de la source du Niger*, created in 1945 in Guinea). Afterwards, areas with high biodiversity values were added, most as Faunal reserves or game hunting reserve, but also national parks were established. An example in Mali is the *Parc National La Boucle du Baoulé* and its faunal reserves, which were created in 1954 and 1959. The current system in both countries is in place already for many decades, backed by national legalisation. In addition there has been a growing

sense of urgency in the 1990s and 2000s to include threatened areas with a high concentration endangered and vulnerable species (Parc National Haut Niger, Ziegler *et al.* 2002).
According to the evaluation of the effectiveness of the PA network in Mali (UICN/BRAO 2008), the PA network would be representative for the bio-geographical diversity of the country (and relevant ecosystems) and protects the sites with a high biodiversity with inclusion of the future Tamesna Reserve in the north and the realisation of the Biosphere Reserve of Bafing Faméle. At the same time, the report states that the IND– Ramsar Site and a globally important area for (migratory) bird populations (Chapter 3) – lacks a formal and legal protection. Also other (temporal) wetlands, essential to the regional biodiversity, are not covered in the PA network. The situation in Guinea is quite similar: with the envisaged inclusion of the Ramsar sites in the PA network, the network will cover most of the ecoregions in the country.

Protected areas have been given a formal, and in most cases, also a practical protection to avoid, amongst others, degradation and poaching. Beyond Pas, the rural areas in Mali and Guinea are heavily used for grazing, wood cutting and agriculture, and partly for mining. In these rural areas a huge degradation of ecosystems has been taking place, and actually is taken place, and many key species have become extinct. The Great Droughts in the 1970s and 1980s have been playing a major role in this, more recently along with population growth and a huge increase in livestock, in particular the Mali.

In practice, the management and protection of PAs is far from easy. From the evaluation of the effectiveness of the PA networks in Mali and Guinea (UICN/BRAO 2008 resp. IUCN 2008), it is clear that there are many threats. Poaching (also by foreign parties) is one of the most important threats, relevant to all PAs, followed by ecosystem degradation mainly through (over)exploitation of natural resources. In most protected areas villages or temporary settlements are located, and local communities rely already for centuries on the ecosystem services of the PAs and exploit the areas (Diallo 2011). Involvement of the local communities is crucial in this context, for their role in safeguarding the ecosystem and biodiversity, as well as the enforcement of the legal protection. The effectiveness of PAs also depends on the political situation and the wellbeing of local communities (poverty, social problems etc.). Diallo (2011) describes the difficult cohabitation between the (enforcement of the) formal protection of the Parc National Haut Niger and the traditional land use systems and customs of local communities. This is exemplary for many protected areas in Africa (cf. Oates 1999, Moorehead 1997).

Although all PAs in Mali are under heavy pressure of human exploitation, degradation, poaching and environmental change, the IUCN-assessments in 2008 shows, that nearly all sites with a high value for the conservation of key species are part of the PA network. This can be interpreted as such, that the remaining populations of endangered and vulnerable species in Mali, as well as the remainder of more or less vital ecosystems, are mainly found in the PA network, while outside the protected areas these species are under heavy threat, very rare or even extinct. This concerns at least large mammal species (such as predators, ungulates and primates), but also endangered reptiles and bird species. It must be stressed however, that not all important areas in the Upper Niger Basin are included, as will be shown in this study.

We may assume that the current PAs indeed represent areas with a high ecological values in terms of representative ecosystems for the region and safeguarding endangered and vulnerable (populations of key) species. Nevertheless, the conclusion in the assessments in 2008, that nearly all sites with a high value for the conservation of key species are protected through the PA networks in Mali and Guinea, must be treated with caution. The information is outdated (even in 2008: UICN/BRAO 2008). There is hardly any recent information on the distribution and actual population size of most of the endangered species. Only from some areas in Guinea more recent

information is available (Ziegler *et al.* 2011). What we do know however, is that key species and representative ecosystems in all of the PAs were under (heavy) threat in 2008 (UICN/BRAO

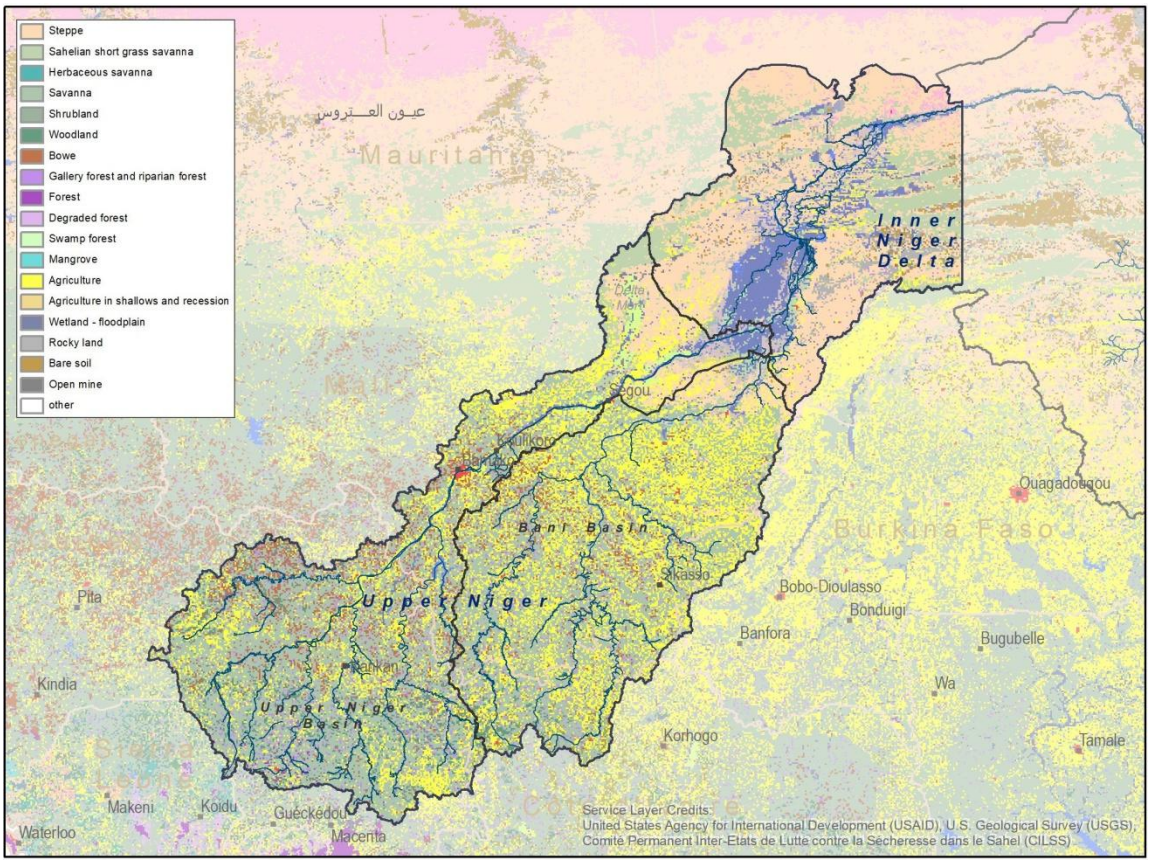


Fig 2.3. Landuse in the Upper Niger Basin, derived from CILSS 2016. This land cover map is based on 2013-data. Note that the resolution of this land cover map is 2x2 km (each cell is 400 ha).

2008) and probably this situation lasts until present or has grown even worse. Outside the protected areas, for instance in the IND, this is certainly the case, based on recent inventories and observations (Wetlands International).

2.2 Vulnerable habitats

Short characterization of habitats in the Upper Niger Basin

Driven by rainfall, the major vegetation types and land-use in the Upper Niger Basin are closely related to the West African eco-climatic zones (Arbonnier 2007, CILSS 2016), clearly visible on land cover maps (MODIS: Boxton *et al.* 2014; CILSS 2016; see Fig. 2.3). The Niger and its tributaries pass most of the eco-climatic zones of West Africa (Fig. 2.4). In general, the different vegetation zones in West Africa follow the rainfall gradient that is running north-south, with the arid Sahara and Sahel biomes in the north and the moist forests in the south. In between these extremes lies the savanna zone which consists of a mixture of grasses and trees. Due to widespread burning practices, the savanna zone has expanded at the cost of woodlands and (dry) forest.

In the south of Guinea, where the Niger, Mafou, Niandan, Milo, Dion and Sankarani rise, the annual rainfall exceeds 2,000 mm. Only a small portion of the UNB, in the very south, belongs to

the western Guineo-Congolian zone, which is known for its dense forests. This zone is commonly known as the Upper Guinea Forest and is one of the 25 global biodiversity hotspots defined by Myers *et al.* (2000). However, the 2013 landcover map (CILSS 2016) shows hardly

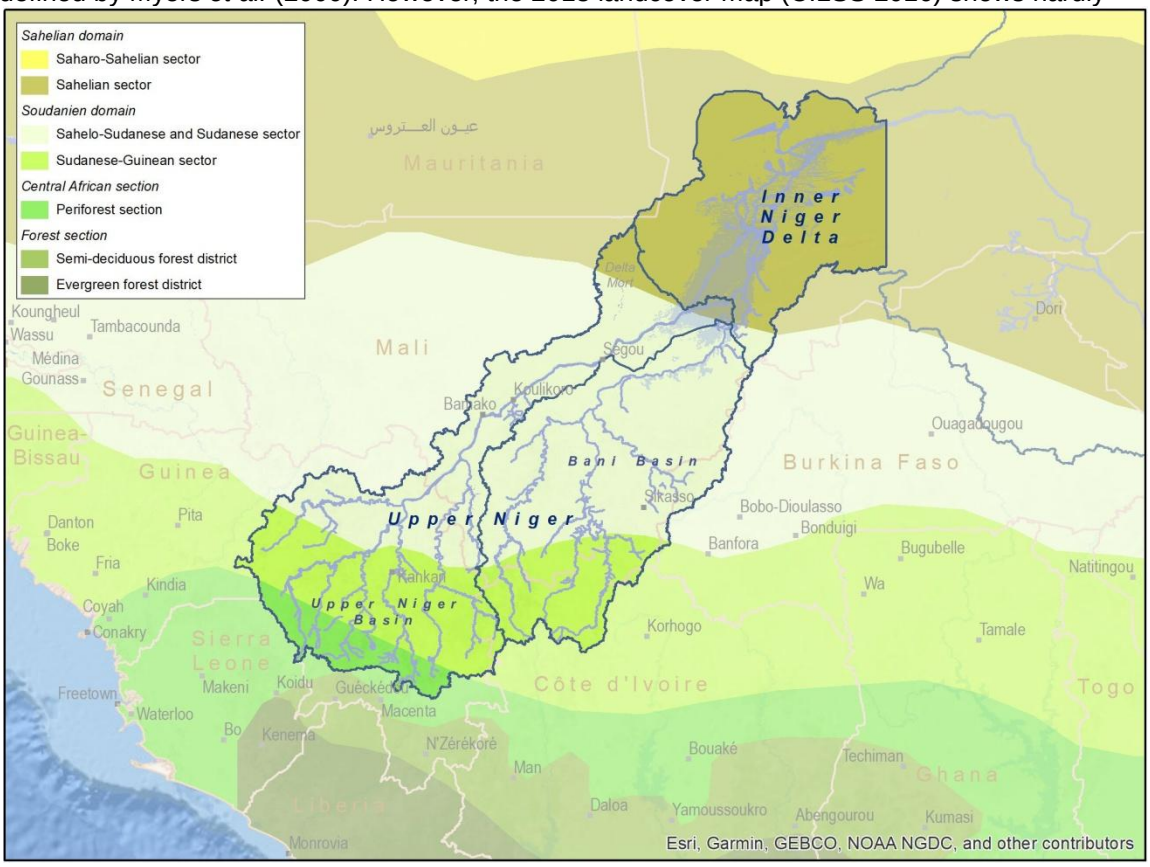


Fig. 2.4. Eco-climatological zones in West-Africa (source CILSS 206, see also Arbonnier 2007).

any contiguous forests for this most southern part of the UNB. Most of the continuous forest had already disappeared before 1975, but it has to be stated that even in 1900 Guinea held only a small part of the Upper Guinean Forest (CILSS 2016). Scattered grid cells on the land use map in the south are still classified as Gallery Forest. As these grid cells have a resolution of 2x2 km, such forests still are, or can be, essential to biodiversity.

Most of the Guinean part of the UNB falls within the Guinea savanna zone with > 1,000 mm rainfall and a wet season of 6 months or more. This zone consists partly of the Guinean Forest-Savanna Mosaic (1,500 – 2,000 mm rainfall) where forests, savanna and grasslands interlace. North of this mosaic lies the Guinea savanna (1,000 – 1,500 mm rainfall) which is usually heavily wooded and in moist places scattered forests may occur. These scattered forests nowadays are believed not to be the remnants of a former vast and continuous forest area, but rather small and often sacred forests established by earlier generations within the savanna landscape (CILSS 2016). Deciduous and semi-deciduous gallery forests border the rivers. At the height of the flood, the floodplains with gallery forest can be inundated. Substantial areas of flooded forests with grassy floodplains occur along the Niger. Hughes & Hughes (1992) state that upland evergreen forests cover the Nimba and Fouta-Djalon Mountains. According to CILSS (2016) this was not the case since 1975, but this may attributed to a definition question (boundaries, typology).

A remarkable feature, especially in the southwester part of the UNB, and partly also occurring in the Guinean and Sudanian zone, are the scattered lateritic plateaus or bowé. These almost impermeable ferruginous plateaus hardly bear any woody vegetation because of the near-absence of a soil layer, but a herbaceous vegetation is usually present. Arable fields occur scattered within the wooded savanna especially in the vicinity of larger villages, but their density is not as high as in the Sudanian zone. The main crops are rice, maize, fonio and millet but also cassava and plantain (CILSS 2016, ABN 2007). At the Guinean-Malinese border livestock and mining form an important economic sectors, next to maize cultivation.

North of the Guinea zone lies the Sudanian zone, which receives less rainfall than the Guinea savanna and has a longer dry season. The southern part consists of wooded savanna and forms a transition zone into the wetter Guinea savanna. The northern zone (600–800 mm) is more open and harbours characteristic tree species such as *Faidherbia albida*, *Vitellaria paradoxa*, *Parkia biglobosa* etc. In the northern Sudano savanna zone grazing is very important, with increasing livestock densities more to the north. Further south (with annual rainfall >800 mm) grazing by large herbivores can be hampered by the tsetse fly *Glossina* spp. which causes sleeping sickness (Cecchi *et al.* 2008, Wint & Robinson 2007).

In general the total biomass (grasses and trees) increases with increasing rainfall, up to the forest zone where a grass layer is absent. In the Sudanian zone dominant tree species are often belonging to the *Combretaceae* and *Caesalpinioideae*. Although Acacia species are present, they are not as dominant as in the Sahelian zone and partly are represented by other species (for example Birnbaum 2012). Gallery forests, with tall tree species are more common in the Guinean zone; these small parts of forests follow watercourses in this part (Birnbaum 2012). Closed woodlands are rare within West Sudanian savanna. The land cover map of 2013 (CILSS 2016) shows the large area of arable fields within this zone: within the Sudano-Sahel zone arable fields cover over 50% of the area.

Within the Sudanian zone maize and cotton are dominant crops in agriculture (ABN 2007) as well as peanuts in the northern part of this zone. Further north, in the Sudano-Sahel zone and Sahel zone within the UNB, land use shifts towards Millet and Sorghum and in the east also to cotton. Along the Niger and Bani flood recession culture and irrigated agriculture is practiced in perimeters along the rivers or, in the case of the latter, in large irrigation zones. The rice granary in West Africa is the Zone d'irrigation d'Office du Niger where >50.000 ha is under irrigation for rice, sugar cane and other cultures during the dry season (*maraichage*). Also near the Sélingué lake, downstream the dam, an irrigation complex is situated.

Agriculture is important in the Sahelo-Sudanian zone but more to the north grazing is increasingly important. In the Sahel zone the grazing pressure is extremely high. In the Sahel the seasonal (and annual) variation in rainfall causes a seasonal pattern in the (spatial) availability in resources (grazing grounds). These variable resources in space and time are since time immemorial effectively exploited by pastoralists moving their herds from one place to the other (transhumance). In the dry season, the floodplains of the Inner Niger Delta and surrounding areas are extremely important for livestock.

Habitats at risk

In general terms, vulnerable habitats on the level of the Upper Niger Basin can be defined as habitats in a more or less natural state that are under pressure of land use (grazing, agriculture), urbanization, mining, water extraction etc. Natural or semi-natural habitats vary with rainfall and soil, and their state is depending on the extent of disturbance and human exploitation. In the northern part of the basin these habitats are prone to droughts in combination with (over)grazing

and wood cutting. In the middle and southern part of the basin agriculture, mining and water extraction are important drivers of vulnerability. On the basis of land use maps (Fig. 2.3) and additional information, it is obvious how important agriculture, and more to the north also grazing, is in the Upper Niger Basin. Based on changes in the Sahel and Sudan zone (for example Tappan *et al.* 2004, Zwarts *et al.* 2009), natural forests and natural wooded savannas, wetlands and specific habitats like bowé can be regarded as vulnerable. There is no complete and spatial information on the distribution of vulnerable habitats in the Upper Niger Basin or parts of it (Guinea, Mali), apart from scattered information on specific areas and species (see Section 2.1 and Section 2.3).

Forests and wooded savanna

All forests in the UBN, ranging from deciduous and semi-deciduous gallery forests and pristine wooded savannas in the south (Guinean zone, Guinean Forest-Savanna Mosaic) to dry forests and flood forests more to the north can be regarded as vulnerable. Forests are prone to logging, wood cutting, bush fires and habitat destruction through mining, shifting cultivation and other practices. Continuous forests in the Upper Niger Basin are very scarce, but given the scale still large forests are present and essential to biodiversity. Even forests with a surface area of several hectares can be home to vulnerable plant species and other species with a small home range. Flood forests and forests fragment along the river may be small but can host important breeding sites or colonies for threatened bird species. At present a proper overview of vulnerable forests in the Upper Niger Basin is lacking, and no direct spatial data are available (see below).

Within the context of ecological hotspots in the BAMGIRE-project, the focus on vulnerable habitats is primarily on those habitats which are influenced by (changes) in water management and that are linked to the Niger river system. Therefore, relevant vulnerable forests concern floodable forest and gallery forests – or valuable secondary forests – which border the river and which have a hydrological connection to the river. Impact of changes in water management could for example be the loss of vulnerable forests through permanent flooding in case dams are built (significant raising of water levels), or the desiccation of vulnerable forests since water levels are permanently lowered downstream dams.

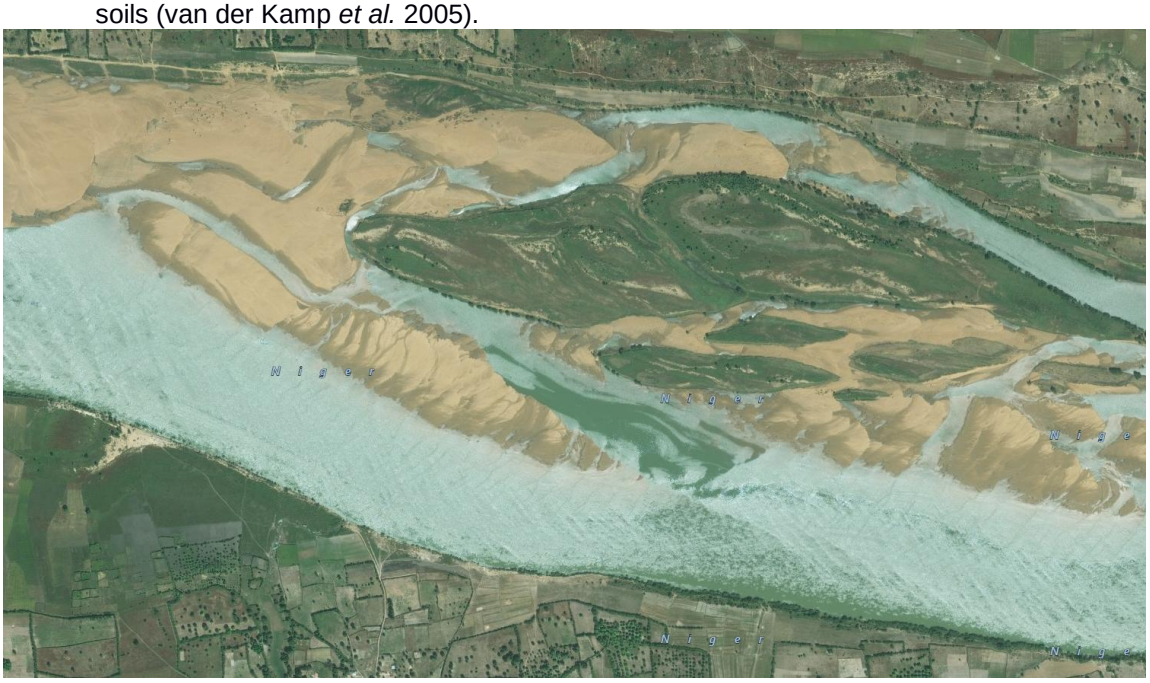
Wetlands

In most of the Upper Niger Basin wetlands are part of the Niger river system and have a riverine character. These concerns smaller or larger floodplains and/or exposed (sand)banks along the river (see photograph pg. 18), (storage) lakes and riverine forests (mentioned afore). In particular the riverine floodplains and exposed banks can cover extensive areas, like in the upper reaches of the Tinkisso and the Niger proper. In parts of the basin the latter has a width of about 2 km.

More to the north, in the Malian part of the Upper Basin also other type of wetlands can be found. These concern in particular the falas (former branches of the Niger) in the Delta Mort (Zone Office du Niger) and lakes. There is no concrete list of wetlands in the Upper Niger Basin. Based on information from different sources at least the following areas can be mentioned:

- Exposed banks and floodplains in the riverbed, which are temporarily flooded during the wet season. These habitats can be important for mammals, and as foraging areas or breeding areas for threatened bird species (for instance African Skimmer, Kittlitz's Plover). To a small extent still flood forests (with *Acacia nilotica, Ziziphus spec*.) can be found on the banks. To a These areas can be found in the Malian part of the Upper Niger Basin, where the width of the rivers Niger and Bani is 0,5 – 2,5 km as well as in the Guinean part of the basin where the Niger river or its tributaries are still broad.

- Lac Sélinkegny, a large storage lake, created in 1987 by the Sélingué dam, without aquatic vegetation. The maximum water levels (349 m IGN) drops 7-10m between January and June, the dry season when water is released to generate electricity. In the course of this period marshy habitats develop along the lake shores on clay and sandy soils (van der Kamp *et al.* 2005).



Snapshot of the Niger river east of Siguiri in Guinea, showing exposed banks and aquatic vegetation during the dry season. The width of the river on this photograph is 1,380 m. Source: Bingmaps.com.

Riverine habitats in the Upper reaches of the Niger Basin, Guinea (photo Erik Klop).

- Temporal lakes and depressions, roughly between Bamako and the Inner Niger Delta. Between the Malian border and the Inner Niger Delta, a number of smaller or large temporal lakes and depression can be found, which are flooded during the wet season, depending on rainfall and connection to the river system (Niger, Bani). Some of these depression have a more or less isolated location and are rain fed. The vegetation is depending on flood duration, depth and land use. Some lakes hold aquatic and helophytic vegetations like *Echinochloa*-vegetations or resembling habitats (with *Vossia cuspidata*). Often these depression or used for cultivation, when the water recedes. These types of wetlands or very important for water birds and a range of other species (amphibians, small mammals, fish species

- Falas Delta Mort – Office du Niger. In the depression of the Delta mort, nowadays the irrigation zone of the Office du Niger, the old branches of the Niger river are called Falas. These natural wetlands are now used for the irrigation system, but still are important wetland areas with marshy habitats. In these areas small breeding colonies and roosting places are present of water birds (van der Kamp *et al.* 2005).

- Irrigated rice field complexes. Rice field complexes in the Upper Niger Basin are mainly found in the Malian part of the basin. Also in the Guinea part of the basin cultures are found, which are often flood recession cultures. These may however host important wetlands values (Wymenga & Zwarts 2010). Large irrigated rice complexes (perimeters) are found just downstream the Sélingue dam, before the confluence of the Sankarani

with the Niger proper, between Bamako and Ségou, east of Ségou, and in the Office du Niger. The latter is one of the largest irrigation zones of West Africa, nevertheless hosting important wetland values (van der Kamp *et al.* 2005, Wymenga & Zwarts 2010).

Other natural vegetations

Apart from wetlands and forests – including wooded savannas – also other natural vegetations can be classified as vulnerable habitats. These include for instance the Bowé landscape in Guinea and dry savanna landscape in the northern part of the Upper Niger Basin. The latter however is, outside fenced reserves, often heavily grazed.

Information gaps and data need

The short description of habitats at risk shows that we still need much more information of the situation in the Upper Niger Basin. These information gaps can be summarised as follow:

- Spatial information on the distribution and occurrence of vulnerable habitats in the Upper Niger Basin is lacking (Guinea and Mali), in particular with reference to riverine forests and wetlands. Although several inventories are existing for parts of the basin or from some habitats, a coherent overview is needed.
- To obtain such an overview for forests it is necessary to collect (spatial) data on existing (national) forest inventories in Guinea and the relevant parts of Mali (Upper Bani), and complete this with additional site and field information. The available data has to be analysed on completeness, quality and actuality.
- To obtain such an overview for wetlands it is necessary to collect (spatial) data on wetlands (water maps based on remote sensing) in Guinea and the relevant parts of Mali (Upper Bani), and complete this with additional site and field information. Ground trotting is needed to collect information on the actual wetland values.
- From habitats at risk, others than forests and wetlands, nearly no concrete and spatial information is available. These habitats refer to dry savannas and bowe landscape. In combination with hydrological data it is necessary to analyse to what extent change in water management or climate could impact on these habitats.

The conclusion can be drawn, that there is need for :

a) a specific action to collect spatial data on vulnerable habitats in the Upper Niger Basin, using (national) inventories and site inventories. Focus lies on the (riverine) zones which may be affected by changes in water management;
b) a specific action to digitise all relevant spatial data on vulnerable habitats in the Upper Niger Basin, using (national) inventories and site inventories.
c) Field missions to these type of habitats for ground thru thing and to collect additional information on the role and function of these habitats, their quality and threats.

2.3 Endangered or endemic species – non avian

Vulnerable species (endangered or endemic)

In general information on vulnerable species (endangered or endemic) in the UNB is very scarce, in particular for the forested parts of Guinea. Although for most species groups – plants, invertebrates (insects, butterflies, dragonflies etc.), fish, amphibians, reptiles and mammals – scattered information is available in handbooks, species inventories etc., adequate spatial information over larger areas is lacking, or available on such an global scale, that it is hardly informative. The most recent update is a situation analysis by IUCN, analysing the status, distribution and threats of vulnerable species in West Africa (Mallon *et al*. 2015). For BAMGIRE

we focus on species occurring in habitats linked to the river system. However, well developed forests along the river, including gallery forests, may host important biodiversity values in the UNB, including the larger mammals mentioned in this Section. We did not check for data on invertebrates, which is even more scarce and only available for a few well-studied sites.

As mentioned in paragraph 3.2, Brugiere & Kormos (2009) focused on large mammals, as this group can serve well as indicator of terrestrial vertebrate diversity and at the same time is the group with the largest amount of available data. They used this group to indentify ecological hotspots, holding the largest number of globally threatened species in Guinea (and probably in the UNB as well) (Brugiere & Kormos 2009). We summarise here existing information, completed with a short description on fish species. Information on birds is presented in Section 2.4.

Aquatic and amphibian mammals

Within the UNB, two aquatic/amphibian mammal species occur which are listed as vulnerable (VU) according to the IUCN Red List version 2016-3: African manatee (*Trichechus senegalensis*) and Common hippo (*Hippopotamus amphibius*). The distribution data as made available by the IUCN (datazone) is presented in Fig. 2.5.

African manatees occur along the coast from Angola up to Senegal, but also inland in the larger river systems. In the Niger river Manatees are reported up to the Upper Niger Basin, amongst others within the Tinkisso Ramsar-site and within the Parc National Haut Niger. In the distribution data of IUCN the Manatee is not indicated for the Bani system, although Mallon *et al*. (2015) claims presence of the species in the Bani river. Isolation of Manatee populations has become a major issue due to the construction of dams, particularly in the Niger and Senegal rivers. The data on African manatees lack accurate estimates of abundance. Also impact of hunting and habitat destruction are not sufficiently documented (Diagne 2016). In fact, spatial data on manatees are lacking and all data on these species should be collected.

Within west and central Africa, the distribution of the *Common hippo* is more fragmented than in eastern or southern Africa. Within the UNB, they are mainly present along the floodplains of the Sankarani, Dion, Milo, Tinkisso and the Guinean part of the Niger (Lewison & Oliver 2008). The species is still present in many parts of the river system in Guinea. Within Mali, the distribution of Common hippos is mainly restricted to the IND (Mallon *et al.* 2015), where they have become rare (Wymenga *et al.* 2002). Brugiere & Kormos (2008) also use the distribution of Pygmy hippopotamus *(Hexaprotodon liberiensis*) to distinguish key biodiversity areas, but in Guinea the distribution of this species is restricted to the wet forests in the very southern part of the country and does not overlap with the UNB.

Carnivores

The *Leopard* has a broad geographic range, found from Africa through Asia. Jacobsen *et al.* (2016) distinguish several subspecies of which *Panthera pardus pardus* (African leapoard) is present in Africa. The historic distribution, covering almost complete sub-Saharan west Africa has become extremely fragmented in West Africa. The IUCN Red List Status (2016) is Vulnerable. Within the UNB, the African leopard is only known to occur in Guinea. Jacobsen *et al.* (2016) mention a population in Parc National Haut Niger and a possible extant population along the border with Sierra Leone near the Niger source (however, both not mentioned by Mallon *et al*. 2015). The populations that remained at the origins of the Milo and the Niandan are possibly extinct.

The *African golden cat* (*Caracal aurata*) is an inhabitant of the moist forests of the Guineo-Congolian zone. The Guinean highlands in the south of the UNB fringe on the northern part of its range. The IUCN Red List Status (2016-3) is Vulnerable (Bahaa-el-din *et al.* 2015).

The populations of *Lion* (*Panthera panthera*) west of the lower Niger river are considered as a separate subpopulation, and are regarded as Critically Endangered according to the IUCN Red List 2016-3 (Henschel *et al.* 2014, Henschel *et al.* 2015). The central and east African lions have the status Vulnerable (Bauer *et al.* 2016). According to recent surveys, the distribution of the west African subpopulation has become very fragmented and Lion presence is only confirmed for three protected areas in West Africa, all outside the UNB and IND. Rumours though persist about the presence in PN Haut Niger and Réserve partielle de Faune de Kankan (Henschel *et al.* 2015, Mallon *et al*. 2015). Lion is considered absent in Boucle de Baoulé and in Bafing-Faleme.

Ungulates

In Mali and Guinea some globally endangered ungulate species are present. These are: *Jentink's duiker* (*Cephalophus jentinki*) (EN), *Zebra duiker* (*Cephalophus zebra*) (VU), *Pygmy hippopotamus* (*Choeropsis liberiensis*) (EN); *Common hippo* (*Hippopotamus amphibious*) (VU); *African savanna elephant* (*Loxodonta africana*) (VU); *Forest elephant (Loxodonta cylotis*) (VU) and the *Western Giant eland* (*Tragelaphus derbianus ssp. derbianus*) (CR). The first three species, as well as Forest elephant, are restricted to the rainforests of the south, and do not occur within the UNB. The forest elephant has a very scattered distribution and is still found in two sites in Upper Guinea, near the borders with Sierra Leone and Liberia (Mallon *et al*. 2015).

Besides the previously mentioned Common hippo, only the range of the Western Giant eland overlaps with the UNB: the eastern boundary of the range runs near the Tinkisso river in Guinea. The Western Giant Eland (Eland de Derby Occidental) is a subspecies of the Giant Eland (*Tragelaphus derbianus*). The population is very small with a total of less than 250 mature individuals that are mainly present in Senegal (IUCN SSC Antelope Specialist Group 2008). The other ungulate species mentioned however do not occur within the UNB. Of these endangered ungulates, African elephant and Common hippo are present within the IND (see Chapter 3).

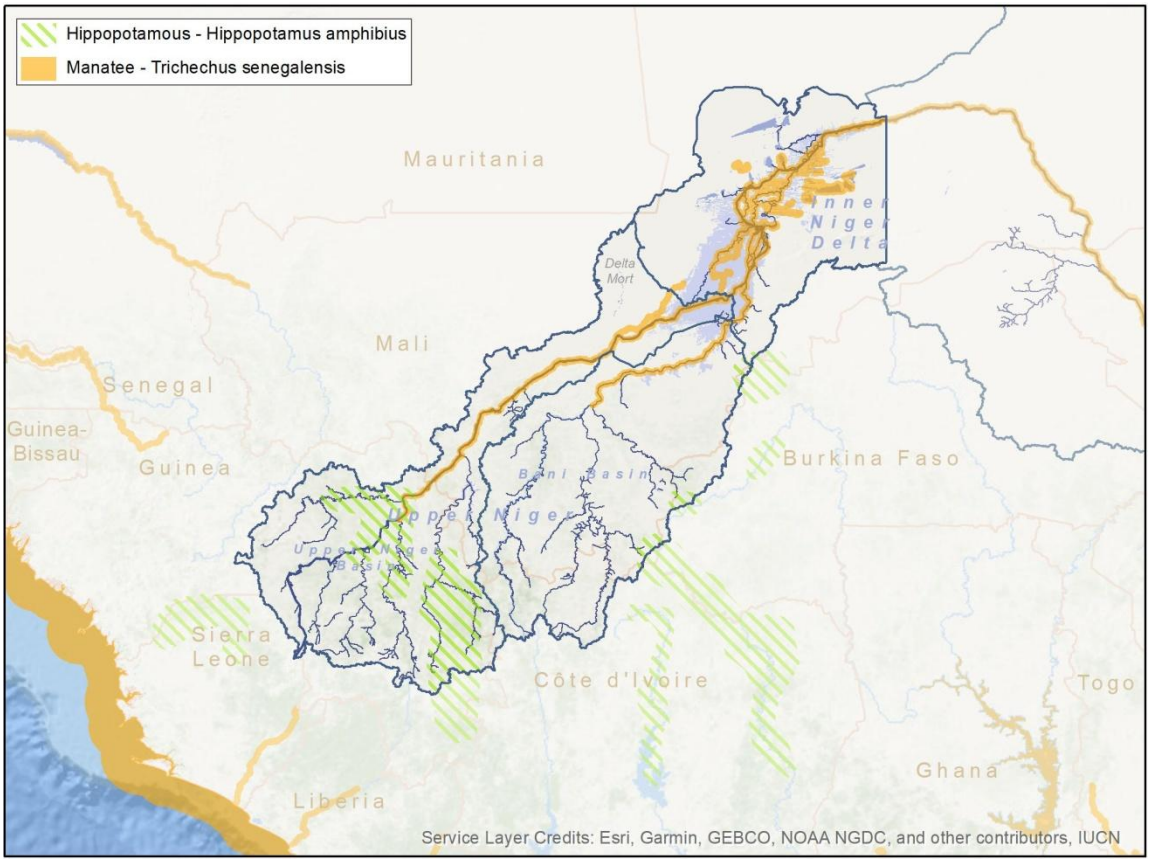


Fig. 2.5. Global distribution of Hippopotamus and Manatee in the Upper Niger Basin and Inner Niger Delta. See text for explanation.

Primates

The western subspecies of Chimpanzee (*Pan troglodytes ssp. verus*) is listed as Critically endangered (CR) according to IUCN Red List 2016-3. They occur in 3 of the 5 protected areas in Guinea (Fleury-Brugiere & Brugiere 2010), but according to IUCN-data, this species is extant in almost complete Guinea and in the very southwest of Mali, part of the Senegal basin. In 2001-2002 Fleury-Brugiere & Brugiere (2010) conducted a nest counting study in the Mafou forest of the Haut Niger National Park. They estimated a number of 0,87 weaned individuals/km^2, which is the highest density recorded in West African protected areas. The population was stable in the period 1995 – 2002. The authors denote gallery forests as the key habitat for chimpanzees within the savanna biome, where the gallery forests function as corridors. More detailed spatial data of this species in Guinea is lacking. According to Mallon *et al*. (2015), the species is still considered to be present in one site in Mali (Bafing complex), but this is north of the UNB.

The range of the *King colobus* (*Colobus polykomos*) stretches along the West African coast from southern Senegal to the Sassandra River in Côte d'Ivoire. The species prefers the 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 (Oates *et al.* 2008).

Fish

The Upper Niger and the tributaries are rapidly flowing streams. The regional fish fauna is adapted to these conditions. Within the Upper Niger Basin about 150 fish species are present, of which 55 species are endemic to western Africa, and three, possibly four, are endemic to the Upper Niger ecoregion: *Brycinus carolinae* (VU), *Micropanchax ehrichi* (NT), *Mormyrops oudoti* (DD), and *Barbus kissiensis* (VU), which may also be present in the Niger River in Nigeria (Smith *et al.* 2009).

In the Fouta Djalon, where the Tinkisso rises, but also the Bafing which is part of the Senegal basin, other species are reported to be endemic. These endemic species are *Barbus anniae* (VU); *Barbus cadenati* (VU), *Barbus ditinensis* (VU), *Barbus foutensis* (VU), *Barbus guineensis* (DD), *Barbus salessei* (VU), *Rhexipanchax lamberti* (VU), *Rhexipanchax kabae* (VU), *Scriptaphyosemion cauveti* (CR), and *Synodontis tourei* (NT) (Smith *et al.* 2009). However, from literature it is unclear whether all of these species are present in the upper reaches of the Tinkisso or if most of them occur in other basins that originate in this ecoregion.

Most of the species are shared with other parts of the Niger basin. Dominant fish families are African tetras (*Alestiidae*), Killifishes (*Aplocheilidae*) *Citharinidae*, Minnows (*Cyprinidae*), and Squeekers (*Mochokidae*) (Thieme *et al.* 2005). Recent research based on DNA shows that the species diversity might be underestimated (Schmidt *et al.* 2016). These authors found that within the group of suckermouth catfishes more species can be distinguished in the Upper Guinean Forest. Several of them are highly endemic, occurring only in one basin or part of a basin. For example *Chiloglanis cf micropogon* is only present in the upper part of the Niger river. Another endemic and Near Threatened species is the Giant sea catfish (*Arius gigas*) which is found in the RAMSAR sites Niger – Mafou and Niger source.

Amphibians and reptiles

There are no data available of amphibians in the Upper Niger Basin. However, the results of a RAP (Rapid Assessment Programm) survey in Guinea's Boké Préfecture (Wright *et al.* 2006) might be translated to our study area. This RAP yielded 26 amphibian species and 11 reptile species. According to the habitat preference and the geographical distribution 13 amphibian species might also occur in the Upper Niger Basin. Most of these species are connected to savanna or farmbush habitat and have a distribution area that exceeds the Upper Guinean forest block or even West Africa. Only a few species are typical forest specialists. Some of the encountered reptile species are protected by CITES (Convention on International Trade in Endangered Species of Wild Flora and Fauna): *Varanus niloticus*, *Chamaleo gracilis* and *Python regius*. Further research is needed to comment on the herpetological diversity in the basin.

In Africa, three species of crocodiles occur. The most widespread is Nile crocodile (*Crocodylus niloticus*) which occurs in suitable savanna habitat throughout the continent. Slender-snouted crocodile (*Crocodylus cataphractus*) is a Critically Endangered species restricted to forested rivers in West and Central Africa. It may be extinct in most parts of West Africa. The smallest species is the African dwarf crocodile (*Osteolaemus tetraspis*), which is listed as Vulnerable. It occurs in densely shaded swamps and streams in closed-canopy rainforest. It is uncertain whether this species occurs in the remaining forests of the Fouta Djalon within our study area.

Conclusions

Apart from the general lack of data (see below), we can conclude that as far as information is available it concerns data from protected areas. These seem to be the sole areas where

populations of vulnerable species are still present, reasons why most of these areas have been designated (Ramsar, Biosphere, National Parks).

However, also outside these PAs we expect endangered or endemic species to be present, in particular in large forest fragments and other habitats with low human pressure. For the species with a large home range these areas can serve as temporary habitat or corridor between key populations. For species with a small home range, these areas still can hold viable populations. However, as the natural habitats in the Upper Niger Basin are becoming more and more fragmented, the ecological connection between these areas is essential for viable populations. Riverine habitats often play or can play a pivotal role as corridor between the larger areas.

Information gaps and data need
Expect for some mammal species, actual and spatial data of vulnerable species (endangered or endemic) in the Upper Niger Basin is lacking completely, or is fragmented and far from complete. It will not be possible, nor is the goal, within the framework of the BAMGIRE program to fill this information gap. However, as far as vulnerable and endemic species are present in riverine habitats – which are influenced by (changes) in water management and that are linked to the Niger river system – it is important to know in which parts of the catchment they are distributed. Therefore, we needed more distribution data on these species, preferably on the level of tributary catchments. Data on aquatic and amphibian vulnerable species have high priority, next to species which reside in riverine habitats. This can be translated in specific actions:

d) collect all spatial data and observations in the Upper Niger Basin on African manatees, Common Hippos, Crocodiles, using (national) inventories and site inventories, as well as observations by local communities;
e) collect all spatial data and observations in the Upper Niger Basin on endemic fish species, on the level of tributary catchments;
f) collect all spatial data and observations in the Upper Niger Basin on vulnerable species in riverine habitats, using (national) inventories and site inventories, as well as observations by local communities;
g) digitise all relevant spatial data on these species, using the collected information;
h) Field missions to riverine habitats to collect additional information on these species.

2.4 Vulnerable bird species and bird concentrations

The IBA holds at least 300 different bird species of which 11 are typical for the Guinea-Congo Forest biome (www.birdlife.org). From the perspective of BAMGIRE we are particularly interested in vulnerable species which use riverine habitats (for breeding, roosting, wintering), and bird concentrations. The latter refer to breeding birds (colonies) or other concentrations of birds, like roosts and wintering concentrations. Also in this case priority is given to breeding colonies and concentrations in riverine habitats.

Vulnerable species (endangered or endemic)
On www.birdlife.org a list of vulnerable species per country is available. When all coastal species (waders, terns etc), species from the moist forests of the Guineo-Congolian zone and species from the south of Guinea are skipped, 25 species remain of which 9 are migratory. Nubian Bustard (Neotis nuba) and Eurasian Curlew occur in the north (desert resp. IND) and are not relevant for the Upper Niger Basin.

Of the remaining 23 species (Table 2.3) 8 species are strictly wetland species and occur mostly in the IND. However, these species may also occur in low numbers in other wetlands in the

Upper Niger Basin. African Skimmer is restricted to river habitats, is very rare, but may occur in the river systems of Niger and Bani. From the Upper Niger Basin no critical sites (sites with relative high numbers, see Section 2.4 and http://csntool.wingsoverwetlands.org/csn) are known. Also from the other wetlands species in Table 2.3. no critical sites are known in the Upper Basin. Most of the other species from Table 2.3. are raptors and vultures which dwell over large areas, mostly (wooded) savannas and are normally not linked to wetlands areas or riverine areas.

Table 2.3. Vulnerable species (VU vulnerable, EN endangered, CR critically endangered and NT near-threathened – IUCN categories).

Latin name	English name	IUCN Category	migratory	Guinea	Mali	hab
Circaetus beaudouini	Beaudouin's Snake-eagle	**VU**		v	v	o
Polemaetus bellicosus	Martial Eagle	**VU**		v	v	o
Neophron percnopterus	Egyptian Vulture	**EN**	v	v		s
Falco cherrug	Saker Falcon	**EN**	v		v	s
Circus macrourus	Pallid Harrier	**NT**	v	v	v	s
Streptopelia turtur	European Turtle-dove	**VU**	v	v	v	s
Necrosyrtes monachus	Hooded Vulture	**CR**		v	v	s
Gyps africanus	White-backed Vulture	**CR**		v	v	s
Gyps rueppelli	Rüppell's Vulture	**CR**		v	v	s
Torgos tracheliotos	Lappet-faced Vulture	**EN**			v	s
Neotis denhami	Denham's Bustard	**NT**		v	v	s
Ardeotis arabs	Arabian Bustard	**NT**			v	s
Terathopius ecaudatus	Bateleur	**NT**		v	v	s
Falco vespertinus	Red-footed Falcon	**NT**			v	s
Sagittarius serpentarius	Secretarybird	**VU**			v	s
Aythya nyroca	Ferruginous Duck	**NT**	v		v	w
Limosa limosa	Black-tailed Godwit	**NT**	v		v	w
Marmaronetta angustirostris	Marbled Teal	**VU**	v		v	w
Aythya ferina	Common Pochard	**VU**	v		v	w
Gallinago media	Great Snipe	**NT**		v	v	w
Glareola nordmanni	Black-winged Pratincole	**NT**			v	w
Rynchops flavirostris	African Skimmer	**NT**		v	v	w
Balearica pavonina	Black Crowned-crane	**VU**		v	v	w

Species as Saker Falcon, Pallid Harrier and vultures may occur in large wetlands – like the IND – to forage on birds or carcasses. These birds are not found in large concentrations or specific areas. From resident birds, information on breeding sites is lacking, but would be very informative in relation to ecological hotspots. The Secretary bird is known to be extremely rare in Guinea and Mali; during years of fieldwork in the IND and large parts of the Upper Basin no observations have been done (Jan van der Kamp, A&W).

Other species than raptors and vultures refer to European Turtle-dove and resp. Denham's Bustard and Arabian Bustard. The Turtle-dove is feeding on seeds in savanna habitats and may also feed on areas in wetlands (Zwarts *et al.* 2009). In terms of ecological hotspots it is relevant that the species is roosting at night in large numbers. An large roost is known from the wetland areas in the irrigation zone of Office du Niger (van der Kamp *et al.* 2005), threatened by frequent hunting. Like raptors, the Bustard species occur over large areas, most dry savanna habitat.

In the Upper Niger Basin a few IBAs are identified by Birdlife, in particular Kouakourou, Sirakoroni–Tyènfala (north of Bamako) and Mafou, which is part of the Parc National Haut Niger in Guinea. Both Sirakoroni–Tyènfala and Mafou are savanna woodlands resp. forests. In these dry areas a high variety of bird species has been recorded (Appendix I), but no vulnerable species (EN, CR, VU, NT). Kouakourou is a wetland area near the Niger. Many parts of the Niger river meet the same criteria as Kouakourou (Appendix I), as stated below for the Delta Mort (Zone Office du Niger) and the Sélingué area. The information on IBAs in Mali and Guinea is in general outdated, due to a lack of recent data.

Bird concentrations (breeding and non-breeding)
Information about bird concentration in the Upper Niger Basin is very scarce. For instance, in the Critical Site Network tool where information from the database of the African Bird Census is incorporated, no sites show up. This does not mean that there are no breeding bird colonies, roosts or wintering concentrations but it signifies that adequate information is lacking. We shortly summarise here available information (not complete). As stated before, priority is given to breeding colonies and concentrations in riverine habitats.

Breeding bird colonies
A number of wetland species is breeding is small and loose or even large colonies. This refers to cormorants, pelicans, storks, ibises and herons. Other wetlands species that nest in colonies are gulls and terns. Some others species do not breed in colonies but can reach quite high densities on preferred sites, like Black-crowned crane.

Based on the work of van der Kamp *et al.* (2005), we know that in the Office du Niger and the Selingué area (lake, irrigation system) no large breeding colonies occur. However, in flood forests along the Niger and Bani river and in the falas complex near Office du Niger small colonies of herons (Cattle egret, Little egret) may occur. Breeding of Black-Crowned crane is not recorded from the Upper Niger Basin. The exposed sand banks in the Niger and Bani may be of importance for African Skimmer and Kitlizz plover, but not information is available.

Roost and winter concentrations
Comparable to colonially breeding water birds, many species of water birds are concentrating in large groups in the non-breeding season. Also roosting behaviour is common in water birds, during the day (like ducks as Garganey and whistling ducks) and during night as cormorants and herons. Specific information on concentrations of water birds from the Upper Niger basin is lacking. We expect however concentrations of water birds and roosts to be present in temporal wetlands and along the river system, in particular of migratory water birds (waders, herons) and resident water birds, and concentrations of birds feeding in rice paddies in irrigation zones.

Information is restricted to the description of some wetlands areas and the work of van der Kamp *et al.* (2005). We summarise the most recent information of two areas which were investigated by the team of Wetlands International in 2000-2005 (van der Kamp *et al.* 2005). These may serve as example for these type of wetlands: irrigation zones, marshy areas and riverine habitats.

Delta Mort – irrigation zone Office du Niger : Purple Swamphen *Porphyrio porphyrio* (hundreds seen), African Pygmy Goose *Nettapus auritus* (some dozens) and African Darter *Anhinga rufa* (>50), vulnerable species, have been observed in substantial numbers and are comparatively well represented in the area; they favour the Nymphea-Typha habitats with some trees and bushes. Marsh Owl *Asio capensis*, generally described as an uncommon to rare breeding species in West Africa (Borrow & Demey 2001), is a fairly common breeding species, with main breeding numbers probably in the fala sectors. Marsh Owls are observed throughout the year and consume rats, mice and insects whereas another insect-eating raptor species, the African Swallow-tailed Kite *Chelictinia riocourrii,* having a seasonal pattern, shows up by the end of the year and disappears in the following months. Some 3000 birds were noted at night roosts in December 2003. Counts may also reveal the Delta Mort's international importance -Ramsar Convention: 1% of (sub)population occurring- for Eurasian Marsh Harrier *Circus aeruginosus,* Purple Heron *Ardea purpurea* and other afrotropical and palearctic species.

Sélingué area (storage lake and irrigation zone): The biodiversity in the Sélingué rice polder seems relatively low compared to natural wetland habitat. In July 2003 African Jacana *Actophilornis africana* was by far the most common species together with Spur-winged Lapwing *Vanellus spinosus,* and small secretive marsh birds like Lesser Moorhen *Gallinula angulata* and Lesser Jacana *Microparra capensis* were regularly seen. Second-common wader species in July (just before palearctic arrivals) was the afrotropical Greater Painted-snipe *Rostratula benghalensis*. The Sélingué irrigation zone may serve as a dry season staging area for species like Cattle Egret *Bubulcus ibis* and Affrican Wattled Lapwing *Vanellus senegallus.* Wood sandpiper *Tringa glareola,* Cattle Egret and Yellow Wagtail *Motacilla flava* were the most numerous species in February counts (like in the Delta Mort). Based on density counts the maximum numbers for Cattle Egret assessed, were 3800 (Dec-Febr), African Jacana 8000 (Jun-Jul), Wood Sandpiper 5200 (Dec-Febr) and Yellow wagtail 4600 (Dec-Febr).

Sélinkegny Lake is an important wintering area for White-faced whistling Duck *Dendrocygna viduata*: maximum numbers counted between June 2002 and June 2004 amounted to 14.000-15.000 birds, maximum reached in February. Osprey *Pandion haliaetus*; a preliminary estimate of 50-100 birds base don mid-winter counts in 2002-2003 could be maintained in 2004 when over 60 birds were counted ons ome 70% of the lake. Dead trees at the lakeside served as a night roost for Long-tailed Cormorant *Phalacrocorax africanus* (several hundreds), Cattle Egret (1500-2000) and Black Kite *Milvus migrans* (>500). Breeding colonies were not found, but overall counts in this eco-zone are expected to reveal whether this is a reality or not. Rice Area and lake combined will certainly meet criterion 5 of the Ramsar Convention: a wetland should be considered internationnally important if it holds regularly 20000 water birds or more.

Information gaps and data need

Expect for specific site information, actual and spatial data on vulnerable species (endangered or endemic) and bird concentrations in the Upper Niger Basin is lacking, fragmented and/or far from complete.

Within the framework of the BAMGIRE program it will not be possible, nor is the goal, to fill this information gap. However, in combination with information on vulnerable habitats (Section 2.2), it is important and helpful to know the function and significance of riverine habitats which are influenced by (changes) in water management. The focus should be on vulnerable species and other (inter)nationally important species which congregate in breeding colonies, roosts or concentrations. Therefore, we needed more data on these habitats, preferably on the level of tributary catchments, in Guinea as well as in Mali (Upper Bani region). This can be translated in specific actions:

a) a specific action to collect spatial data and observations in the Upper Niger Basin (censuses) on habitat level, which can be combined with data on vulnerable habitats (see Section 2.2);
b) Field missions to riverine habitats, and indentified wetlands areas (see Section 2.2), to collect additional and actual information on this topic (Guinea, Bani).

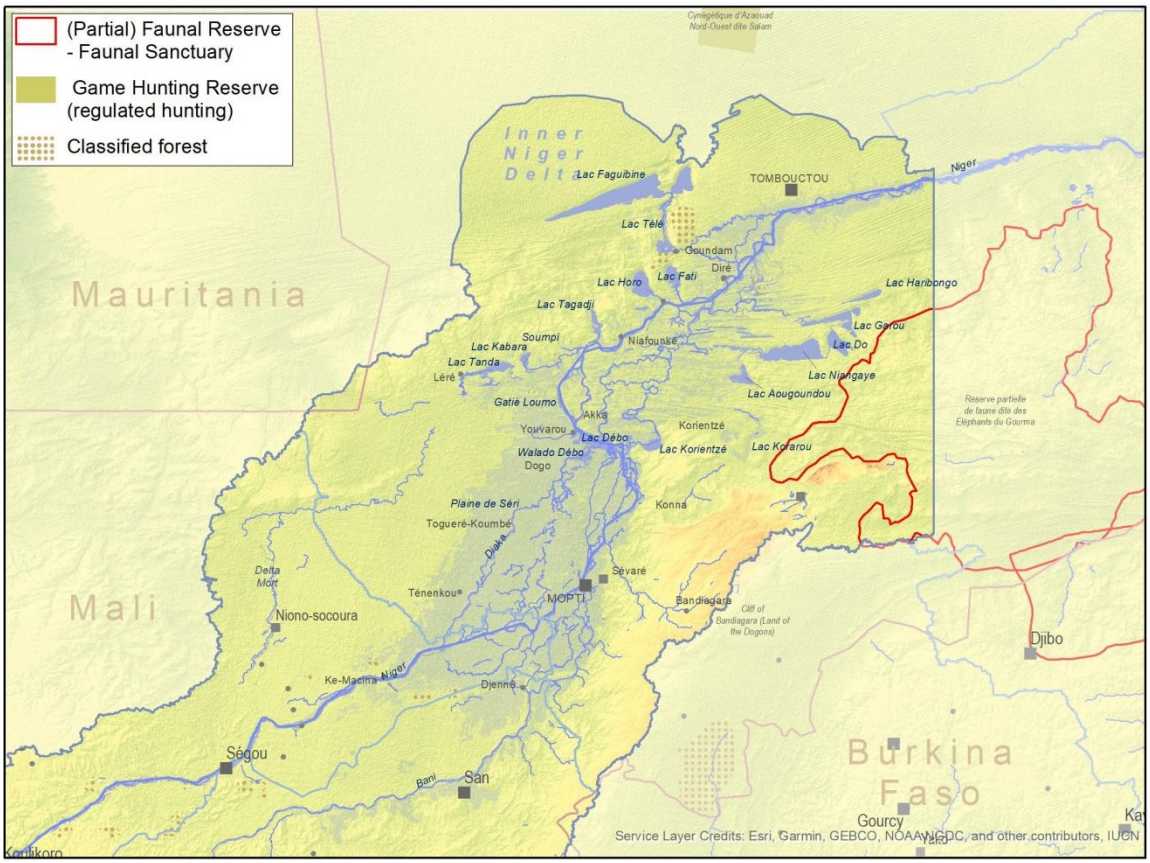


Fig. 3.1. The floodplain of the Inner Niger Delta and connected water bodies, showing the outer limits of the floodplain. Based on IGN-maps from the 1950s (Zwarts et al. 2005, Zwarts & Hoekema 2013). Also the protected area are shown.

3 Inner Niger Delta

3.1 Short characterization

The Inner Niger Delta downstream of the Upper Niger Basin (Fig. 3.1) is a rather flat savanna and floodplain landscape in the Sahel, in the north bordering the Sahara desert. The catchment of the Niger river encompasses the floodplain of the Niger proper, a series of lakes in the north and the savanna landscape south of the Niger and east of the delta, including the mountainous region of Gourma – Douentza. The extent of the floodplain ecosystem is shown in Fig. 3.1, showing the outer limits based on IGN-maps from the 1950s (Zwarts *et al.* 2005, Zwarts & Hoekema 2013). More in detail, the following landscapes can be distinguished.

Floodplain of the Inner Niger Delta
The Inner Niger Delta is one of the largest floodplains in Africa. The Delta not only stands out because of its size, but also due to its hydrological dynamics. Starting in July, the water rises about 4 m in 100 days. In years of high river discharge, peak level may be 6 m higher than a few months previously. The large between-year differences in flooding make the system even more dynamic. In a year with a high peak flood level in the Inner Delta, the flood lasts four months longer than in a year with a low flood: the wave comes in a wet year one month earlier and continues for an additional three months. When the water level starts to rise in July in the south-western part of the Delta, the plains in the northeast are still dry. By the time the northern plains become flooded two months later, the water level is already declining in the south.

The topographical maps of the Institut Géographique National (IGN) reveal that the inundation zone of the Inner Niger Delta measures 36,470 km^2, including 5340 km^2 of levees, dunes and other islands within that area. They also show that water coverage declines from 31,130 km^2 in wet periods to 3840 km^2 in the dry period. Topographical maps show the maximal flooded zone, but the area actually inundated varies considerably between years. Zwarts & Grigoras (2005) used satellite images to construct a digital flooding model, covering the range of water levels between -2 and +511 cm, as measured on the gauge at Akka in the central lakes.

There is a very good fit between the water level, such as measured in Akka (situated in the middle of the Inner Niger Delta) during rising water and the flood extent (km^2). In 1984, the water level at Akka did not exceed 336 cm and the flooded area was limited to a mere 7800 km^2. In contrast, in 1957 and 1964, the water level at Akka reached the very high level of about 600 cm, leading to a flooded area of 22,000 km^2. It should be noted that this is still substantially smaller than the total floodplain of 31,000 km^2 as shown on the IGN maps. This apparent discrepancy is caused by the shallow northward slope of the floodplain that delays flooding in the north with two-three months; by that time the southern floodplain has already been drained of water. Because the remote sensing analysis is based on actual water coverage, the area flooded at any one time is always less than the total area flooded in the course of a year.

Northern lakes
In the northern part of the Inner Niger Delta a series of lakes fringes the west flank of the delta as well as the east flank of the delta. The lakes and depressions are connected to the system of the Inner Niger Delta, but depending on maximum flood height and filling up of canals with sand dunes, the actual inundation varies.

Lakes on the west bank

The lakes on the west bank are connected to the floodplain and filled with water most of the year, although the extent of flooding is varying with rainfall, and even more, with the flood height in the delta. The water level in most of these lakes is managed to facilitate the cultivation of the lake shores and the lakes itself, depending on depth and inundation. Some small shallow lakes or depressions near the floodplain are all cultivated. Each of the large lakes can hold significant numbers of water birds and can be considered as ecological hotpots. The following larger lakes are distinguished:

- **Lac Tanda** – lake near Léré, shore have been cultivated (in the past). No active water management
- **Lac Kabara** - lake near Léré, shore have partly been cultivated (in the past). No active water management
- **Lac Tagadji** – relative large lake, of which the edges are partly cultivated. Water levels are managed through inlet at the entrance of the lake.
- **Lac Horo** –relative large and shallow lake, at low water levels fully cultivated. Water levels are managed through inlet at the entrance of the lake.
- **Lac Fati** - relative deep lake, of which the edges are partly cultivated. Water levels are managed through inlet at the entrance of the lake.
- **Lac Télé** - relative small and shallow lake, at low water levels fully cultivated. Water levels are managed through inlet at the entrance of the lake. The canal running east of Télé to the north, via Lac Takara, feeds Lac Faquibine, more to the north. This canal is often blocked by sand dunes.
- **Lac Faquibine & Gouber** – Large lake east of Tombouctou, of which only the eastern part holds regularly water depending on rainfall and the water level in the canal which feeds the lake. Large parts of the lake are cultivated, in the western part of Lac Facquibine forest of Acacias have developed.

Lakes on the east bank

The lakes on the east flank are only inundated and filled with water in case of a high flood. These must be regarded as temporary lakes. These lakes are situated south of the Niger and are part of west – east depressions which are characteristic for this dry savanna landscape. The following larger lakes are distinguished:

- **Lac Haribongo** - temporal lake/depression only flooded at high flood levels.
- **Lac Garou** & Lac Gakoney - temporal lake/depression only flooded at high flood levels. On the lake bottom some scattered cultivation are present,
- **Lac Niangaye** – temporal shallow lake flooded at high flood levels, more often than Lac Garou. Most parts of the lake are cultivated.
- **Lac Do** - temporal lake/depression only flooded at high flood levels.
- **Lac Aougoundou** - temporal lake/depression only flooded at high flood levels.
- **Lac Korarou** - temporal lake/depression only flooded at high flood levels.

Savanna and mountainous areas of Gourma - Douentza

South of the Niger and east of the floodplain a vast and sparsely wooded savanna landscape stretches, bordered by the Niger river in the north and the mountains of Douentza and Hombori in the south. This area is part of the catchment of the Inner Niger Delta, but apart from the lakes mentioned before, there is no flooding.

For more information about the Inner Niger Delta we refer amongst others to Zwarts *et al.* (2005) and Zwarts *et al.* (2009). Both can be downloaded in French and English on www.altwym.nl/publications.

3.2 Protected areas

The designation of international important areas for biodiversity and ecosystems in Mali and the legal system of protected areas has been elaborated in Section 2.1. In this Section designated and legal protected areas in the sub basin of the Inner Niger Delta are briefly mentioned (Fig. 3.1).

Designated areas of international importance
In Mali designated international important areas by the government refer to Biosphere reserves and Ramsar sites. Since 1 February 2004 the government of Mali designated the entire floodplain area of the IND as Ramsar site, covering a surface area of 41,195 km^2. Already three sites were designated since May 1987, all of which are now part of the Ramsar site as a whole. The designation of the sites resulted in the initiation of projects by the IUCN (1980s) and Wetlands International since 1998.

Legal protected areas
The floodplains of the Inner Niger Delta have no legal protected status. A number of Classified forests have been designated in the north of the delta:

- Small forests between Youvarou and Niafounké and two large classified forests near Goundam (Fati-Somidara, Tagadrin), all along the western flank of the delta. The areas near Goundam can be considered as almost treeless savanna and desert landscape;
- Four small forests (Koagodyana, Aina, Diendel, Amari) east of Diré on the floodplain. The forests are located at the higher levees and dunes; the actual density of trees in these forest is very low.

On the east flank of the Inner Niger Delta the Partial Faunal Reserve Gourma is situated, a protected areas for Elephants which roam the savanna landscape between the Reserve du Sahel in Burkina Faso and the areas of Gourma. Near Ménaka, just east of the Niger river and southeast of Gao, a partial faunal reserve for Giraffes is located in combination with game hunting reserves (see table in Section 2.1). These protected areas however are not part of the basin of the Inner Niger Delta as defined in BAMGIRE.

3.3 Vegetation and habitats in the Inner Niger Delta

General characterization
The different biotopes of the delta can be identified by their vegetation, reflecting a gradient from dry savanna (south, middle) and desert (extreme north) to seasonally inundated floodplains and lakes with permanent water (Fig. 3.2).

Quensière (1984) divides the Inner Niger Delta in four hydrographical zones: the upper Delta, the middle delta, the lower Delta and L'Erg Niafonké or Nord dunaire. The upper and middle delta form the southern part. The upper delta covers the southern part from Ké-Macina to Sofara, while the middle delta covers the rest of the southern delta with the relatively high and dry 'centre vide'. The lower delta covers the central lakes (Débo, Walado, Korientzé), which can be seen as the northern limit of the southern floodplain being as good as totally flooded at highest water levels. L'Erg Niafonké or Nord dunaire refers to the northern delta, north of the central lakes. This parts extends towards Tombouctou in the north, and consists of floodplain habitats interspersed with east-west running dune complexes.

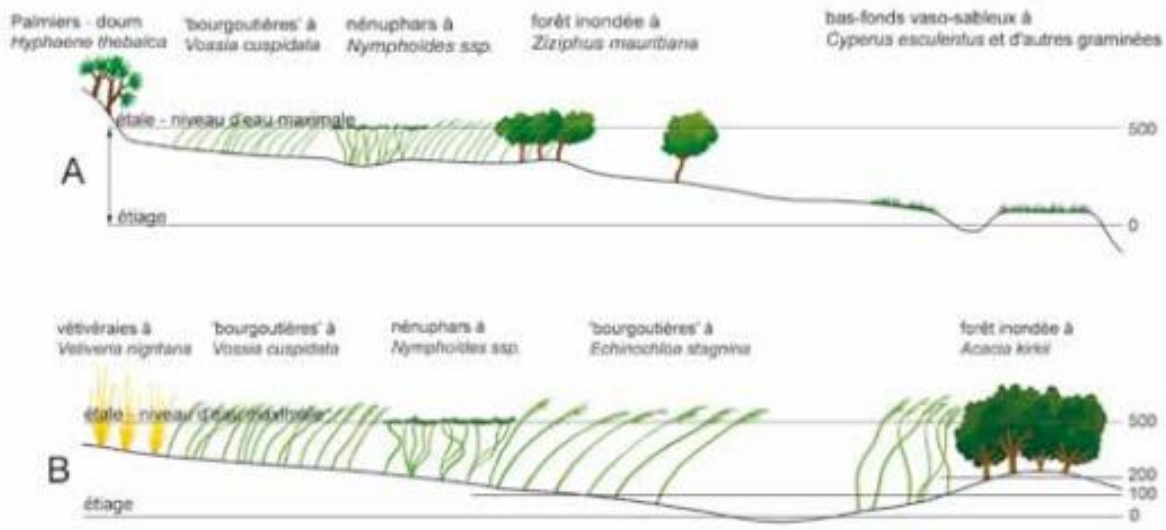


Fig. 3.2. Succession of key habitats in the central part of the IND, from Wymenga et al. (2002).

The flooded parts in the southern and northern IND are vegetated with plant and tree species which are adapted to steep fluctuations in water level, seasonal flooding and long dry periods (Zwarts *et al.* 2009). The distribution of the main vegetation types is determined by the flood duration and thus the depth of water. Main vegetation communities are, according to increasing water depth (Fig. 3.2.), on levees low-lying *Mimosa pigra* shrub and the tall Black vetiver grass *Vetiveria nigritana*, cultivated (floating) rice *Oryza glaberrima*, *Nymphaea lotus*, Wild rice *Oryza longistaminata / barthii*, Dideré *Vossia cuspidata*, and wild and planted Bourgou *Echinochloa stagnina* on the floodplain. During flooding, wild rice, bourgou, and also dideré (known in eastern Africa as Hippo Grass, but as dideré in the Delta), form huge floating meadows, with Nymphaea fields in between.

The lowest floodplains often become green as soon as a dense vegetation of grasses and Guinea Rush *Cyperus articulatus* emerges after the flood has passed. However these green floodplains are short-lived and quickly transform into dry dusty steppe with hardly any vegetation, a combined effect of the withering sun and intensive grazing by cattle, sheep and goats. Twenty percent of the 20 million goats and sheep and 40% of the five million cows in Mali are concentrated in the Inner Delta and its surroundings during the dry period. During the flood this set of vegetations is manifested in particular in the southern IND as an immense green plain that is intensively grazed during the retreat of the water (décrue) The cattle particularly benefit from the bourgou being the most nutritious and the last grass to graze before the next flood.

Flood forests are dominated by *Acacia kirkii* but also *Ziziphus spina-cristii* is frequently found. Only a few flood forests remain and a number of scattered remnants of former flood forests (van der Kamp *et al.* 2002, Beintema *et al.* 2007). Such remnants are important areas and have high potential for regeneration of flood forests, particularly in het Pora region, near Aman Nangou, Bouna and Gourao. The floodplain of the IND is fringed by higher plaines where Red Acacia *Acacia seyal* is present together with, especially on drier places, other tree species like *Balanites aegyptiaca*, *Bauhinia rufescens*, *Detarium microcarpum* and *Diospyros mespiliformis*. The delta north of the central Debo complex is characterised by parallel dune formations of ancient eolic origin (the so-called *Erg de Niafounké*), with characteristic Doum Palm *Hyphaene thebaïca*, floodable areas in between and a number of lakes in its peripheral zone (see above). In the non-flooded much drier areas often *Acacia tortilis* and *A. senegal* are found.

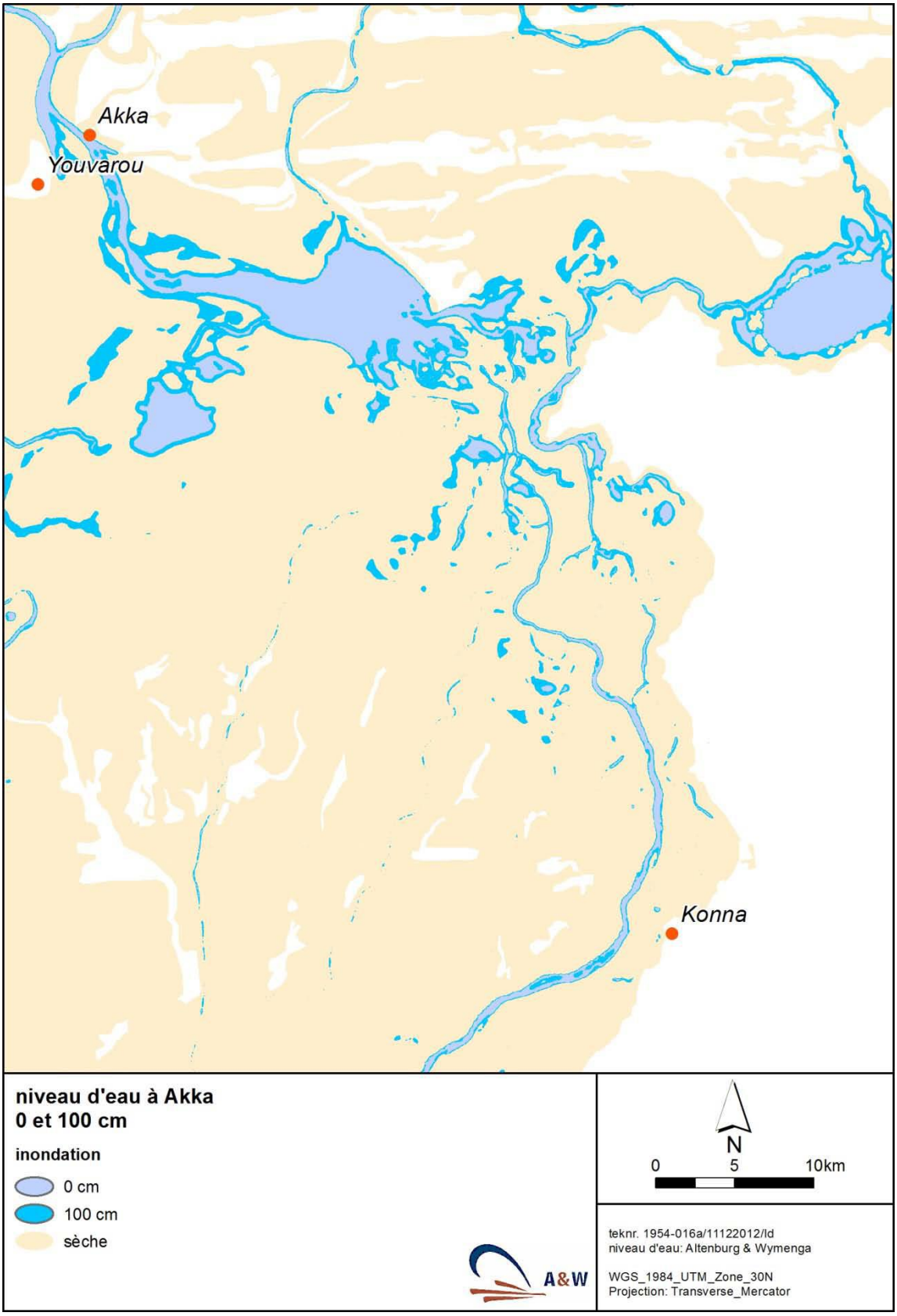


Fig. 3.3. Water area at 0 or 100 cm at the Akka gauge compared to the inundation zone at a high flood of about 600 cm (yellow), in the central part of the delta. Note that a water level of 100 cm all floodplains are already dry, except the shallow borders of Lac Debo.

Key habitats in the Inner Niger Delta

Although soil (clay, sand) is an important determinant of the growth conditions of the vegetation, the occurrence of vegetation types on the floodplain of the IND is mainly a function of flood duration (numbers of days inundated). Flood duration is depending of the water level and the water level is a function of the annual river discharge of the Bani and Niger river, both feeding into the delta. To characterise the (potential) occurrence of vegetations water levels can be used, as indicator of water depth and flood duration. The maximum water level on a fixed location can be translated in water depth, using the flood model of Zwarts & Grigoras (2005). Due to the highly varying annual river discharge, the maximum flood height (maximum water level) and thus flood duration and water depth on a fixed location, are varying annually. As a consequence the optimal growing zone for a specific type of vegetation may vary spatially from year to year, depending on the maximum flood level. As described in detail by Zwarts *et al.* (2005b) and Zwarts *et al.* (2009) the response of the vegetation on changing water levels is delayed by 2-3 years.

In this Section we briefly characterise the key habitats in the delta, using existing information, mainly from Zwarts (2012) and Zwarts *et al.* (2005b, 2009). Important sources, which are incorporated in that work are Marie (2000, 2002), Hiernaux (1982), Hiernaux *et al.* (1983), Hiernaux & Diarra (1986). After a short characterisation the optimal growing zone is defined (when known). Key habitats are described following the gradient from permanent water, towards the floodplain and the higher non-flooded levees and vegetated plaines.

Permanent water

The habitat 'permanent water' are permanent water bodies, which in a floodplain ecosystem, consist of water bodies which are also holding water during the dry season, hence at the lowest flood level (*étiage*) when the floodplain is exposed and dry. In practice this refers to the Niger river proper and the deepest parts of the lakes.

Permanent water has a very important function as refugium for aquatic organisms during the period of low flood (March-July). It is the only place where the remaining population can survive during low floods. This is particularly relevant for fish species as well as large mammal and reptile species bound to water like Hippo, Manatee and Monitor lizard (and Nile crocodile but this species is not known anymore for the IND, see Section 3.6). All these species are under large threat, as they are very vulnerable at low water levels. Already in 1984, Quensière (1984) published an extensive study on the fisheries in the delta, concluding there was a heavy exploitation leading to the loss of species, a reduction of the length of the reproduction cycle and a strong reduction in size. Since the 1980s the fish catch in the delta further increased, at least in terms of effort by fishermen. The existence of refugia in the form of permanent water bodies for (remaining) fish during the period of low flood, is essential for the fish populations in the delta and the annual reproduction.

Permanent water bodies can easily be distinguished on the basis of satellite images which show the water bodies at the low flood levels. As can be derived from Zwarts & Grigorias (2005) and Zwarts (2012), at the end of the dry period (*étiage*) – when the water level on the gauge in Akka is 0-40 cm – the following parts of the delta still hold water:

- the Niger river proper, running from Ké-Macina to Mopti, toward the Debo lake complex and Akka, further north to Diré and Tombouctou. All branches including the Diaka are dry, as well as parts of the Bani river (Fig 3.3 for central delta);

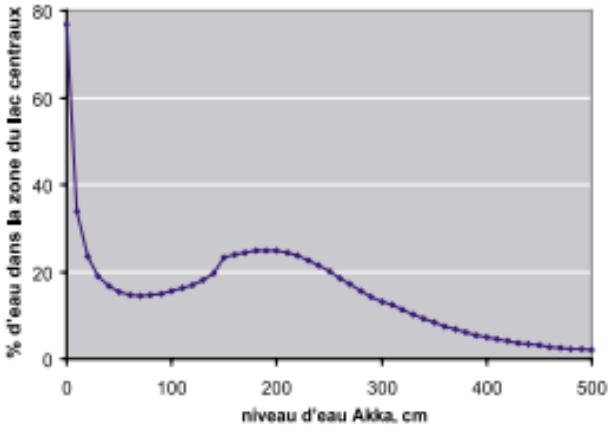


Fig. 3.4. A. Water bodies in the Inner Niger Delta at two moments during the étiage during low water levels. B. Proportion (%) of the inundated surface area in the Inner NIger Delta as a function of the water level at Akka. From Zwarts et al. (2005).

- Parts of Lac Debo and Lac Korientzé, and (not each year) a small part of Walado-Debo. At low water levels most of the remaining water in the IND is concentrated in the central lakes (Fig. 3.3 and Fig. 3.4);
- Lac Fati and, not annually, parts of Lac Télé.

The height of the lowest water level has changed in the course of years through the upstream water management. Since the creation of the dam and storage at Sélingué in 1987, a part of the flow is withheld during the wet season, and released during the dry season (Zwarts *et al.* 2005). This leads to a higher water level during the étiage. However, as most of the additional water released by Sélingué is being consumed by the irrigation system of Office du Niger, the overall impact on the dry season level is very low (Zwarts 2012).

Exposed sandbanks and mudflats during low water levels

During the receding flood and during the étiage (period of lowest flood) sandy and muddy banks become exposed in the central lakes in the delta. These floodplains often become green as soon as a dense vegetation of grasses and Guinea Rush *Cyperus articulatus* emerges after the flood has passed. However these green floodplains are short-lived and quickly transform into dry dusty steppe with hardly any vegetation, a combined effect of the withering sun and intensive grazing by cattle, sheep and goats.

However, these banks also hold locally high densities of bivalves and molluscs which are of extreme importance as food for a range of migratory water birds species. These migratory species – in particular Glossy Ibis, Ruff, Black-tailed godwit – feed on these benthivore organisms to gain weight prior to migration. In other parts of the delta these bivalve and mollusc communities do not occur, or at least not in high densities profitable for birds to feed on (Zwarts *et al.* 2009, van der Kamp *et al.* 2002).

The banks with high densities of bivalves and molluscs are found in the lower parts of the delta in the central lakes, and become exposed when the water level is decreasing below 100 cm at Akka. The highest density is found between 20-90 cm at Akka, with a peak around 50 cm at Akka (Fig. 3.4). In the case of a flood level of c. 470 (468 cm is average over the past 10 years, www.opidin.org) the maximum water depth of this zone is 380-450 cm. The areas covers a zone with a surface area of 5-15 km^2 (see Zwarts *et al.* 2009).

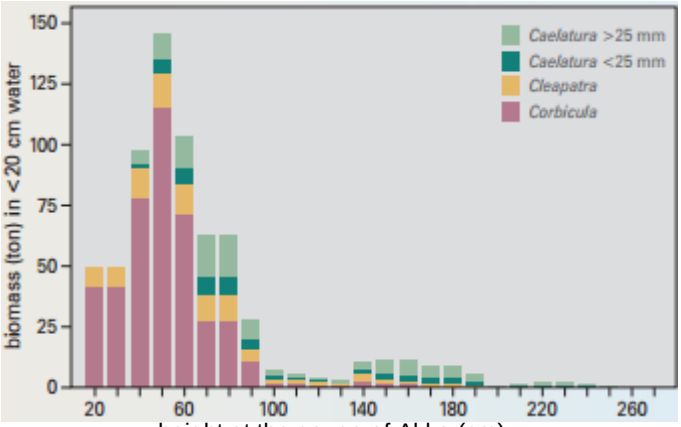


Fig. 3.5. Biomass (in tonnes dry flesh) of bivalves and molluscs as a function of the height at the gauge of Akka (in cm). The peak of biomass is found at a height of 50 cm relative to the gauge of Akka. From Zwarts et al. (2009).

The timing of departure of migratory birds to the breeding grounds (Febr – March) hinges on the timely weight gain prior to the long flight northwards. When the zone becomes exposed (water level at Akka < 100 cm) to early - *before* the birds prepare for migration - there will be no food for these migratory species. During the great drought in the 1980s this happened in 1984, with mass starvation of Ruff. The timing of the 'migration window' therefore is an essential parameter for determination of the environmental flow.

Bourgou fields and other floating vegetations

Bourgou fields are floating grass fields of *Echinocloa stagnina* and an essential habitat in the DIN floodplain ecosystem. Their structure (stems up to 6 m in length) constitutes an ideal habitat for the reproduction and the growth of first-year fish populations. Bourgou habitats are of major importance for populations of several resident and migratory bird species, including herons and egrets (Zwarts *et al.* 2005, 2009). Bourgou is essential for livestock in the dry season (pasture, forage). The grazing system of the transhumance is the mainstay of livestock in this Sahel-zone, and the IND lies at the heart (for example De Leeuw & Milligan 1993). Next to bourgou other floating grass fields are present in more shallow parts of the floodplain, dominated by *Vossia cuspidate*, locally known as Dideré. The production of bourgou (and other livestock fodder) is a function of flooding. The water depth for optimal bourgou production is 4-5 m, and for Dideré 2-3 m (Fig. 3.5). Here we summarise existing information from the work of Zwarts *et al.* (2005b, 2009) and Zwarts (2012).

Given a water depth of 4-5 m, the surface area of optimal *bourgou* habitat can be calculated for different flood levels (Fig. 3.6). In 1984, when peak water level reached only 336 cm, none of the floodplains in the Inner Niger Delta had a water column in excess of 4 m. *Bourgou* was outcompeted by plant species as *Didere* in suboptimal habitats with less than 4 m of water. Relatively small changes in flood level of the IND thus have a large impact on plant species restricted to a narrow range of water depths.

In contrast to *bourgou*, cultivated rice grows in shallower water 1.0-2.5 m deep. The area where water depth varies between 1 and 2 m measures only 800 km2 during a low flood (360 cm at Akka), but increases to 4300 km2 during a high flood (580 cm). Water depth is not the only criterion for farmers to cultivate an area for rice growing. Rice cultivation is restricted to substrates that are rather clayey, which explains why rice is almost absent from the sandy northern half of the Inner Delta. The clay content of the soil being rather high in the southern section of the Delta, it is here that most rice fields are concentrated. The area of the Inner Niger Delta cultivated for rice has increased from 160 km2 in 1920 to about 1600 km2 in 1980-2000.

Upper panel: The floodplains Inner Niger Delta are covered by a dense vegetation of floating grasses: wild rice in shallow and bourgou, in deep water. Bourgou is also planted by local people. Lower panel: Enclosed bourgou plantations with fishing nets, indicating a further intensification of the fishing methods (see van der Kamp & Diallo 2012).

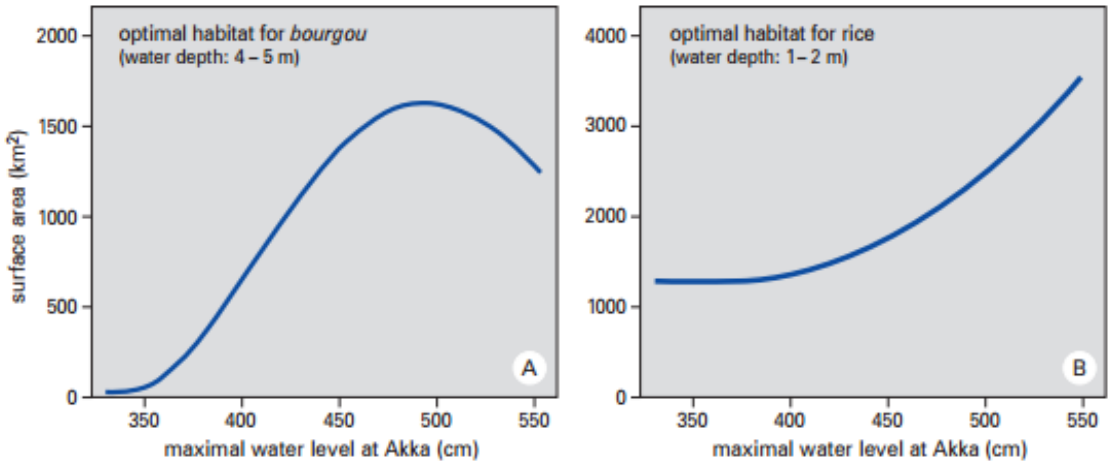


Fig. 3.6. Surface area (km2) in the IND where we expect (A) optimal bourgou habitat (4-5 m water depth) or B optimal habitat for rice growing (4-5 m water depth), both as a function of water level at Akka. From Zwarts et al. (2009).

Using the digital flooding model and the optimal growing zones, Zwarts (2012) produced vegetation maps of the southern half of the IND delta for different flood levels. Given that *bourgou* is dominant where the maximal water depth amounts to 3-5 m, the surface area of optimal *bourgou* habitat can be calculated for different flood levels. In the same way the zone can be determined where *didéré* is expected to be dominant (water depth 2-3 m). Wild as well as cultivated rice is found at a similar water depth (1-2 m) and Vetiver grass in more shallow water (0-1 m).

The expected zoning of these four dominant vegetation types is shown in Fig. 3.7–3.10 for a peak flood level of 600, 500, 400 and 300 cm at Akka. These maps must be read as 'expectation' maps since the actual presence of these vegetation is of depending on the actual flood heights and the (delayed) response of the vegetation to these flood heights. Also, on these expectation maps there is correction made for cultivation perimeters where farmers cultivate rice (and removed existing natural vegetation, see Zwarts *et al.* 2005b, Zwarts 2012). It is evident however from the maps that relatively small changes in flood level of the Inner Niger Delta have a large impact on the distribution of plant species restricted to a narrow range of water depths.

Since we have no data on the water depth of the zone remaining covered by water at 0 cm at Akka (no gauge for levels below 0), we had to assume that the area (indicated as open water in Fig. 3.2) would remain open water independent of the water level. That is not entirely true, however. As described by Zwarts (2012), *bourgou* started to colonize the open water of Lac Walado in years with a very low water level (1980s). Hence *bourgou* will not disappear from the IND if the water level would decline to 300 cm, but find a last refuge in Lac Walado and also Lac Debo. This does not change the fact that the potential surface area of *bourgou* will show a very large decline at a reduced flood level.

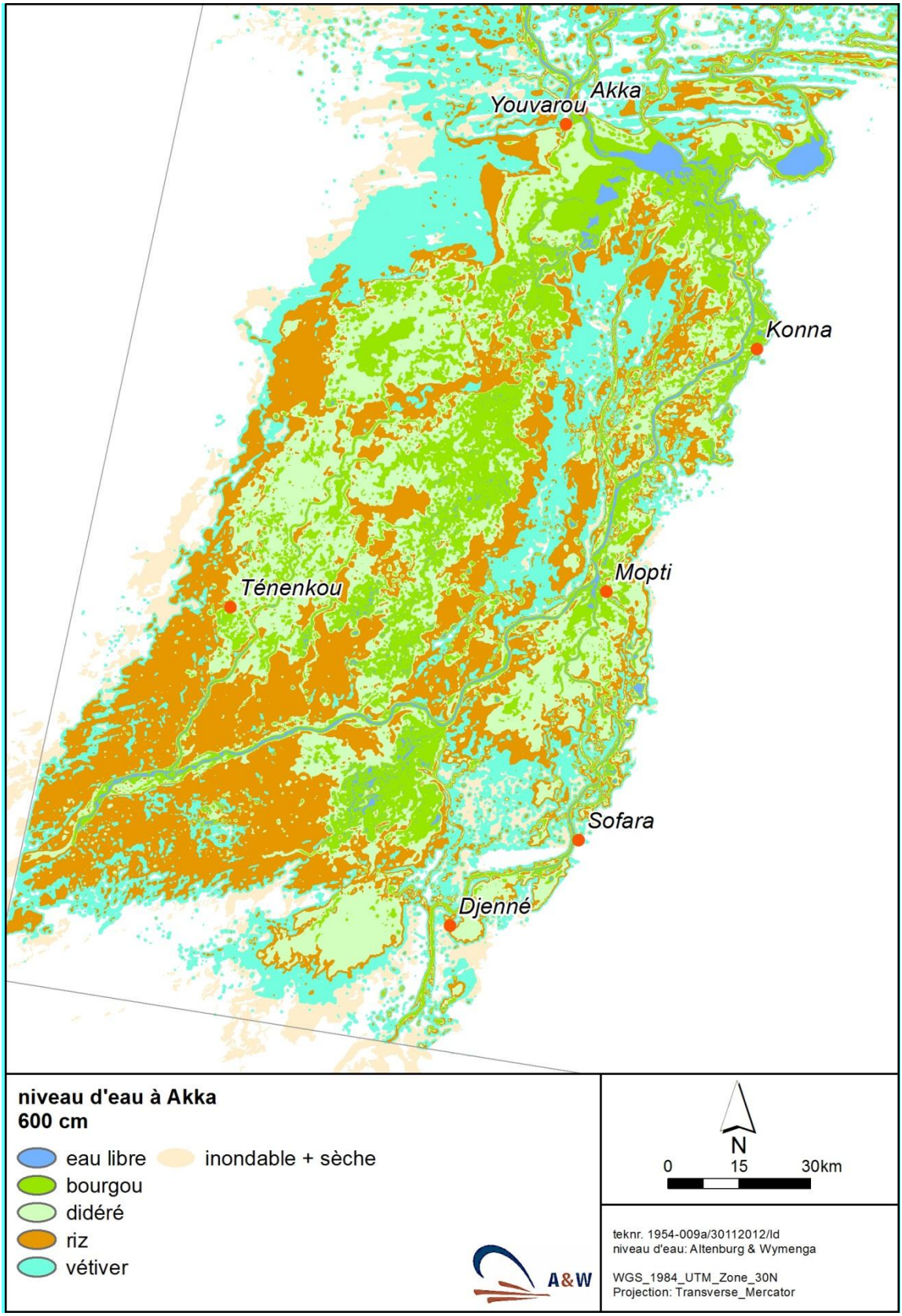


Fig. 3.7. Expected dominant vegetation communities in the southern part of the IND at a maximum annual flood level of 600 cm at the gauge of Akka. See text for explanation.

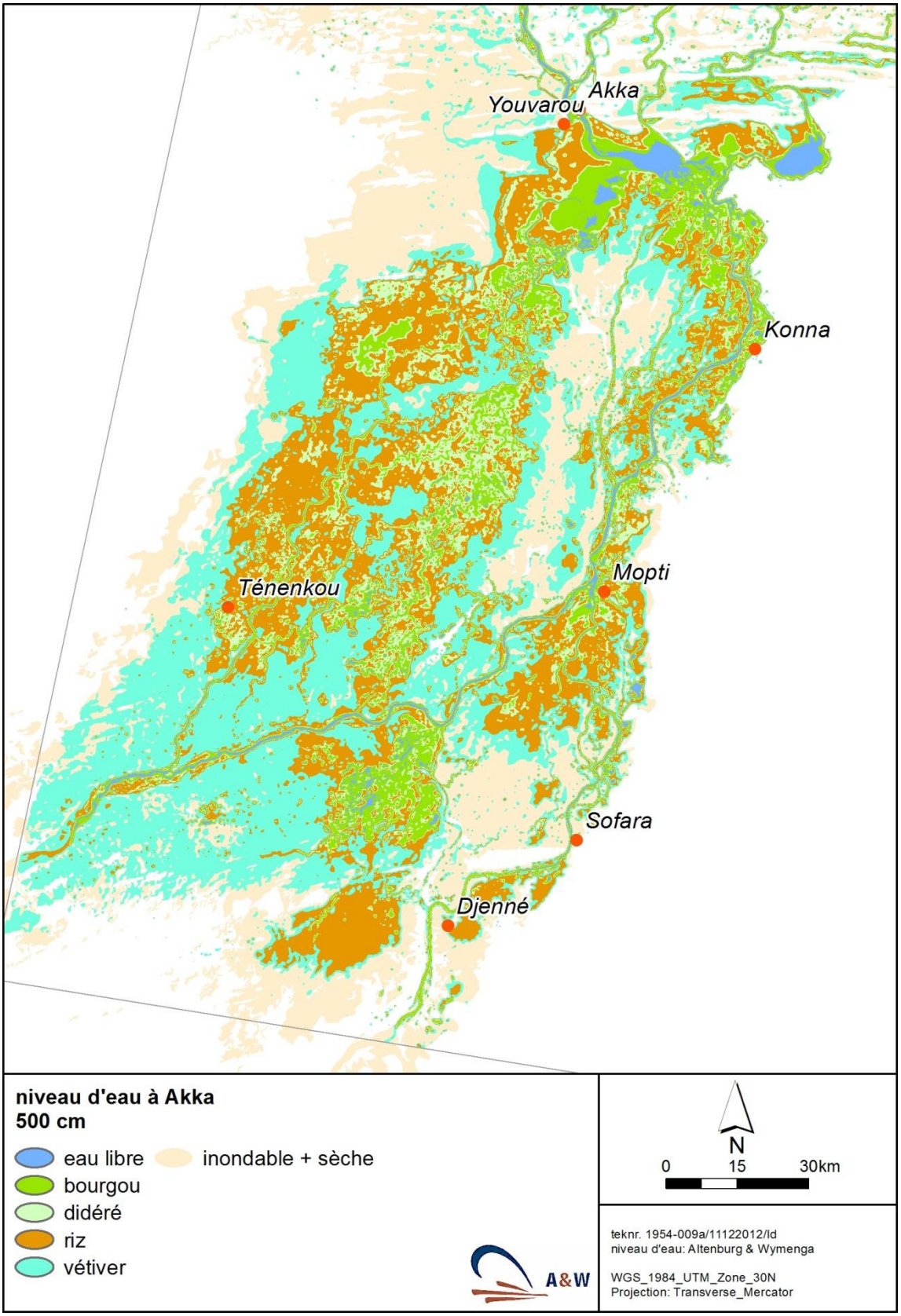


Fig. 3.8. Expected dominant vegetation communities in the southern part of the IND at a maximum annual flood level of 500 cm at the gauge of Akka. See text for explanation.

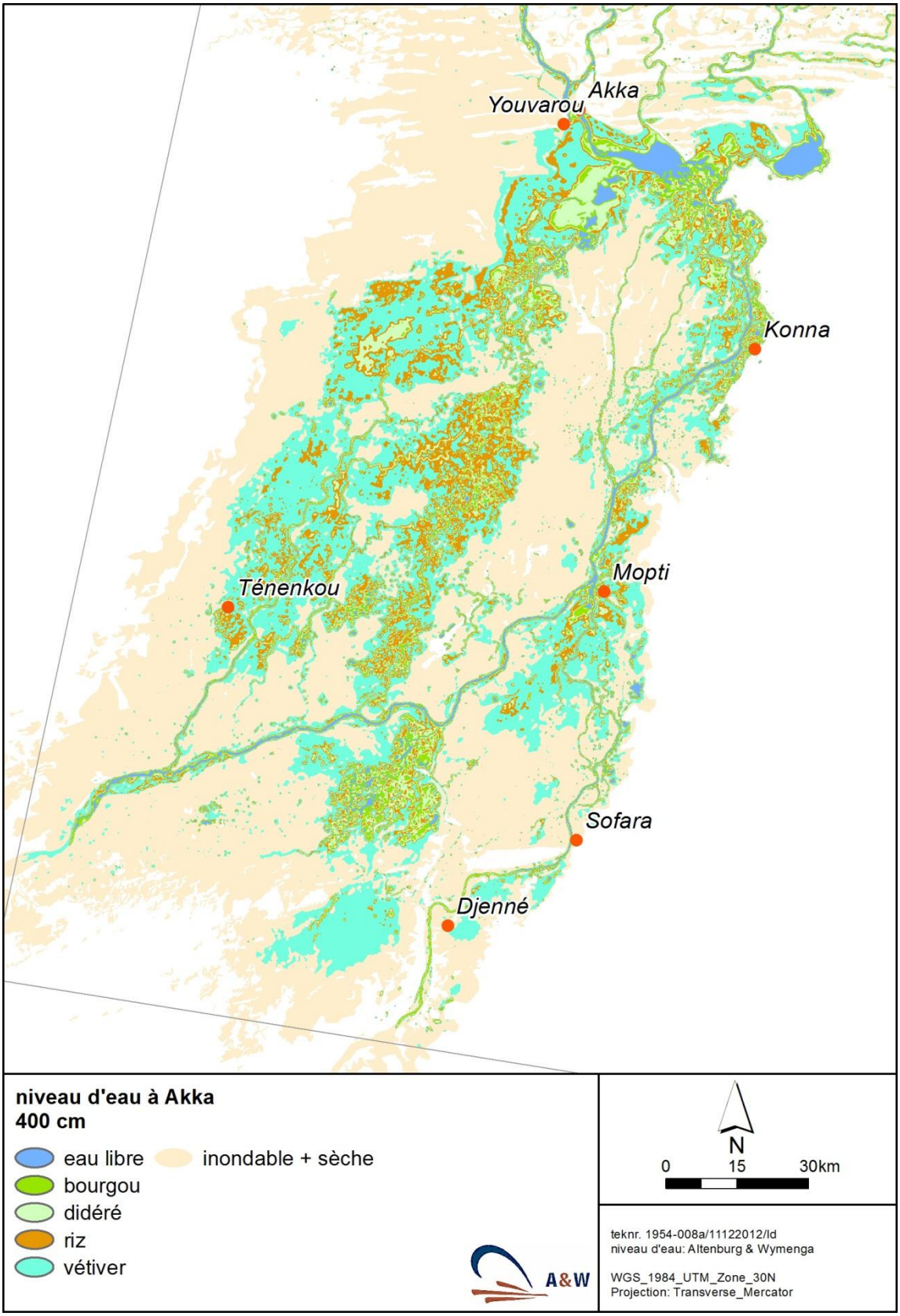


Fig. 3.9. Expected dominant vegetation communities in the southern part of the IND at a maximum annual flood level of 600 cm at the gauge of Akka. See text for explanation.

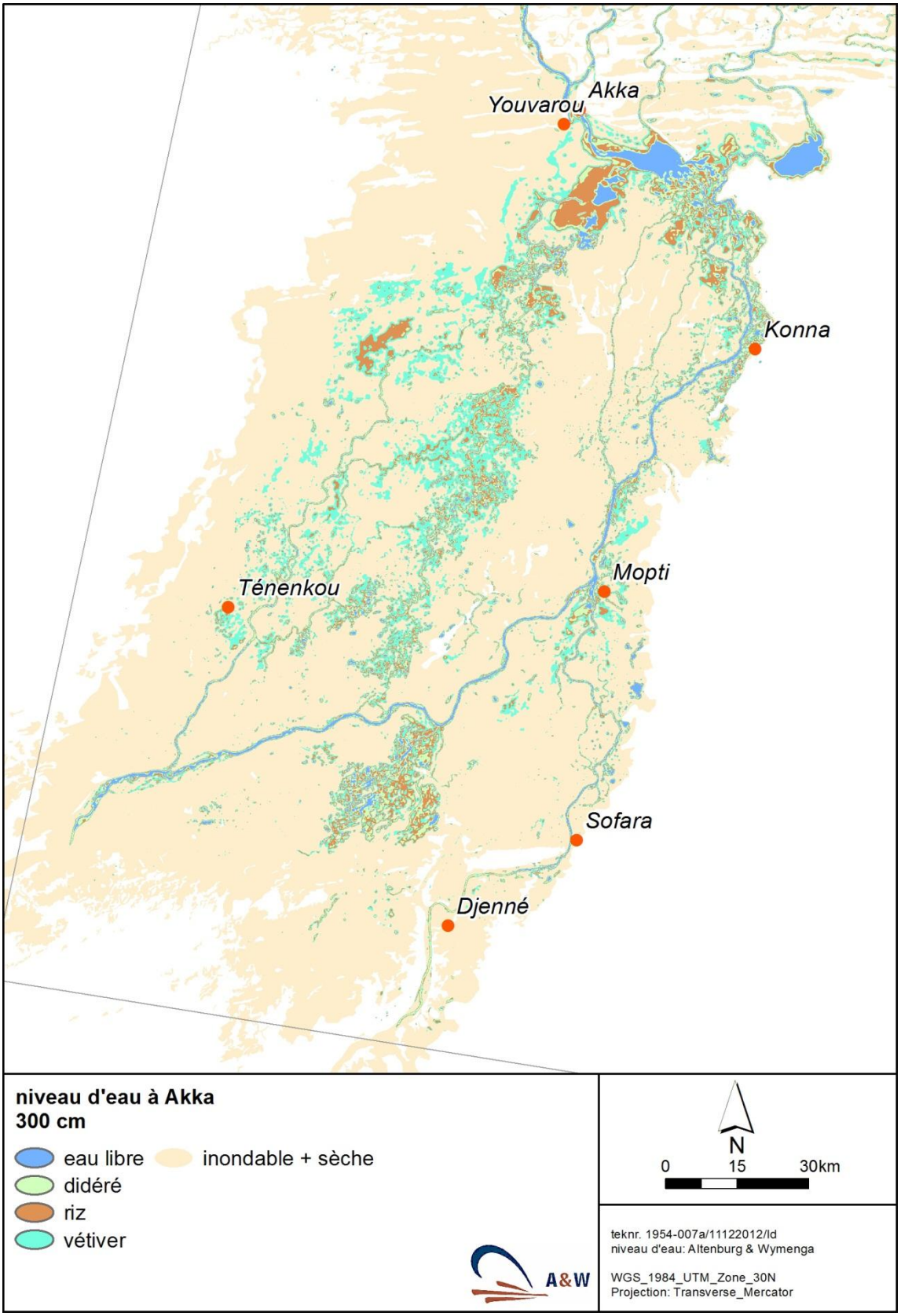


Fig. 3.10. Expected dominant vegetation communities in the southern part of the IND at a maximum annual flood level of 600 cm at the gauge of Akka. See text for explanation.

Mares (ponds)
In the floodplain system of the IND numerous smaller and larger *mares* or found: small ponds or pools, depression or even small, shallow lakes which are – depending on the maximum flood height - flooded during the upcoming flood. As long as the flood is high enough, these water bodies stay connected to the river, but often the shallow canal between the river and the ponds runs dry while the ponds still hold water. In the course of the dry season the pools run dry via evaporation.

The water bodies mostly vegetated by *Nymphaea*-species (*nénuphares*). Especially during the receding flood the ponds are often rich in birds, partly foraging on the seeds of water lilly (in particular ducks like Garganey) or on fish, which are trapped in the isolated water bodies. As temporary habitats the ponds are very important for fish. These fish populations are exploited by local communities for communal fishing when the flood retreats.

Spatial data on the distribution of *mares* is not available yet, as the relative small water bodies cannot be distinguished in the current flooding model of Zwarts & Grigoras (2005), although many small patches can be distinguished on the water maps from the receding flood.

Flood(ed) Forests
The flooded forests, with their reputation as breeding ground for large breeding colonies of water birds, form a unique habitat in the IND. Few tree species support prolonged flooding alternating with several months of drought, and therefore flooded forests often include only one dominant species: *Acacia kirkii.* Another species *Ziziphus spina-cristii* is also found frequently. Since the memory of man, the local populations managed these forests according to a system of shared responsibilities: farmers/ breeders during the dry season and fishermen during the floods. This system collapsed in the 1960s when the national authorities imposed their regulation on traditional management by the inhabitants of the delta. In addition, the Great Drought has led to the destruction of most of the flooded forests for the development of new rice fields on lower ground. With the return, at the end of the century, of the rains and consequently of the more effective floods the inhabitants recognized and often regretted their losses.

Rural communities initiated restoration efforts, with the help of IUCN (since 1984), Wetlands International (since the late 1990s) and other partners. Attempts to restore the flooded forests have had different results. Some cases such as the forests of Akkagoun and Dentaka can be considered a great success. The Akkagoun Forest has received a legal protection status in 1991, followed by the establishment of the Association for the Management of the Akkagoun Forest in 1999; The implementation of their Management Plan is coordinated by the Local Management Committee. Unlike Akkagoun, where the restoration took place through the spreading of seeds, the reconstitution of the Dentaka forest was spontaneous thanks to postponed grazing and the guarding by the local fishermen. Also for this forest a management plan has been developed. Efforts elsewhere in the DIN have not yielded great results so far, but everywhere a feeling for the restoration of flooded forests has been reported. The example of Dentaka clearly shows that relatively little effort can lead to a rapid replenishment of forests!

Flood forests are found in the lower parts of the floodplain, at a water depth of 100-250 cm, more or less overlapping with the distribution zone of wild rice, *dideré* and partly cultivated rice. This is one of the reasons flood forests have been removed during the great droughts to make room for rice cultivations. The most recent information on the occurrence of flood forests is summarised by Beintema *et al.* (2007), Zwarts *et al.* (2009) and Zwarts (2012). Fig. 3.11 shows the locations of lost and present flood forests. The actual situation, as far as known, is listed in Table 3.1.

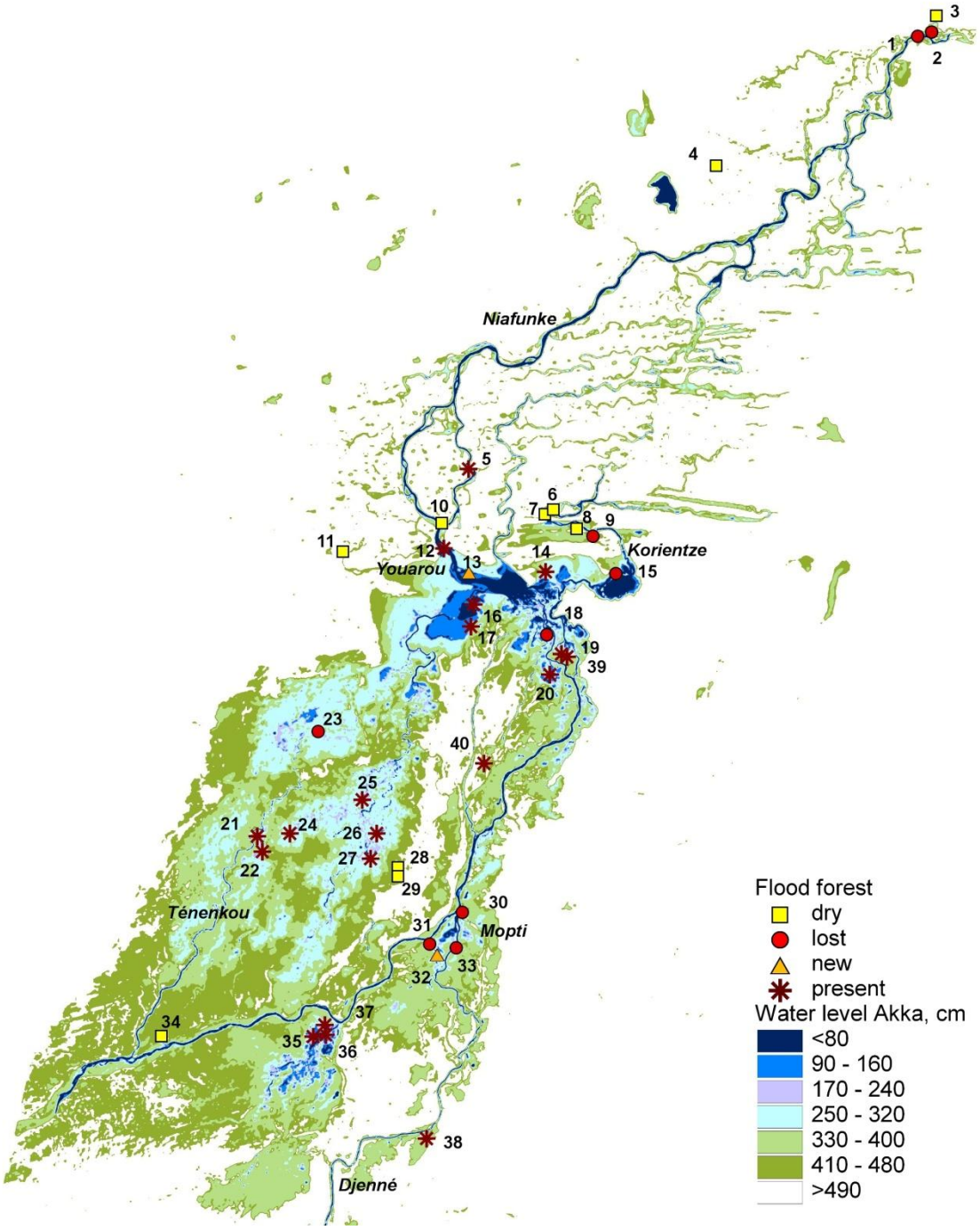


Fig. 3.11. Flood forests in the Inner Niger Delta, with a distinction in stil existing forest (new, present) and lost flood forest (dry, lost). From Beintema et al. (2007) and Zwarts et al. (2009). The numbers of the flood forests refer to the numbers in Table 3.1. where additional information is given on status and presence of colonies of water birds.

Table 3.1. Flood forests in the Inner Niger Delta, with a description of the status in 2007 (based on field visits) and the presence of colonies of water birds. Information: Beintema et al. (2007), Zwarts et al. (2009), personal information Mori Diallo (Wetlands International) & Jan van der Kamp (Altenburg & Wymenga).

nr	name	Status	Colonies and roosts in 2005-2007
1	Toya	lost	Nowadays none. Before the forest was destroyed, large colonies of various water birds were present
2	Djelika (Kourioumé)	lost	Nowadays none. Before the forest was destroyed, large colonies of various water birds were present
3	Kabara	dry	Nowadays none. Before construction of dykes/ dams and subsequent drought colonies were present
4	In Tarouel	dry	-
5	Legual Poural (Owa)	present	Nowadays none, but it could regain its specific breeding site for Gray Heron colonies
6	Konso Souma (Kossouma, Koussouma)	dry	-
7	Toga	dry	-
8	Toba	dry	Used as roosting place by Cattle egrets
9	Bama (Beima)	lost	Nowadays none. Before the forest was destroyed, large colonies of various water birds were present
10	Gome (Goma)	dry	Nowadays none. Before the forest was destroyed, large colonies of various water birds were present
11	Doundewal (Kerdial)	dry	Nowadays none. Before the forest was destroyed, large colonies of various water birds were present
12	Akkagoun	present	Colonies of water birds are present
13	Sobesaba (Sobesaga)	new	Water birds are beginning to use the new trees as perches, potential future nesting site
14	Gourao (Simaye)	present	Before the forest was degraded colonies were present
15	Korientzé	lost	-
16	Kota	present	Nowadays none, but once pelicans and terns were present
17	Dentaka	present	One of the largest mixed colonies in Africa, with 70,000 couples of 16 different Afrotropical waterbird species
18	Bora bora (Boro boro)	lost	Nowadays none, formerly with nesting herons
19	Képagou	present	?
20	Mbouna (Bouna, Timisobo)	present	?
21	Amanangou (Koumbé Niasso)	present	?
22	Longuel	present	?
23	Idole Diouguba (Toguéré Koumbé)	lost	Nowadays none, colonies disappeared by disturbances
24	Tiayawal Fufu	present	Living colony of c. 1000 water birds, also with African cormorants and Anhingas
25	Dioulali	present	~100 nesting birds
26	Simion	present	Colony of mixed species, 100 à 200 pairs of African cormorants, cattle egrets, oriental darters
27	Tenakaye (Kadial)	present	Nowadays none, formerly colonies were present
28	Nelbel	dry	Some colonies present, also colonies lost
29	Boundouol	dry	?
30	Wilibana (Wendoubana)	lost	Nowadays none, colonies disappeared after deforestation
31	Ngomi	lost	Nowadays none, colonies disappeared after deforestation
32	Konosoro	new	Roosting place for herons and cormorants. Colonies of birds exploited by local people.
33	Tiayawal Tomona (Djibitaga)	lost	Nowadays none, colonies disappeared after deforestation

34	Ndiakoye Nelbi (Tilembaya)	dry	Nowadays none, colonies disappeared after extreme drought
35	Pora I	present	Roosting place
36	Pora II	present	Small colonies of herons and cormorants
37	Pora III	present	?
38	Soro (Tomina)	present	Nowadays none, colonies disappeared after degradation of the forest during extreme droughts
39	Sibila	present	Roosting place for herons
40	Mayo Raneo Sud	present	Roosting place for night-herons

Dry wooded savanna - mostly Acacia seyal

No forests are indicated on the vegetation map of the Inner Niger Delta made by Zwarts *et al.* (2005) since the resolution of the satellite images used by them was too coarse to distinguish trees. Although there are hardly any forests in the Inner Niger Delta, trees occur in many areas, although in a low density. Especially the areas with higher densities are often found in parts which are not dry but concern more or less moist soils in depressions. These wooded savannas are mostly above the upper limit of flooding, although parts of these areas may be temporarily flooded with a shallow layer of water. Most important tree is Red Acacia *Acacia seyal*. Wood production in is important for local communities. From the ecological point of view the wooded parts shelter a range of species by providing food and cover. The forests of *Acacia seyal* are a hotspot for migratory passerines (Zwarts *et al.* 2015).

Zwarts (2012) did a first attempt to describe the distribution of the woody vegetation in the IND. It was necessary to distinguish areas with a variable density of trees. In total eight categories were distinguished based on the canopy, the relative coverage of the tree crowns. Mapping the woody vegetation in this way was time-consuming, so only a part of the Inner Niger Delta was done (Fig. 3.12). Within the area where tree densities were assessed, measuring 1956 km^2, woody vegetation was registered on 210 km^2. Thus 89% of the selected area is bare without any tree and within the zones where trees are noted, nearly everywhere the landscape remains very open with only scattered trees.

For several reasons there are only a few trees in the Inner Niger Delta. The grazing pressure is so high that trees cannot settle. Within the Inner Niger Delta, less trees are found in the low-lying floodplains, but this is not because of the deep flooding since some tree species (*Acacia kirkii*, *Ziziphus spina-cristi*) grow in water being flooded by 3-4 m of water. The Akkagoun and Dentaka forests (Fig. 3.12) could come into existence in the 1980s when grazing was prevented during some years. A second explanation of the open, bare landscape is that trees are removed by farmers when they made their fields and continue to do so in an attempt to reduce the number of seed-eating birds breeding in the trees in the direct surroundings of their fields. That is why rice field on the floodplains are tree-less (Fig. 3.13).

The on-going extension of farmland will cause a further reduction of the riverine forests on the remaining floodplains of Inner Niger Delta. On the other hand, dry woodland may reappear in areas being no longer inundated and, for that reason, left by the farmers.

Fig. 3.13 A&B. The tree canopy in the surroundings of Akka and Youvarou (A) and in the surroundings of Koubaye-Kotaba and Dakobory, halfway between Mopti and Ténenkou, along the Niger River (B). The background colours show the elevation, from dark blue (deep water) to light blue (shallow water) given in 58 categories of 10 cm (0 to 580 cm relative to the gauge of Akka; same data as Fig. 3.7). White areas: no trees and not flooded at a very high flood level of 580 cm.

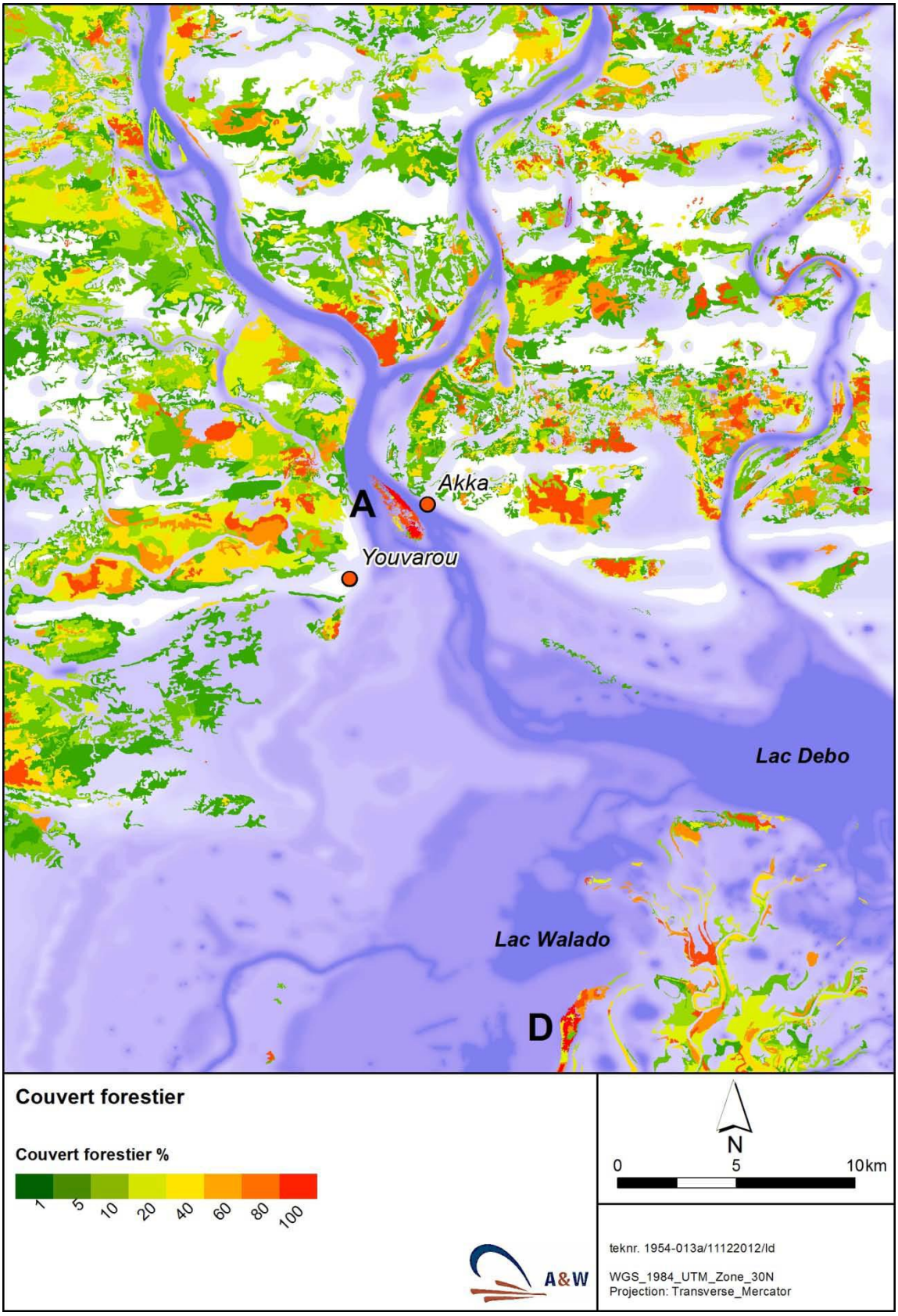


Fig. 3.13 A – see text on page 60. The flood forests of Akkagoun (= A) and Dentaka (= D) are indicated.

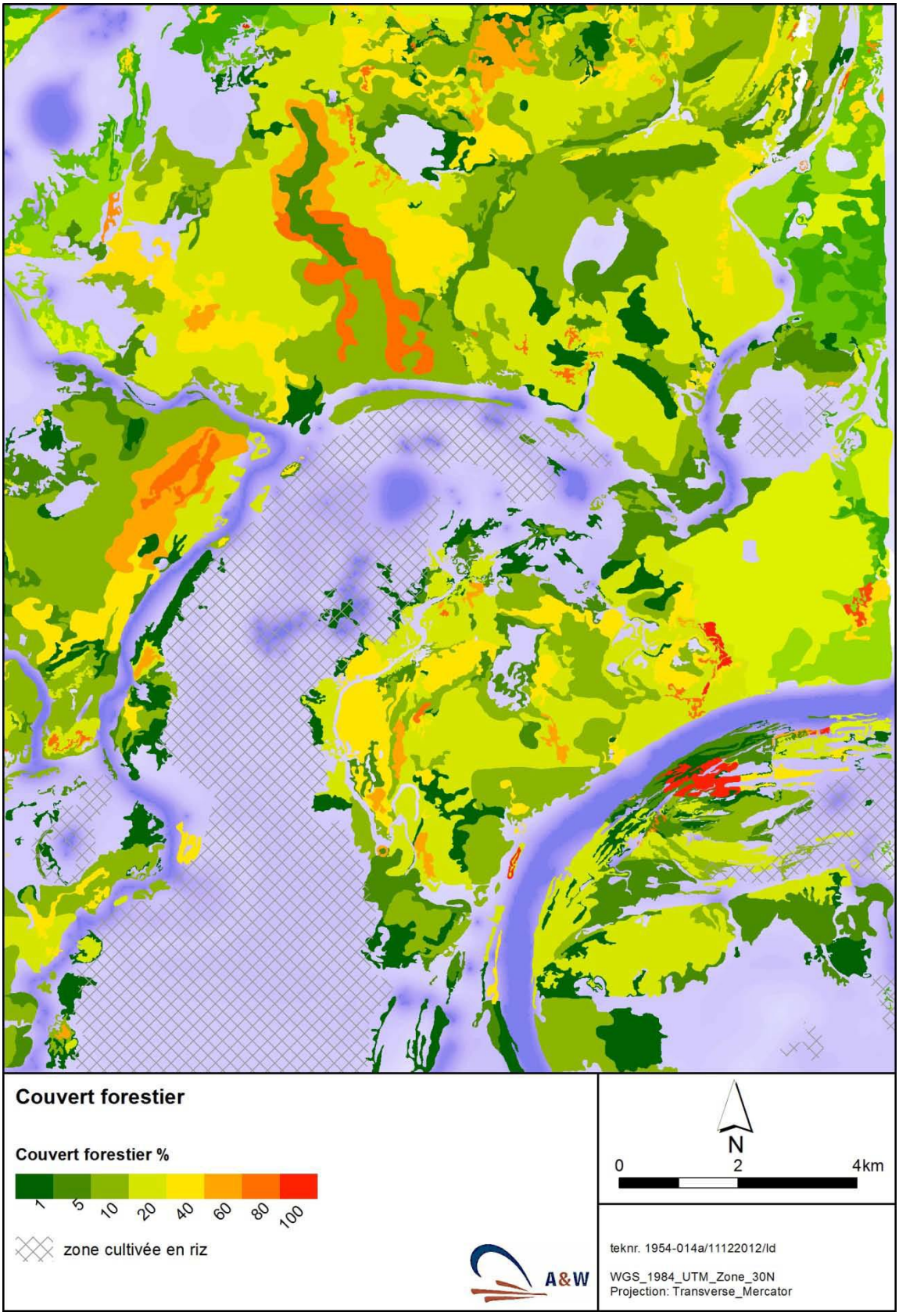


Fig. 3.13 B. – see text on page 60. All trees have been removed where farmers grow rice on the floodplains (riz à submersion libre; cross-hatched).

Information gaps and data need

The short description of key habitats shows that already a lot of information is available, in particular in relation to flooding and the spatial distribution. However, part of the data is outdated or we needed more detailed information about the spatial distribution in relation to flooding:

- Spatial information on water depth in the Inner Niger Delta, in particular the occurrence of deep areas as these areas may deserve special attention as refugium for fish and other aquatic organism during the dry season (*étiage*);
- Spatial distribution of the bivalve- and mollusc- zones, based of actual field missions;
- Field mission to map the current areas with planted and wild bourgou, in addition and completing the current digital information. To be used for ground thruthing of remote sensing with high resolution satellite images (Sentinel);
- Flooding map with separation in connected and unconnected areas to the river system. This will be included in the new flooding model in BAMGIRE;
- Field mission to map the current areas with flood forests, in addition and completing the current digital information. To be used for ground thruthing of remote sensing with high resolution satellite images (Sentinel);
- Field mission to map the current areas with (moist and dry) forests, in addition and completing the current digital information. To be used for ground truthing of remote sensing with high resolution satellite images (Sentinel);

3.4 Breeding birds, important habitats and bird concentrations

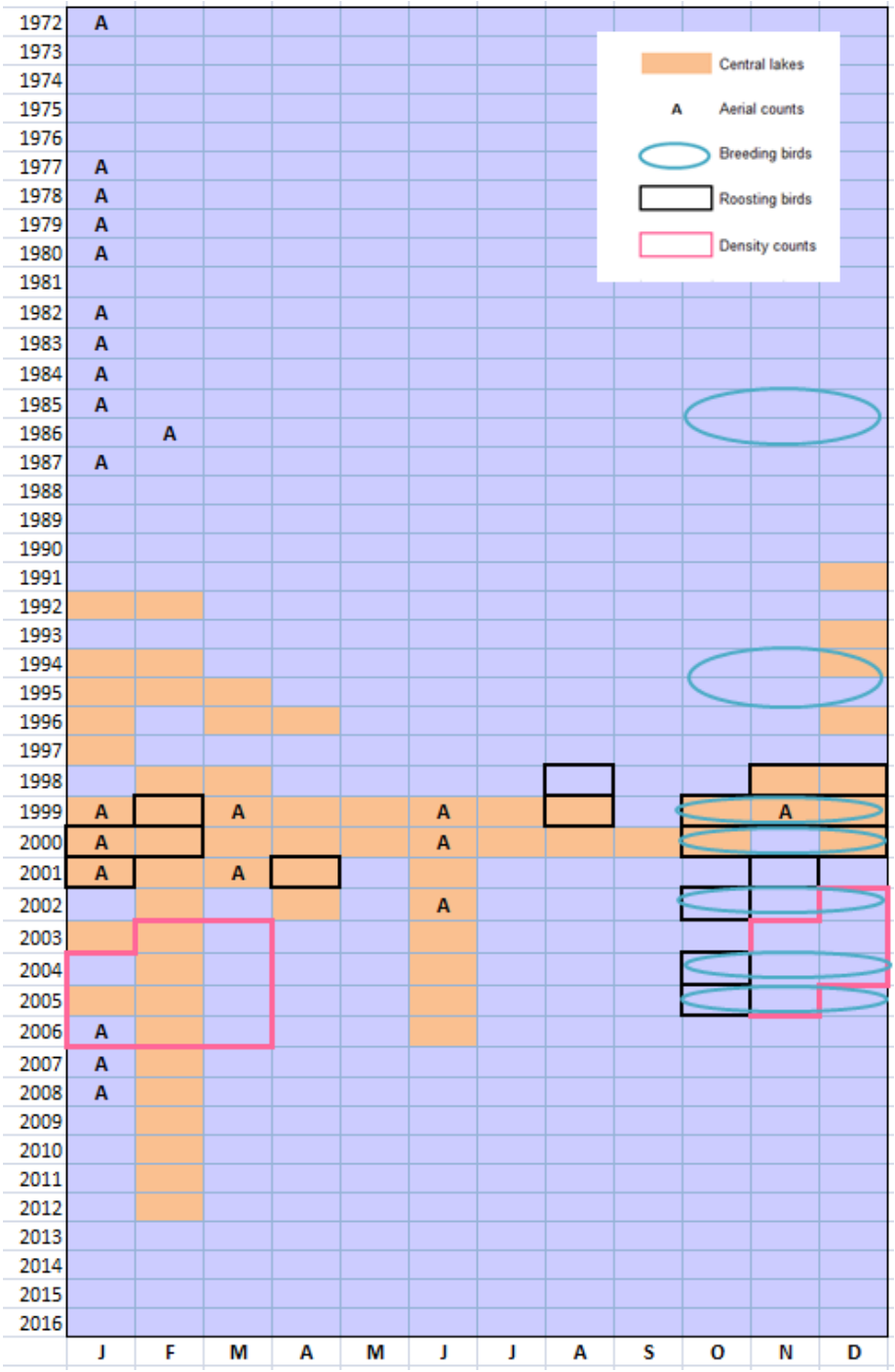
The IND is one of the major floodplains in Africa and as such of paramount importance as wintering area for migratory species and habitat (breeding, non-breeding) for resident species. This refers primarily to water birds. However, the IND hosts also large population of a number of land bird species, including birds of prey, which use the unflooded parts of the floodplain and the adjacent (wooded) savanna landscape. The enormous international ornithological importance of the area has been documented long ago, amongst other by Gallais (1967) and other ornithologists (see box 6 in Zwarts *et al.* 2009).

Available information: systematic counts and data collection

Since the early 1970s a series of systematic aerial censuses have been carried out in the IND by the French CRPBO, WWF/IUCN and ONCFS (Table 3.2), the last one in a series of three censuses in 2008. The aerial counts cover the entire IND including the lake on the east and west bank. Colonially breeding water birds were systematically covered for the first time in the 1980s by a WWF/IUCN project (Skinner *et al.* 1987), and were repeated in the 1990 and 2000s. The water birds breed in huge colonies in a few flood forests of the delta, and information is gathered by counting nests in combination with numbers of birds performing foraging flights (to and from the colonies, see van der Kamp *et al.* 2005). The most recent coverage of colonially breeding water birds was carried out in 2006, and since then no quantitative information on the status of the breeding populations in the IND is available (Table 3.2).

During the receding flood, starting as soon as the water level at the Akka Gauge drops below a level of 200 cm, the central lakes form a concentration place for water birds, feeding on fish, seeds of bourgou and other water plants and mollusk and bivalves. During a water level of 200 cm at Akka, the southern part of the floodplain is almost dry, which is the reason that water birds concentrate at the central lakes. Also the northern lakes – Lac Télé, Lac Fati and Lac Horo and depending on the highest flood level also parts of Lac Facquibine – may still hold large concentrations of water birds.

Table 3.2. Timing and methods of bird counts in the Inner Niger Delta, covering 63 ground surveys of the central lake area, 23 aerial counts, 7 systematic counts of large colonially breeding water birds, 17 counts of herons and other water birds at large communal roosts, and 1617 density counts between 15 November and 15 March in wetlands habitats in the IND. From Zwarts et al. (2009) with additional counts in 2008-2012.



In the framework of some large project funded by the Dutch government (PIN, BBI), since 1998 Wetlands International in Sevaré systematically counted the central lake area to map and analyse the dynamics of the water bird populations in the central lakes, in response to flooding (van der Kamp *et al.* 2002, van der Kamp *et al.* 2005, Zwarts *et al.* 2009). Before 1998 a number

of comparable surveys has been done by a team of J. van der Kamp, L. Zwarts, B. Fofana and S. Konta, which means that a long series of counts is available. The most recent count of the central lakes has been carried out in 2012 (van der Kamp & Diallo 2012). Since then no quantitative information on the status of the water birds in the IND is available (Table 3.2).

Apart from these counts, a series of roost of herons and other water birds at large communal roosts was done (flood forests, van der Kamp *et al.* 2005), and 1617 density counts between 15 November and 15 March in wetlands habitats in the IND. The density counts refer to small plots of different habitat types, which enabled to establish the distribution of non-gregarious species in the delta on a systematic way (Zwarts *et al.* 2009).

The timing of counts in the IND show, that recent counts are not available beyond the central lake count in 2012. Insecurity hampered the execution of new counts so far. Given the heavy pressure on the ecosystem (see van der Kamp & Diallo 2012), and the recent high floods, it is of utmost importance to gather actual data:

- Monitoring of colonially breeding water birds at the existing flood forests in the IND in the period October – November;
- Monitoring of water birds in the central lake area (below a water level of 200 cm at Akka);
- Aerial census of the IND including the lakes on the east and west bank, as performed by the ONFCS in large wetlands complexes in the Sahel. A cooperation of organisations, amongst which are ONFCS-UST, Wetlands International, AEWA and MAVA, are working on an initiative to restart the monitoring of these large wetlands via aerial censuses (pers. com. C. Dechamps, P. Defos du Rau, J-Y Mondain-Monval and colleagues);
- Assess the function and importance of the northern lakes for bird populations, as actual and field data are very scarce (see next Sections);
- Develop systematic monitoring system for habitat types, using density counts, in the Delta to measure the ecological quality of the habitats for non-gregarious species.

Breeding birds

Historical data of breeding birds

The flood forests of *A. Kirkii* (Fig 3.11) host large mixed breeding colonies. Studies carried out in the 1980s and around the millennium show 17 nesting species, including the Cattle Heron *Bubulcus ibis* and the African Cormorant *Phalacrocorax africanus*, which were the most common breeders with a more or less stable number of 65000 and 18000 pairs. However, the cormorant population suddenly fell in 2005 when great mortality was observed. The cause of this loss of three-quarters of their breeding population has never been clarified, but a food shortage linked to overfishing may be a plausible explanation.

Some species have benefited (temporarily) from improved floods since the end of the Great Drought (1994), or from flood conditions allowing a breeding cycle until March (Gray Heron *Ardea cinerea*, Purple Heron *Ardea purpurea*, Glossy ibis *Plegadis falcinellus*, African sacred Ibis *Threskiornis aethiopica*) or by a higher breeding success (Oriental darter *Anhinga melanogaster*). The high water with flooding in the central lake area until March became very rare, explaining the disappearance of nesting Grey and Purple herons and the Glossy Ibis. The African openbill (*Anastomus lamelligerus)* has also disappeared, but for this species the IND was rather a refuge during the Great Drought.

Table 3.3. Estimated number of breeding pairs of colonial water birds in the southern half of the Inner Niger Delta, 1986-2006 (the same 4 colonies in 1986/87 to 2005/06, 8 colonies - including 4 newly discovered - in 2005/06; Fig. 49). Egrets, excluding Cattle Egret, were lumped in the counts of 2005/06. Sources: Skinner et al. (1987); van der Kamp et al. (2002, 2005). From Zwarts et al. (2009).*

Year	1986/87	1994-96	1999-2001	2002/03	2004/05	2005/06	2005/06*
Max. water level, cm	388	534	511	411	410	442	442
Long-tailed Cormorant x 1000	17-17.5	16-17	18-20	16-17	17-19	4.8	7.2
African Darter	40-45	15-30	300-350	210-230	130-150	240-250	240-250
Grey Heron	okt-15	30-50	1-okt	0	0	?	?
Black-headed Heron	10	1-mei	<5	<5	<5	<5	<5
Purple Heron	0	2-okt	0	0	0	0	0
Black-crowned Night Heron	<10	100-300	1-okt	<10	<10	?	<10
Black Heron	200-250	150	130	80	<50	?	45-60
Cattle Egret	63-65 000	65-90 000	50-60 000	55-60 000	40-50 000	65-70 000	110-115 000
Squacco Heron	550-650	?	500	500	500		
Little Egret	900-1000	500-1000	500-1000	1000	1500		
Little Egret dark morph	80-110	?	80	80	50	3500	5000
Intermediate Egret	800-875	>200	1700	?	1800		
Great Egret	2800-3100	500-1000	1500-1800	800-1000	800-1000		
African Openbill	30-40	0-1	0	0	0	0	0
African Spoonbill	300-350	50	100-150	?	100-150	?	?
Glossy Ibis	0	150	0	0	0	0	0
Sacred Ibis	30-40	50	200-250	?	100	?	?

Two other species are worth mentioning. The Whiskered tern (*Chlidonias hybrida*) has been found breeding in the IND since the early 1990s. During the great flood of 1999 a total of 200-250 breeding pairs was estimated. Despite the annual breeding in the center of the DIN - the only nesting site known in West Africa - their prospect is not that good due to the disturbance of the floating nests by fishing activities.

The black crowned Crane (*Balearica pavonina*) breeds again in the IND but is threatened by the fact that young birds are systematically collected (taken from the nest or otherwise captured) and sold. Important breeding areas are located in the Plaines de Seri and the bourgou fields south of Debo-Walado complex. A survey in 2001 revealed that in the cities of Mopti and Bamako the number of domesticated cranes was two to three times larger than the wild population of the DIN, which is doomed to disappear. In addition, domesticated cranes are not able to reproduce.

Colonially breeding water birds

Breeding colonies of large wading birds in the Inner Niger Delta are situated in flood forests of *Acacia kirkii*, of which the impenetrable crowns and large needles provide excellent protection against predators, especially in combination with water underneath. In the last decades 13-17 species of large wading birds were found breeding in flood forest colonies. Table 3.3 summarises the most recent information on the population development of these colonially breeding water birds. For more detailed information we refer to Zwarts *et al.* (2009). The most recent inventory in 2005-2007 yielded very large breeding colonies in two forests, Akagoun and Dentaka. These are the strongholds of colonially breeding water birds in the IND. Also, smaller

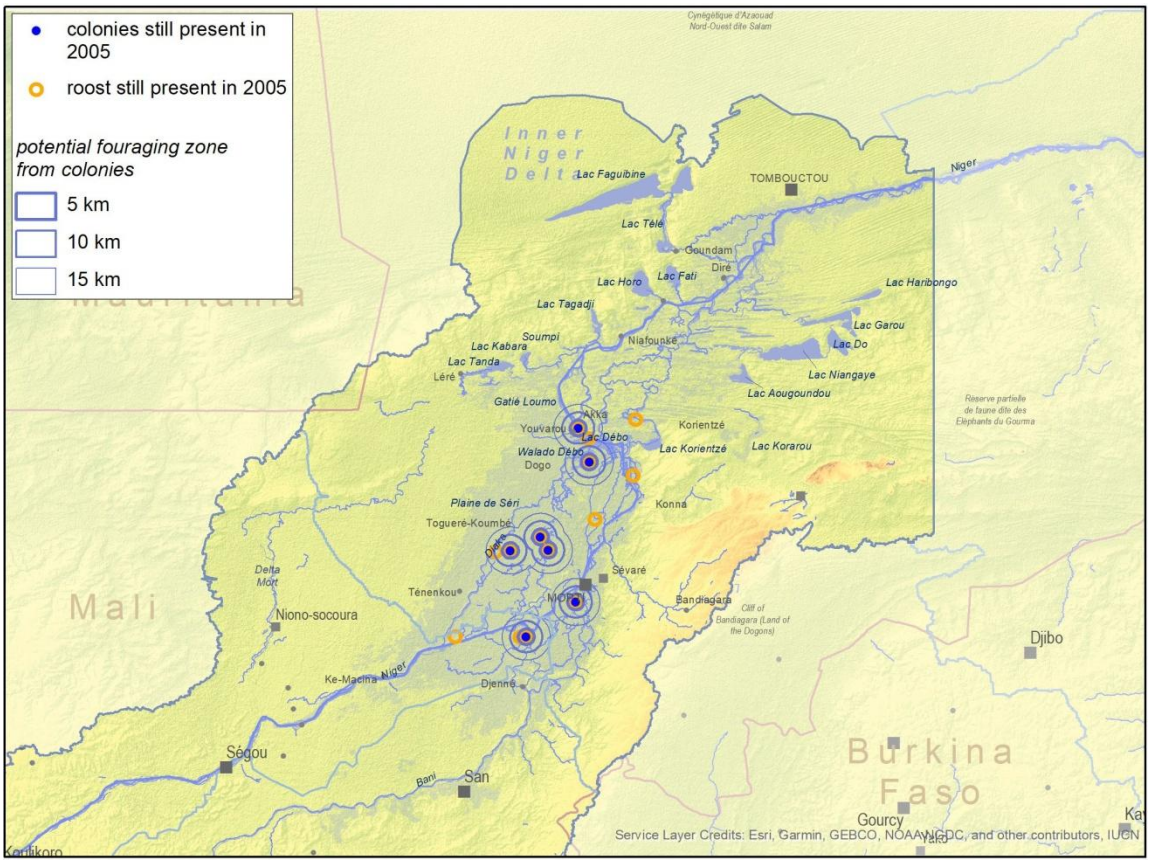


Fig. 3.14. Location of flood forests with colonially breeding water birds (Beintema et al. 2007, van der Kamp & Diallo unpubl.), with an indication of the foraging areas (radius of 5, 10 and 15 km – see Beintema et al. 2007).

colonies were determined in five other flood forests, varying from breeding attempts to small colonies of more than 100 nests. The colony in the forest of Tiayawal Fufu with more than 1.000 nests was a surprise, as this colony was not know at that time (Beintema *et al.* 2007). The current status (last census in 2005) of breeding birds is unknown, apart from the observation that the flood forests of Akkagoun and Dentaka still host breeding colonies. We have no information on current threats (poaching, disturbance, cutting trees) not population developments.

In addition three other colonial species of water birds occur: Whiskered Tern *Chlidonias hybridus*, considered a non-breeding bird in West-Africa by Borrow & Demey (2001), is found breeding in the Debo area since 1991 in scattered colonies (200-250 pairs). Also a small colony of Little Tern *Sterna albifrons* is present (van der Kamp *et al.* 2002). Finally, Abdim's Stork *Ciconia abdimii* is breeding in small colonies in trees in some villages around the IND (Zwarts *et al.* 2005).

Concentrations of water birds

The IND can be considered as a dynamic ecosystem where the annual floods alter an arid landscape in a widely flooded delta. The flood wave moves through the delta for 3 to 4 months and transforms the IND into an enormous green zone. This vegetation, of which the bourgou plays a crucial role as a forage resource for the Peulh cattle, is also exploited by herbivorous water birds (geese and ducks) and used as nesting habitat by many other species including the

Black crowned Crane. The occurrence and abundance of (water)birds in the delta must be mirrored against the following processes related to bird movements and dynamics of the delta proper and the Sahel as wider environment:

- The migration window of migratory birds: large numbers of birds from the north arrive in the Sahel, and the IND, in the period September-October and either stay till March – April, or migrate further east and pass the are during their return migration;
- The breeding season and intra-African migration of resident birds: Resident birds breed mostly during the wet season (September-November) and (partly) migrate to other areas in Africa (example: Abdims Stork migrate to Mozambique) during the hot, dry season;
- Flooding cycle: the seasonal flooding cycle in the IND determines the temporal and spatial feeding conditions for birds. Flooding starts in September-November (*crue*), is at its maximum between early and end November (Akka), the flood recedes during December – April (*décrue*) and is at its lowest in May-July (*étiage*). During the décrue and étiage the resources for birds are scarce.
- Annual variations in flooding: The size of the large floodplains in the Sahel and the occurrence of temporal wetlands / lakes is largely depending on the annual rainfall. Depending on these conditions, migratory birds but also residents may move between these areas. This means that the abundance of birds in the IND is partly also depending on the droughts and rains/flooding elsewhere in the Sahel (Zwarts *et al.* 2009).

The complex of the central lakes was subjected to a monitoring of water birds between 1991 and 2012 (Table 3.2). An irregular series of aerial surveys, aimed at establishing the distribution and total numbers of geese and ducks in the IND, also contributed to the identification of the Debo complex as an area of ornithological interest. These counts were performed by CRBPO, IUCN, ONCFS and WI between 1972 and 2008. The aerial counts also underpin the paramount significance of the northern lakes. The ornithological significance of the IND as well as the dynamics of the waterbird populations in the area are summarised and documented by Zwarts *et al.* (2009). These includes censuses up to 2008 (excluding the last aerial census by ONFCS). Since then, two other counts of the central lakes have been performed, in 2011 and 2012 (van der Kamp & Diallo 2012). In this report we shortly summarize the existing information, for details we refer to Zwarts *et al.* (2005, 2009), van der Kamp *et al.* (2005), Wymenga *et al.* (2002) and van der Kamp & Diallo (2012).

Presence of water birds according to the flood cycle

As the retreat of the water (*décrue*) starts water birds – during the height of the flood widely dispersed and mostly untraceable in the vast flooded area - are increasingly concentrated in areas where the water is of appropriate depth and where adjacent wetland allow them to feed. At the end of the *décrue*, birds are found, often in large concentrations, in the last humid places: lakes, shallow areas and ponds, which at that moment represent only 2% of the IND flood area.

Flooding (crue)

During the high water phase (October - December) the Debo complex manifests itself as a vast flooded area making an 'empty' and silent impression. The distribution of most of the water birds is linked to the shallower areas around the delta and its high grounds. This is also where the feeding areas are located of birds nesting in the flooded forests of the Debo complex. These forests are the only sites in this period of flood, where the activities of (the reproducing) water birds are concentrated: cormorants, herons and egrets, and spoonbills and ibis. Their feeding radius extends up to a few tens of kilometers from the nesting colonies (Fig. 3.14).

The Purple Heron (*Ardea purpurea)*, a Palaearctic species that arrives during the flood period, exploits the same area as African breeding birds in using the flooded forests of the Debo complex as a dormitory. During the day, this species disperses over the bourgou fields. Once they have completed their breeding, cormorants, herons and egrets travel to the south of the delta, where the retreat of the water has begun, to discover favorable fishing areas.

This movement is also reported in two species of Palaearctic passerines, the Western yellow wagtail (*Motacilla flava)* and the Sand martin (*Riparia riparia*), two species which have been abundant since their arrival in the delta during the flood. They are insectivorous species with huge dormitories (hundreds of thousands of birds) in the Debo complex during the flood, but they are almost absent during the day; Their feeding areas are located outside the complex.

Receding flood (décrue)

During the receding flood, when the water retreats with 2-3 cm a day, the Debo complex shows an increasingly available surface area for exploitation of food. Next to cormorants, herons and egrets, a large number of wading bird species are concentrating here, amongst which are godwits, sandpipers (Ruff!), lapwings, snipes, etc., whose numbers increase until the maxima are reached. The totals counted during the multiannual monitoring can currently exceed 100 000 birds, most of which are of Eurasian origin.

This progressive increase also applies to the above-mentioned Palearctic passerines, the Western yellow wagtail and the Sand martin. The two are present until the maximum of the flood in the Debos but when the retreat of the water is noticed these passerines leave the complex to start exploiting the areas exposed in the south of the delta. Finally, following the retreat of the water, they return to the Debo complex. The northern lakes (Horo, Fati and Télé) also serve as staging areas (with large dormitories), especially in February-March.

The function and significance of the Debo-complex is in particular important when the water level decreases below 200 cm at the Akka gauge, as at these lower water levels food resources become available and the remaining part of the delta becomes more and more dry. Van der Kamp & Diallo (2012) show this relationship for a number of species (Fig. 3.15). In these graphs, based on avaible data of the monitoring in the past, including 2012 as most recent count, the number of birds of a species has been plotted against water level at Akka (See Section 3.8).

Situation during the Great Drought

The totals of the monitoring were much higher during the Great Drought (1972-1993), notably by the enormous numbers of Palaearctic ducks that had their last ecological refuge in December-February when the rest of the delta was already practically dry. In the early 1990s there were 250,000-400,000 birds (Northern Pintail *Anas acuta* and Garganey *Anas querquedula*, taken together). Since the end of the Great Drought the numbers of ducks are generally limited to a few thousands of birds in the Debo complex. Almost all of their numbers is distributed throughout the delta, outside the complex. All these Palaearctic birds have already left before the period of low water, of which the duration varies according to the performance of the flood.

Lowest water level (étiage)

At low water levels, the Debo complex is one of the last areas in the IND of water birds gathering together, with only 2% of its maximum flooding remaining. Apart from the small numbers of Palaearctic birds that inhabit them, it is especially the afrotropical species which are present in this period. The most noteworthy is the Kittlitz's Plover *Charadrius pecuarius*, whose numbers since its appearance during the recession, continue to grow to a maximum in June. The maximum record of about 14,000 birds was established in June 2004; Similar sites with

gatherings of several thousands Kittlitz's Plovers are rare elsewhere in Africa, so this record (western African) demonstrates the extreme interest of the Debo complex for the species.

South-central roosting

Roost counts in the flooded forests of the southern delta (Fig 3.11, Table 3.1.) clearly demonstrated that the nesting species in colonies also follow the retreat of the water after completing their breeding period. During these counts in November (towards the maximum level of the flood), they show enormous twilight movements towards the flooded forests in the delta to the south of the Seri - Mopti Plain line, and almost nothing in the central lake area where the Cattle Egret is the first to complete its breeding season in September-October. Two months later the image of twilight movements is reversed. The upstream delta is dried up and the birds have followed the retreat of the water to arrive at the Debo complex. Their roostings/ resting places are now located in the flooded forests there. The roost counts are summarised in van der Kamp *et al.* (2005) and Zwarts *et al.* (2009).

The Forest of Dentaka contains a resting place visited by tens of thousands of cormorants, herons and egrets from all directions. The forests of Akkagoun and Gourao have a more modest but still impressive population. The Debo Complex and its surrounding areas serve as a feeding area, not only for all these birds but also for local fishermen and transhumants, in a common effort to catch the last fish of the fishing season. The resting places disappear when the forests no longer have their 'feet' in the water, and most of the afrotropical cormorants, herons and egrets disperse across the delta and the river basin, to return at the end of June/ August, at the beginning of the new breeding season. The Palaearctic herons and egrets, leave in March and April, and will return in September - October.

Abundance of non-gregarious species

Although the impressive gatherings of birds on roosts, in breeding colonies or in the remaining water bodies picture the (international) significance of the Inner Delta for birds vividly, there are also non-gregarious species for which the IND is of paramount importance. These species disperse in the floating bourgou and grass vegetations, in rice fields and other habitats. A census of the total number of birds is a mission impossible, and for that reason a series of systematic density counts has been done (Wetlands International and partners).

From 2002-2006 habitats in the delta were systematically sampled and in total 1167 small plots were counted. This enabled to make a sound estimate of the denisity of birds per ha per habitat, depending on water level. This work has been published by van der Kamp *et al.* (2005), Wymenga & Zwarts (2010) and Zwarts *et al.* (2009). We summarise the main outcomes here in Fig. 3.15 and 3.16). These figures show, that the highest densities were attained in the bourgou habitats and bare and short grass habitat (lowest parts of floodplains), but also wild and cultivated rice are frequented by birds. Most common are some passerines (Yellow wagtail!), waders, herons and egrets.

The optimal water depth is species-specific: herons prefer bourgou fields at a water depth of 80-160 cm. They sit and walk on the bourgou stems and feed on the small fish in the bourgou habitat. Waders and passerines prefer the shallow and humid habitats. The density counts revealed that also non-gregarious species occur in huge numbers in the IND. For example, numbers of Yellow Wagtail were estimated at c. 900.000, resembling roost estimates of hundred of thousands birds. Species like Squacco heron may reach total numbers above 150.000 ind. (Zwarts *et al.* 2005, 2009).

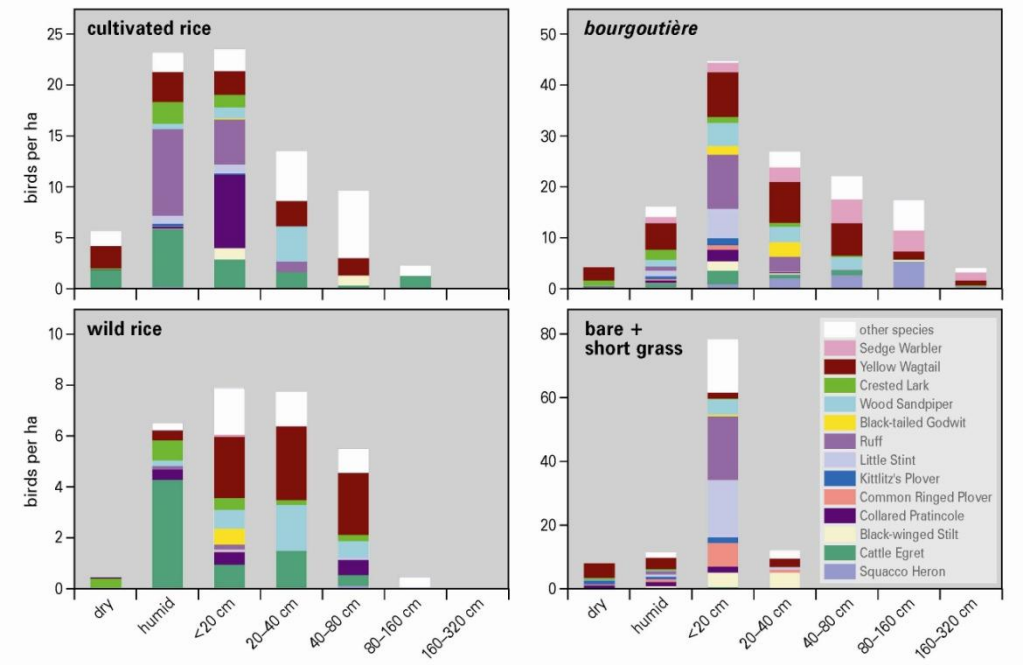


Fig. 3.15. Density (n/ha habitat) of the 13 commonest bird species, and summed density of 49 other species for dry or humid ground or for six different levels of water depth, in four main habitats: cultivated rice (n=168), bourgoutière (n=945), wild rice (n=160) and bare ground + short grass (n=95). All data were collected on the floodplains of the Inner Niger Delta (date: Fig. 48; location: Fig. 61 in Zwarts et al. 2009). Note the different scales. From Zwarts et al. (2009).

The role and significance of the northern lakes

The role and significance of the northern lakes for the bird population in the IND is governed by the water level in the lakes. Like the floodplains in the delta proper, the lakes which hold water in most of the years, and also during the *décrue* (Lac Horo, Lac Fati, Lac Télé, Lac Faquibine), are concentration places for water birds. The water levels in the relative shallow lakes (Lac Horo, Lac Télé, eastern part Lac Faquibine) are managed in such a way, that agriculture is possible along the edges and with a decreasing water level also more towards in the centre of the lakes. These vegetated lakes are also very important for non-gregarious species.

Systematic information on the occurrence of birds in the norther lakes field is lacking almost completely, apart from aerial counts (Table 3.1) and censuses by van der Kamp *et al.* (2005). Aerial censuses (Appendix II) revealed the importance for Anatidae (ducks) and some wader species (Ruff). Field surveys on the ground show (van der Kamp *et al.* 2002, 2005), that Lac Horo is a stronghold for Little Grebe *Tachybaptus ruficollis* (estimate >100 pairs) and Common Moorhen *Gallinula chloropus* (5-10.000); the latter were probably residents as birds sold on the local market showed hardly any fat in early March.

Density counts of van der Kamp *et al.* (2005) in March 2003 in Lac Télé high densities of waders (Wood Sandpiper, Ruff), egrets (Squacco heron, Purple heron), Purple swamphen and smaller passerines as Yellow wagtail, Sedge warbler (see Zwarts *et al.* 2009 for estimate of numbers). Later visits (2010) confirmed the high densities of these species. We expect also for other lakes and species important numbers, but actual data are lacking.

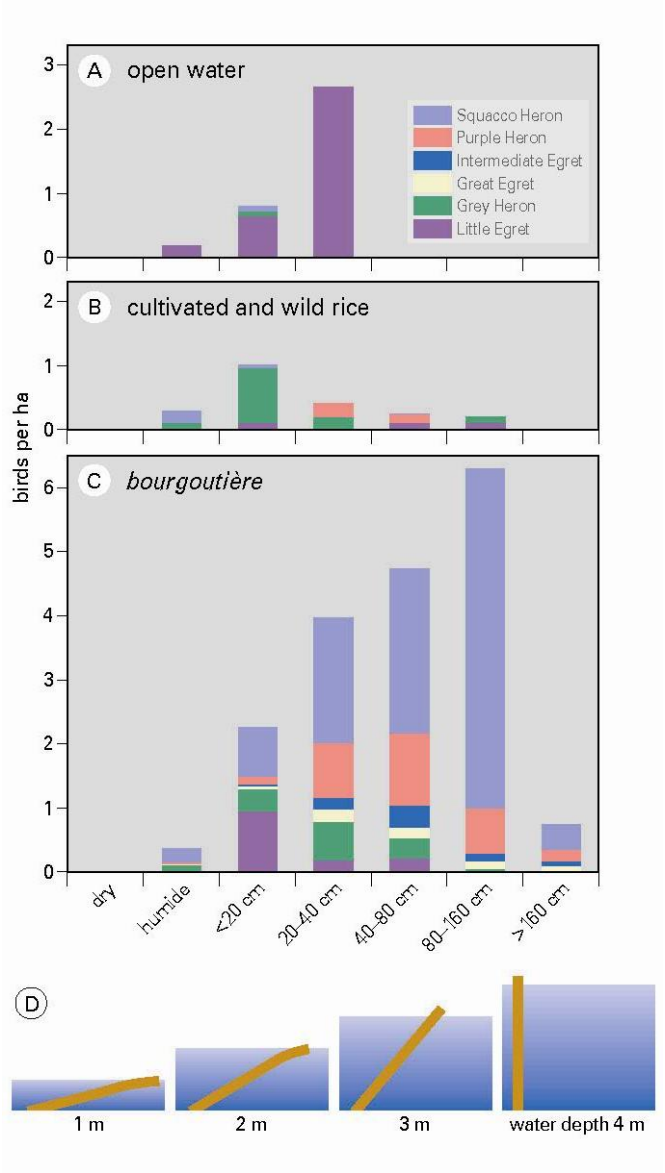


Fig. 3.16. Feeding density per ha of five heron and egret species as a function of water depth in (A) open water, (B) wild or cultivated rice and in (C) bourgoutière (bourgou or didéré). All density counts were performed on the floodplains of the Inner Niger Delta, between 15 November and 1 March. Panel (D) visualises the changing position of bourgou stems with declining water level, and how this determines heron usage. From Zwarts et al. 2009.

Lac Facquibine is one of the larger lakes, but only the eastern part is inundated regularly, and the inundation is depending on the water level at Diré. It is a very rich and productive ecosystem, on which communities in the northern part of the delta rely already since time ememorial (Hamerlynck & Aly Moulaye Zeine 2011). In particular in the western part a densely wooded system has developed in the past years, but also cultures are present. The lake is rich in birds, in particular Garganey, Ruff and Black-tailed godwit. In the past a few hundred thousands of birds have been counted during aerial censuses, but recent data are lacking.

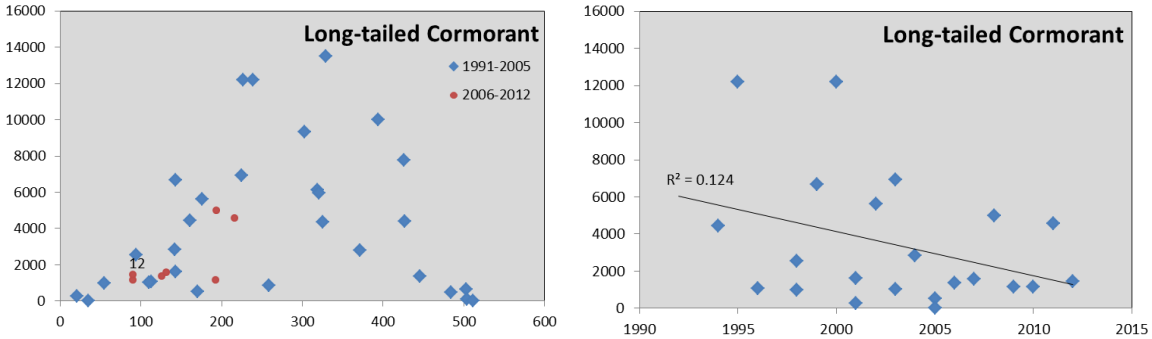
Exploitation of birds in the northern lakes is practiced on wide scale, mainly by local fishermen (mainly hooklines). Visits to local trademen at Goundam revealed *daily* catches of Great Bittern *Botaurus stellaris*, Purple Heron *Ardea purpurea* and Purple Swamphen *Porphyrio porphyrio*.

3.5 Abundance of water birds in the Debo-complex in relation to water level

The distribution of water birds in the delta is closely related to water levels. Van der Kamp & Diallo (2012) illustrated this for a number of species, representing different taxonomic groups. We have included their description in this Section, as these descriptions include the most recent counts.

Long-tailed Cormorant – *Phalacrocorax africanus*

The IND hosts a large and stable population estimated at some 17 000 to 20 000 breeding pairs, despite a serious collapse with losses up to 75% in 2005 from which it had recovered three years later. They show up in numbers as high as 12 000-13 000 birds in the Debo area which represents not more than 20% of total numbers assessed during roost counts in the southern IND. Highest numbers occur with water levels between 2 and 4 m (Akka gauge, Lake Debo). Recent count totals appear somewhat lower, while numbers counted since 1991 show a downward trend.



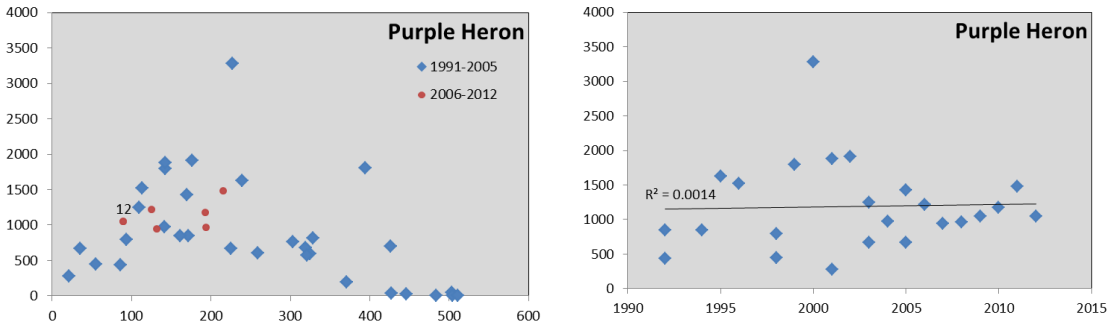
Number of Long-tailed Cormorants counted in Lake Debo+Walado since 1991 as a function of water level (cm at the gauge of Akka; left) and during the course of the years (right) after a selection is made for counts where the water level was beneath 250 cm. The left panel shows separately the counts during the last 7 years and before. The 2012 count is indicated with the digit 12.

Purple Heron – *Ardea purpurea*

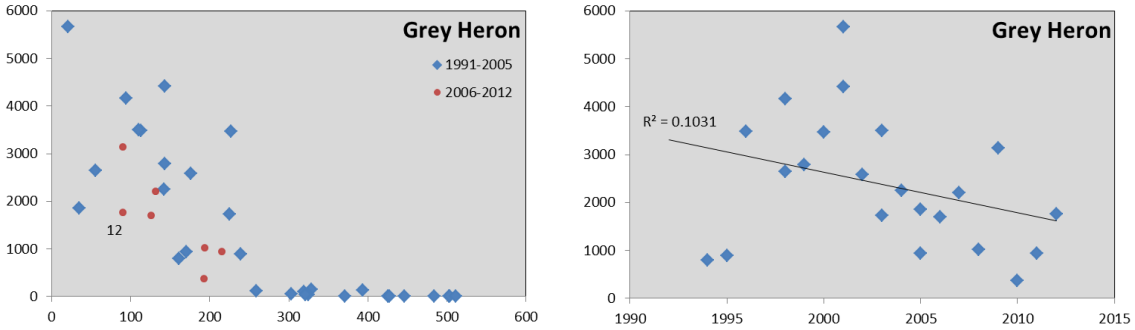
The Purple Heron population in the IND consists essentially of palearctic migrants, although breeding has been recorded. Major numbers (> 1000 birds) are generally counted in Debo when water levels are between 1 and 2.5 m. This may seem too deep to stand fishing but Purple Herons benefit, like several other species, from the immense fields of floating bourgou on which they can stand fishing and resting. Totals in 1998-2005 usually did not exceed 2000 birds but in 2000, after a high flood, more than 3000 birds were counted. Numbers seen over the years do not show a clear trend, while numbers counted in recent years do not seem to be off-range.

Grey Heron – *Ardea cinerea*

Although only a minor part of the Grey Heron population in Europe crosses the Sahara on migration, thousands are counted in the central lakes of the IND when the flood recedes. They breed irregularly, in very small numbers, and only during high floods. Their numbers keep growing at lowering water levels, even beyond the point where bourgou fields fall dry. Purple Heron are by then forced to leave the area whereas Grey Herons continue to fish in open, shallow water. The recent counts since 2005 reveal relatively low-ranging totals, and the count series since 1991 shows a clear downward trend.



Number of Purple Herons counted in Lake Debo+Walado since 1991 as a function of water level (cm at the gauge of Akka; left) and during the course of the years (right) after a selection is made for counts where the water level was beneath 250 cm. The left panel shows separately the counts during the last 7 years and before. The 2012 count is indicated with the digit 12.



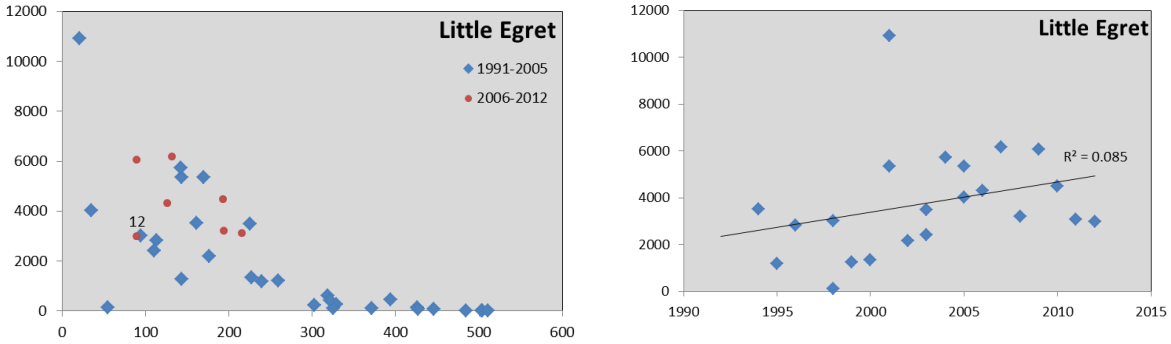
Number of Grey Herons counted in Lake Debo+Walado since 1991 as a function of water level (cm at the gauge of Akka; left) and during the course of the years (right) after a selection is made for counts where the water level was beneath 250 cm. The left panel shows separately the counts during the last 7 years and before.

Little Egret - *Egretta garzetta*

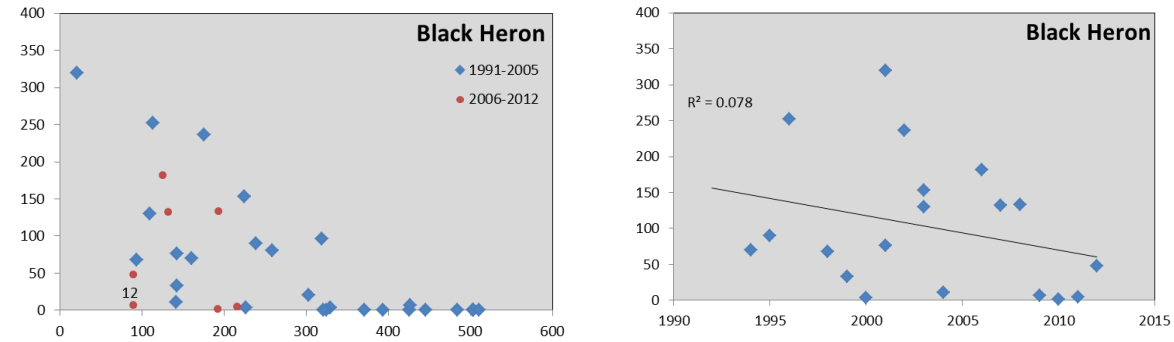
The afrotropical and palearctic populations are indiscernible in the field, and thus not more than a general impression or trend can be given of Little Egret presence in the IND. Roost counts in the first decade of this century suggested 1000-1500 bp, which might represent a major part of the Little Egrets counted in the Debo-Korientzé area. The total estimation for the IND based on density counts carried out in 2002-2004 indicates, however, a minimum wintering total of 25 000 – 30 000, which would reduce the afrotropical share to some 20-25%. Numbers counted peak when water levels fall beneath 2 m, whereas the recent count series (2005-2012) shows results relatively high in the numbers-water depth scatter. This supports the upward trend shown in the census results over the years 1991 – 2012. To be noted: the 2012 count result is the only one underneath the trend line; twice as much birds have been seen at similar water depth in one of the previous recent counts.

Black Heron - *Egretta ardesiaca*

A species of great concern as it is considered close to extinction in the IND. Skinner *et al.* (1987) estimated their population in the 1980s at 200-250 breeding pairs, whereas counts since 1991 show a rapid decline suggesting a loss of some 90% of the birds. When water depth becomes less than 3 m the species used to show up in dense, lively umbrella groups, but their present scarcity makes it hard to find such a scene.



Number of Little Egrets counted in Lake Debo+Walado since 1991 as a function of water level (cm at the gauge of Akka; left) and during the course of the years (right) after a selection is made for counts where the water level was beneath 250 cm. The left panel shows separately the counts during the last 7 years and before.

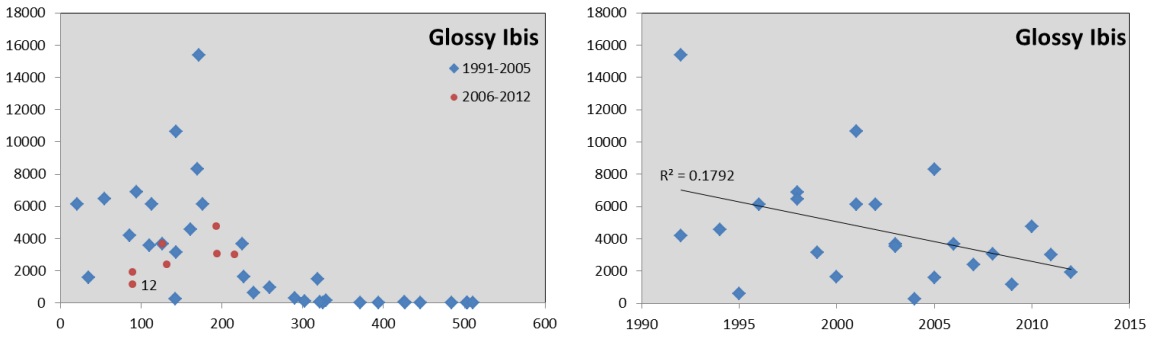


Number of Back Herons counted in Lake Debo+Walado since 1991 as a function of water level (cm at the gauge of Akka; left) and during the course of the years (right) after a selection is made for counts where the water level was beneath 250 cm. The left panel shows separately the counts during the last 7 years and before. The 2012 count is indicated with the digit 12.

Glossy Ibis - *Plegadis falcinellus*

Until the 1980s Glossy Ibis aggregations of 25 000 – 35 000 birds were to be observed in the Debo-Korientzé zone, but these days are long gone. Between the 1970s and the early 2000s numbers have fallen deeply, without evidence of recovery in recent time. The species has, however, recolonised the western Mediterranean (Italy, Spain, Portugal, France, Algeria, Morocco) by the end of the latest century whereas today several thousands of pairs are recorded breeding in the area. Recent observations of increased numbers during the non-breeding period along the Senegal River suggest that Glossy Ibises originating from the West-Mediterranean population have a wintering zone in this freshwater basin; so far, no colour-ringed birds from this population have been spotted in the IND.

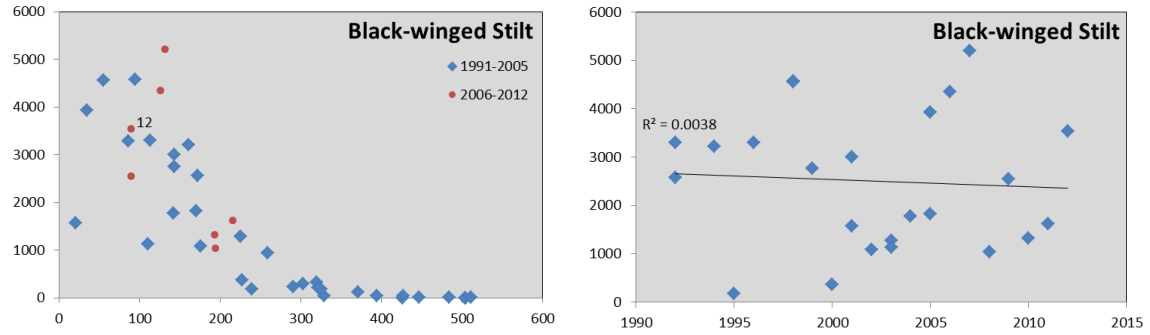
Glossy Ibis numbers strongly rise around 2.5 m at the Akka gauge. From this moment on large areas with small molluscs, their main food during pre-migration fattening, are about to emerge. The water table graph shows under-performing count results, in line with declining census totals over the years.



Number of Glossy Ibis counted in Lake Debo+Walado since 1991 as a function of water level (cm at the gauge of Akka; left) and during the course of the years (right) after a selection is made for counts where the water level was beneath 250 cm. The left panel shows separately the counts during the last 7 years and before.

Black-winged Stilt - *Himantopus himantopus*

This species occurs widespread in and beyond the IND, and although its central lakes may host aggregations of more than five thousand birds this does not represent more than 50% of the total population, as during a recent aerial census by a French team more than 10 000 birds were counted. Black-winged Stilt has only once been recorded breeding in the IND (2000). The recent counts do not differ from the picture in earlier years showing a steep rise below 2 m on the gauge of Akka, where the Niger River leaves Lake Debo; no clear inter-annual trend is visible either.



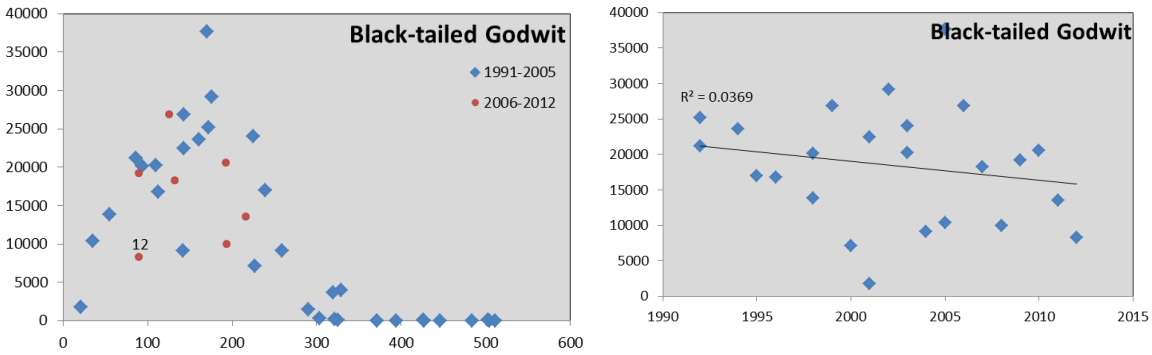
Number of Black-winged Stilts counted in Lake Debo+Walado since 1991 as a function of water level (cm at the gauge of Akka; left) and during the course of the years (right) after a selection is made for counts where the water level was beneath 250 cm. The left panel shows separately the counts during the last 7 years and before. The 2012 count is indicated with the digit 12.

Black-tailed Godwit – *Limosa limosa*

Black-tailed Godwits gather in huge concentrations of 10 000 to 40 000 birds in the Debo area as they seem nowadays highly dependent on the massive stock of small *Corbicula* molluscs in this area. During higher floods, when this mollusc stock cannot be sufficiently exploited as it is not harvestable in time, they have been observed feeding –again in large concentrations- on spilt rice, just as in the rice zone along the Atlantic coast. Godwits show up in high numbers as soon as the 3 m level is reached, peak between 2 and 1 m but decline when the water table drops further, unlike Black-winged Stilt numbers that continue to rise. This difference may be explained by the fact that latter species feeds not only on molluscs but also on fish which stays available when mollusc exploitation has ended.

West-European Blacktails have suffered a dramatic decline on their breeding grounds over the latest decades. This has clearly been sensed in their Atlantic winter quarters where numbers declined proportionally. IND birds originate from more eastern breeding areas where suitable habitats are presumably less affected by modern farming; numbers over the years have only

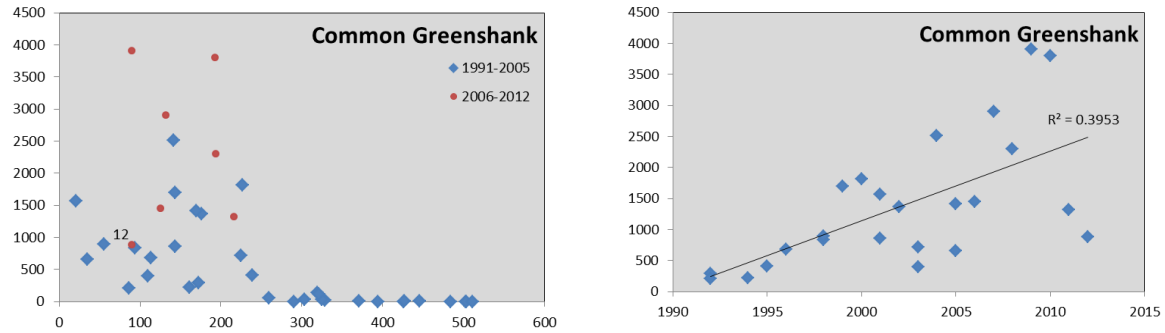
slightly declined in the IND. However, the 2012 census showed an unusually low total in relation to flood level and date. Whether this is a cause of concern is as yet unclear, but as indicated above, large-scale bourgou planting may be at stake: it reduces the area of open feeding grounds, and covers the adjacent downstream sandflats with muddy substrate where filtering *Corbicula* bivalves do less well.



Number of Black-tailed Godwits counted in Lake Debo+Walado since 1991 as a function of water level (cm at the gauge of Akka; left) and during the course of the years (right) after a selection is made for counts where the water level was beneath 250 cm. The left panel shows separately the counts during the last 7 years and before. The 2012 count is indicated with the digit 12.

Common Greenshank – *Tringa nebularia*

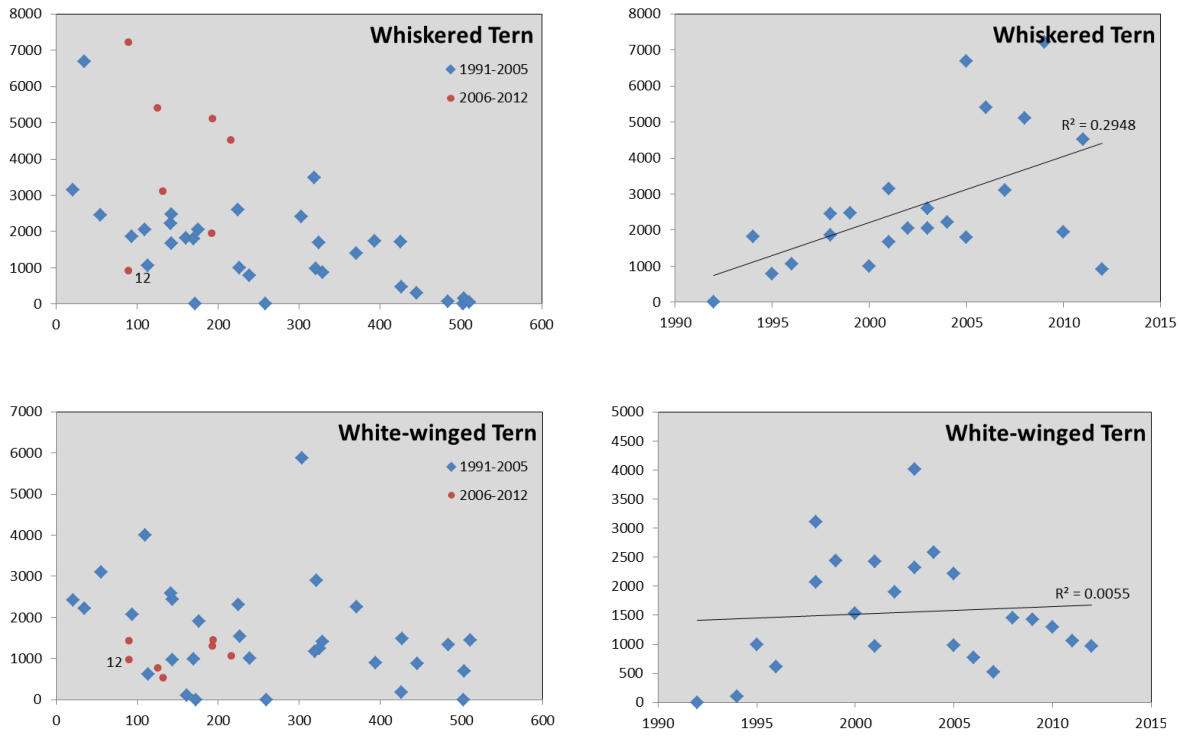
A widespread species in the IND that concentrates partly in Debo, similar to the Black-winged Stilt distribution pattern. Their arrival is noted around 2.5 m on the Akka gauge and shows a steep rise. They may associate with Spotted Redshanks, Black-winged Stilts and Little Egrets in frenzies attracting Whiskered and White-winged Terns keen on the benefits of these communal fish chases. Greenshank numbers thrived in recent years which contributed strongly to an upward trend over the years but counted totals fell deep down since the top years 2009 and 2010. Could Greenshank be outcompeted in the quest for fish fry becoming increasingly scarce?



Number of Common Greenshanks counted in Lake Debo+Walado since 1991 as a function of water level (cm at the gauge of Akka; left) and during the course of the years (right) after a selection is made for counts where the water level was beneath 250 cm. The left panel shows separately the counts during the last 7 years and before. The 2012 count is indicated with the digit 12.

Whiskered Tern – *Chlidonias hybrid and* White-winged Tern – *Chlidonias leucopterus*
Both marsh tern species are abundantly observed in the central lakes during the flood season, with just a handful of single Black Tern records over the latest decades. The populations already present during total inundation of the area, when very few other water birds are seen, are joint by birds leaving more southerly whereabouts in the IND or elsewhere as these dry out. Strong SW-NE movements from both species towards Debo along the Diaka , a Niger branch, have been noticed as the Akka gauge showed water levels declining between 4 and 3 m. No real surprise, therefore, that numbers of both species rise in the course of the deflooding season. Looking separately at the graphs showing numbers against water table, the count results of recent years stand out as they show contrasting ranges in relation to trend lines.

Whiskered numbers are higher than average whereas those of White-wings stay lower than expected. This is also reflected in the census results since the mid-1990s; by then White-winged Terns were usually more numerous (max. 5900, Jan. 1997) than Whiskered, whereas by the mid-2000s latter species became more common than White-wings, with an impressive maximum of 7200 birds in March 2009. It seems as yet unlikely that Whiskered Tern's settlement as a breeding bird in the IND in the early 1990s has boosted their numbers in the central lakes, since hardly any fledglings have been observed over the years.

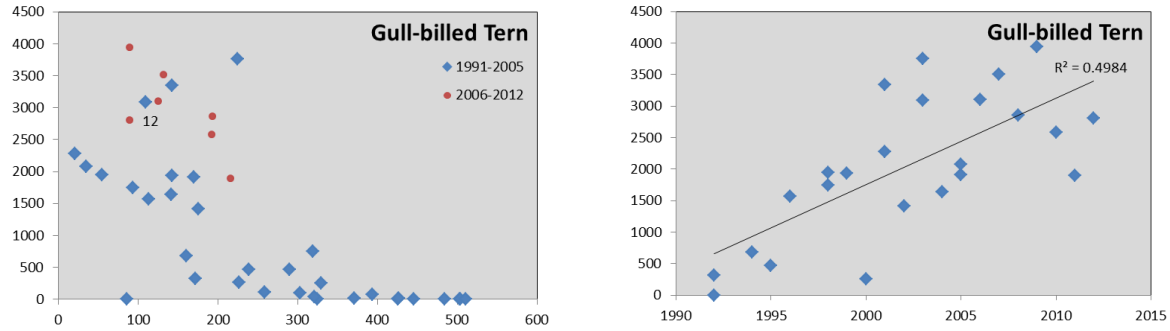


Number of Whiskered (upper panel) and White-winged Terns (lower panel) counted in Lake Debo+Walado since 1991 as a function of water level (cm at the gauge of Akka; left) and during the course of the years (right) after a selection is made for counts where the water level was beneath 250 cm. The left panel shows separately the counts during the last 7 years and before. The 2012 count is indicated with the digit 12.

Gull-billed Tern – *Gelochelidon nilotica*

Hundreds of Gull-billed Terns are already observed when the water table in the central lakes is still between 3 and 4 m. Once over thousand birds -one metre further down- the increase keeps looking steady, featuring, however, recent count totals well above the trend line. This is in line with the steady increase since the early 1990s, from some hundreds to almost 4000 birds in 2007.

However, in Zwarts *et al.* (2009) is put forward that the apparent inter-annual increase should rather be considered as a setback, since in the early 1990s (last years of the Great Drought) most Gull-billed Terns had feeding grounds beyond the central lakes area, but still roosted in Debo. Whereas hundreds of birds were counted by day, some 6000 birds arrived at their Debo roost at dusk. This suggests that the birds gradually came back to Debo when the floods improved by the mid-1990s, and turns the actual 4000 birds into a substantial decline.

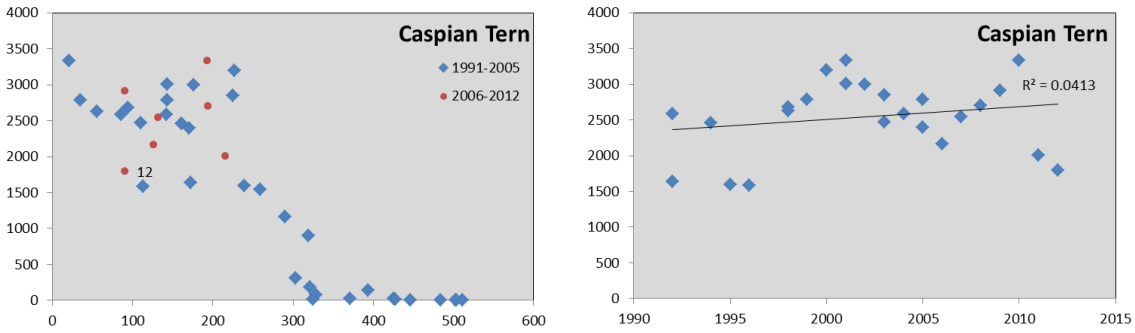


Number of Gull-billed Terns counted in Lake Debo+Walado since 1991 as a function of water level (cm at the gauge of Akka; left) and during the course of the years (right) after a selection is made for counts where the water level was beneath 250 cm. The left panel shows separately the counts during the last 7 years and before. The 2012 count is indicated with the digit 12.

Caspian Tern – *Sterna caspia*

The Caspian Tern population in the IND consists of palearctic migrants from the Baltic and the Ukraine, whereas on the Atlantic coast these migrants mingle with local breeding birds. Fishermen fancy Caspian Terns for their meat, and when the Debo complex is the only place left in the dry season, the entire population gathers here whilst showing up as soon as the first sandy ridges emerge, around 3 m on the Akka gauge. By 2.5 m numbers level off indicating that all birds have arrived. Numbers present show a clear relation with flooded area (km2), mortality being higher in dry years.

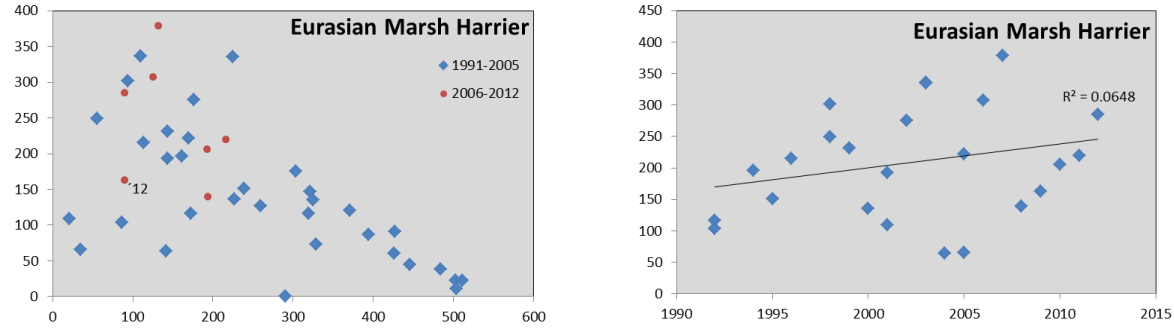
The Debo population builds up under good flood conditions, and reacts accordingly in adverse years. However, the counted numbers in 2011 and 2012 catch the eye, as they seem disproportionally low. Similar low numbers were seen in 1995 and 1996, but Debo stayed inundated very long during these surprisingly good flood seasons, whereas 2011 and .2012 offered fine staging conditions.



Number of Caspian Terns counted in Lake Debo+Walado since 1991 as a function of water level (cm at the gauge of Akka; left) and during the course of the years (right) after a selection is made for counts where the water level was beneath 250 cm. The left panel shows separately the counts during the last 7 years and before. The 2012 count is indicated with the digit 12.

Eurasian Marsh Harrier – *Circus aeruginosus*

Persecution and pesticides in Europe have kept Marsh Harrier breeding populations small until the 1970s. The recovery that followed led to its settlement even in habitats considered unsuitable beforehand. Notably the northern and eastern populations in Europe migrate to sub-Saharan Africa, where the large sahelian wetlands are among the first feeding areas to be encountered after crossing the Sahara desert. Most Marsh Harriers fly further south at arrival in September but some tens of birds have been counted in the central lakes around the flood peak (Oct-Dec) when the area is completely inundated. When the flood recedes they come back to Debo-Korientzé, where numbers up to some 400 birds have been counted recently. This maximum contributes, as one of the recent count results that lay relatively high in the scatter, to the upward trend over the years that has been found indeed.



Number of Eurasian Marsh Harriers counted in Lake Debo+Walado since 1991 as a function of water level (cm at the gauge of Akka; left) and during the course of the years (right) after a selection is made for counts where the water level was beneath 250 cm. The left panel shows separately the counts during the last 7 years and before. The 2012 count is indicated with the digit 12.

Conclusions

Van der Kamp & Diallo (2012) performed the most recent count of water birds in the central lake area and provide the most updated information on the status of the area for water birds, including recent developments. Although, their count and analysis is from 2012 (five years old) we repeat their conclusions hereafter:

- Fisheries have reached an alarming stage, as through overfishing even the smallest size-classes of bigger species are under attack.
- Bourgou *Echinochloa stagnina* plantations in Debo are now massively enclosed by fine-meshed fishing nets, leaving next to nothing for the next flood seasons.
- Large-scale bourgou planting by fishermen in Lake Debo, particularly during the latest flood season 2011-2012, may have adverse effects on wader survival and species distribution by reducing their feeding grounds in the only area with massive mollusc

stocks, on which several wader species, like Black-tailed Godwit, Ruff and Glossy Ibis capitalize for their pre-migration energy intake.

- Pictures of 14 species show that in the latest decades (1991-2012) upward and downward trends are balanced, with some having no clear directions in between. However, the 2012 count may provide first signals of change: remarkably low totals for waders like Black-tailed Godwit and Greenshank, and for Caspian Tern where a seemingly disproportional decrease set in already in 2011, suggests that given the respective high and low floods in these two years, more than the usual mortality alone is at stake.
- Herons, egrets and other species of marshy habitat may benefit from the bourgou extensions but as these are intensively exploited their security is far from guaranteed. Fishermen have been seen shooting these birds while checking their nets.
- Without firm management measures fisheries in the IND have no future.
- This applies as well to water birds which would benefit from the creation of strictly protected sites where they can breed, stage and winter under good feeding and security conditions.

3.6 International importance of the IND for bird populations

As a consequence of the available habitats the avifauna of the Inner Delta primarily consists of wetland species. In total **111 species of water birds** (wetland-related species excluded) have been recorded by Van der Kamp *et al.* (2002, 2005), of which 43 occur in small to large numbers and 68 have been observed rarely or irregularly during 1998-2004. The avifauna comprises species which are piscivorous (herons, cormorants, terns), benthivorous and omnivorous (waders, ibises) and insectivorous (some plover species, wagtails), besides a few seed-eating species (mainly ducks). This means, that water birds are involved in most links of the food web in the floodplain. (Zwarts *et al.* 2005)

In order to be able to establish the international significance of a wetland, there are the criteria of the Ramsar Convention to which the area in question must comply. The relevant criteria to be applied to the IND are criteria 2 and 6 (www.ramsar.org) :

- Criterion 2: A wetland should be considered a site of international importance if it contains vulnerable, threatened or severely endangered species, or threatened ecological communities.
- Criterion 6: A wetland should be considered a site of international importance if it usually contains 1% of a population of a waterbird species or subspecies.

Table 3.4 (page 68-69). Maxima of a selection of water birds in Lac Debo, Walado Debo and Lac Korientzé in the central part of the Inner Niger Delta in 2000-2012 (van der Kamp & Diallo 2012, Zwarts et al. 2009). Maximum numbers of Long-tailed Cormorant and African Darters are based on roost counts, Intermediate Egret´s maximum was observed in January 2000 (van der Kamp et al 2002). The figures are compared to the 1%-criterium on www.wetlands.org*. Birds in bold letters surpase the 1% criterion on bases of density counts.*

Species			max 2000-2012	1% criterion	x1%
Pelecanus onocrotalus	**Pélican blanc**	**Great White Pelican**	**4300**	**600**	**7,2**
Pelecanus rufescens	Pélican roussatre	Pink-backed Pelican	2	710	
Phal. africanus	**Cormoran africain**	**Long-tailed Cormorant**	**55867**	**1400**	**39,9**
Anhinga rufa	**Anhinga roux**	**African Darter**	**641**	**250**	**2,6**
Ardea cinerea	**Héron cendré**	**Grey Heron**	**5663**	**10000**	**0,6**
Ardea melanocephala	Héron mélanocéphale	Black-headed Heron	94	2200	
Ardea purpurea	**Héron pourpré**	**Purple Heron**	**4171**	**2000**	**2,1**
Casmerodius albus	**Grande Aigrette**	**Great Egret**	**5534**	**2200**	**2,5**
Egretta ardesiaca	Aigrette ardoisée	Black Heron	320	1000	
Mesophyx intermedia	Aigrette intermédiaire	Intermediate Egret	1501		
Egretta gularis	Aigrette à gorge blanche	Western Reef-Egret	261	1000	
Egretta garzetta	**Aigrette garzette**	**Little Egret**	**10915**	**3200**	**3,4**
Bubulcus ibis	Héron gardeboeuf	Cattle Egret	6098	20000	
Ardeola ralloides	**Crabier chevelu**	**Squacco Heron**	**1661**	**1000**	**1,7**
Butorides striatus	Héron vert	Striated Heron	6		
Nycticorax nycticorax	**Bihoreau gris**	**Black-crowned Night-heron**	**4620**	**10000**	**0,5**
Ixobrychus minutus	Blongios nain	Little Bittern	2	150	
Botaurus stellaris	Butor étoilé	Great Bittern	29	65/820	
Mycteria ibis	Tantale ibis	Yellow-billed Stork	210	870	
Ciconia ciconia	Cigogne blanche	White Stork	39	5200	
Ephi. senegalensis	Jabiru du Sénégal	Saddlebill	1	50	
Leptoptilos crumeniferus	Marabout d'Afrique	Marabou Stork	380	3200	
Threskiornis aethiopicus	Ibis sacré	Sacred Ibis	1037	3000	
Plegadis falcinellus	**Ibis falcinelle**	**Glossy Ibis**	**10651**	**560**	**19,0**
Platalea leucorodia	**Spatule blanche**	**Eurasian Spoonbill**	**141**	**110**	**1,3**
Platalea alba	**Spatule d'Afrique**	**African Spoonbill**	**893**	**1000**	**0,9**
Scopus umbretta	Ombrette du Sénégal	Hamerkop	1	0	
Dendrocygna bicolor	**Dendrocygne fauve**	**Fulvous Whistling-Duck**	**170**	**140**	**1,2**
Dendrocygna viduata	**Dendrocygne veuf**	**White-faced Whistling-Duck**	**6643**	**6500**	**1,0**
Plec. gambensis	**Oie de Gambie**	**Spur-winged Goose**	**11457**	**710**	**16,1**
Sarkidiornis melanotos	**Canard casqué**	**Comb Duck**	**902**	**280**	**3,2**
Alopochen aegyptiacus	**Oie d'Egypte**	**Egyptian Goose**	**590**	**70**	**8,4**
Nettapus auritus	**Sarcelle à oreillons**	**African Pygmy-Goose**	**41**	**100**	**0,4**
Tadorna tadorna	Tadorne de Bélon	Shellduck	1	1200	
Anas crecca	Sarcelle d´hiver	Teal	60		
Anas querquedula	**Sarcelle d'été**	**Garganey**	**4525**	**20000**	**0,2**
Aythya nyroca	Fuligule nyroca	Ferruginous Duck	6	25	
Balearica pavonina	Grue couronnée	Black Crowned Crane	23	85	
Gallinula chloropus	Poule d'eau	Common Moorhen	210		
Gallinula angulata	Gallinule africaine	Lesser Moorhen	196	10000	
Porphyrio alleni	Talève d'Allen	Allen's Gallinule	6	10000	
Porphyrio porphyrio	**Poule sultane**	**Purple Swamphen**	**673**	**250**	**2,7**

Microparra capensis	Jacana nain	Lesser Jacana	70	1000	
Actophilornis africana	Jacana à poitrine dorée	African Jacana	4083	20000	
Rostratula benghalensis	Rhynchée peinte	Greater Painted Snipe	102	1000	
Himantopus himantopus	Echasse blanche	Black-winged Stilt	5203	760/1400	
Recurvirostra avosetta	Avocette élégante	Pied Avocet	32	730	
Burhinus senegalensis	**Oedicnème du Sénégal**	**Senegal Thick-knee**	**64**	**100**	**0,6**
Pluvianus aegyptius	**Pluvian d'Egypte**	**Egyptian Plover**	**753**	**320**	**2,4**
Glareola pratincola	**Glaréole à collier**	**Collared Pratincole**	**20904**	**190**	**110,0**
Glareola cinereus	Glaréole cendré	Grey Pratincole	9	250	
Vanellus spinosus	**Vanneau éperonné**	**Spur-winged Plover**	**5732**	**2600**	**2,2**
Vanellus tectus	Vanneau coiffé	Black-headed Lapwing	12	10000	
Vanellus albiceps	Vanneau à tete blanche	White-headed Lapwing	5	390	
Vanellus senegallus	Vanneau du Sénégal	Wattled Lapwing	1	390	
Puvialis squatarola	Pluvier argenté	Grey Plover	7	2500	
Charadrius hiaticula	**Grand Gravelot**	**Common Ringed Plover**	**4696**	**2800**	**1,7**
Charadrius dubius	Petit Gravelot	Little Ringed Plover	31	2400	
Charadrius pecuarius	Gravelot patre	Kittlitz's Plover	13676	320	42,7
Charadrius alexandrinus	Gravelot à collier interrompu	Kentish Plover	4	660	
Charadrius marginatus	**Gravelot à front blanc**	**White-fronted Plover**	**633**	**120**	**5,3**
Limosa limosa	**Barge à queue noire**	**Black-tailed Godwit**	**37650**	**1700**	**22,1**
Numenius arquata	Courlis cendré	Eurasian Curlew	212	8400	
Tringa erythropus	**Chevalier arlequin**	**Spotted Redshank**	**4557**	**850**	**5,4**
Tringa totanus	Chevalier gambette	Common Redshank	8	2400/7000	
Tringa stagnatilis	**Chevalier stagnatile**	**Marsh Sandpiper**	**112**	**240**	**0,5**
Tringa nebularia	**Chevalier aboyeur**	**Common Greenshank**	**3910**	**2300**	**1,7**
Tringa ochropus	Chevalier culblanc	Green Sandpiper	5	15500	
Tringa glareola	**Chevalier sylvain**	**Wood Sandpiper**	**521**	**10400**	**0,1**
Tringa hypoleucos	Chevalier guignette	Common Sandpiper	74	17300	
Arenaria interpres	Tournepierre à collier	Ruddy Turnstone	24	730	
Gallinago media	**Bécassine double**	**Great Snipe**	**140**	**300**	**0,5**
Gallinago gallinago	Bécassine des marais	Common Snipe	9	25000	
Calidris minuta	**Bécasseau minute**	**Little Stint**	**31802**	**3000**	**10,6**
Calidris temminckii	Bécasseau de Temminck	Temminck's Stint	3	410	
Calidris alpina	Bécasseau variable	Dunlin	3	9500/310	
Calidris ferruginea	Bécasseau cocorli	Curlew Sandpiper	3754	10000	
Philomachus pugnax	**Chevalier combattant**	**Ruff**	**55858**	**12200**	**4,6**
Larus fuscus	Goéland brun	Lesser Black-backed Gull	235	5500	
Larus cirrocephalus	Mouette à tete grise	Grey-headed Gull	19	300	
Larus ridibundus	Mouette rieuse	Common Black-headed Gull	33	0	
Chlidonias hybridus	**Guifette moustac**	**Whiskered Tern**	**7211**	**250**	**28,8**
Chlidonias leucopterus	Guifette leucoptère	White-winged Tern	4009	30000	
Gelochelidon nilotica	**Sterne hansel**	**Gull-billed Tern**	**3937**	**170**	**23,2**
Sterna caspia	**Sterne caspienne**	**Caspian Tern**	**3337**	**520**	**6,4**
Sterna albifrons	**Sterne naine**	**Little Tern**	**346**	**25**	**13,8**

Based on the results of waterbird monitoring around the millennium and the first decade in the 2000s (1998-2012, the only period of monthly counts), the IND complex met criterion 2 for 11 species, of which 9-10 afrotropical, and criterion 6 For 27 species including a minimum of 9 afrotropicals. Out of a total of some 90 species included in the counts so far, 12% of the species meets criterion 2 and 30% at criterion 6. This again underscores the international importance of the Debo complex. However, being slightly dated, an update of these data is necessary.

The counts show that the Delta holds very large concentrations of water birds including afrotropical birds as well as palearctic migrants (breeding in Europe and western Asia). In the Debo complex – the study area in the central part of the Delta consisting of Lac Debo, Walado Debo and Lac Korientzé - at least **twenty-seven species** are present in internationally (very) important numbers (Table 3.4). For the whole delta, we expect at least 39 species to meet this criteria, as density counts reveal huge numbers of non-gregarious, dispersed birds (Zwarts et al. 2009). In comparison with other sahelian floodplains, the Inner Niger Delta is especially important for species like Purple Heron *Ardea purpurea*, Glossy Ibis *Plegadis falcinellus*, Spur-winged Goose *Plectropterus gambensis,* Kittlitz's Plover *Charadrius pecuarius*, Spotted Redshank *Tringa erythropus* and Caspian Tern *Sterna caspia.* Aerial January censuses executed in the 1970s, 1980s (CRBPO-France; IUCN/WWF) and in 1999-2001 (ONCFS-France, Girard & Thal 1999, 2000, 2001) underline the crucial importance of the Delta for afrotropical and palearctic *Anatidae* (see also Wymenga *et al* 2002).

Large afrotropical wading birds are only present in (very) low numbers, which is partly the result of the severe drought in the 1970s and 1980s but predominantly as a result of human pressure such as hunting and disturbance or destruction of breeding sites. However, the Delta is important to a number of bio-indicator species like African Pygmy Goose *Nettapus auritus* (waterlily habitat), Black Crowned Crane *Balearica pavonina* (critically endangered in the Delta) and the Great Snipe *Gallinago media* (Near-Threatened palearctic species). The Delta hosts small breeding colonies of Whiskered Tern *Chlidonias hybridus*, the first and only ones recorded in West Africa.

The presence and distribution of water birds in wetlands is driven by available food resources and the possibilities to exploit them. In the Debo complex, where huge concentrations of water birds were present during the receding floods, molluscs and fish provide crucial food resources. The possibilities for food exploitation are dictated by water levels; data which were gathered in Debo during the last decade, and more intensively during the project period 1998-2002, show how water birds respond to varying water levels (previous Section). Dropping water levels lead to concentration of fish stock and exploitable molluscs.

3.7 Information on other fauna (non avian)

Fish species and populations

Information on fish populations is scarce, but in the (recent) past relevant information has been gathered about fish species and dynamics of fish population in the IND (ORSTOM, Quensière 1994). Existing information is summarised by Thieme *et al.* (2005), and presented here.

In total about 130 different species of fish are found in the IND, but few species are endemic because times the Niger River was linked to the Chad and Nile systems at various historic times (Lowe-McConnell 1985). Two of the near-endemic fish species found here are *Syndodontis gobroni* and a cichlid, *Gobiocichla wonderi*. Many species migrate upriver and downriver as well as laterally out on to the floodplain as the water rises (Quensière 1994). When the flood recedes,

the fish move upriver and two deeper parts in the river. Also, fish are trapped in small, isolated ponds (mares), where they are caught by local communities. Some fish species can survive in these dwindling pools by aestivating or by breathing air (Lowe-McConnell 1985).

Fish migrations include both lateral movements onto floodplains and long-distance, longitudinal movements. There is anecdotal evidence of several fish moving as much as 440-640 km up the Niger River into the IND with the onset of floods (Welcomme 1986). One of the African tetras, *Bycinus leuciscus*, has been observed moving 50 km from the river mainstream to the edge of the floodplain and may move 125-400 km upstream from the IND to the Markala dam as floods subside (Lowe-McConnell 1985). Dams like Markala and Sélingué are blocking fish migration; at Markala a fish passage system is present, but information on the effectiveness of this system is not present (Fatogoma *et al*. 2006). Most migratory fish have a high fecundity and a breeding period synchronized with the rising flood, which promotes genetic mixing among fish that gather in a limited number of spawning sites from widely dispersed areas of the river (Laë 1992, 1995).

Overfishing and poaching are serious problems of concern. About 90% of Mali's freshwater fish catch comes from the IND (Zwarts *et al.* 2005); yet the size of the catch has declined considerably since 1969, as has the average size of landed fish (Finlayson and Moser 1991; Hughes and Hughes 1992). Prior to 1960, traditional management determined fishing practices for the delta. Two ethnic groups, the Bozos and the Somonos, are the primary fishermen in the IND. The change from traditional management to governmental regulation in 1960 opened fishery access to all citizens. The number of fishermen in the delta doubled from 1977 to 1997 (Laë 1992, 1995). This increase combined with the use of more sophisticated fishing equipment (such as nylon nets) has led to the decline in the catch of certain species, including the economically valuable *Polypterus senegalus* and *Gymnarchus niloticus* (Hughes and Hughes 1992; Ticheler 2000). As reported by van der Kamp & Diallo (2012)

Mammals

Several mammal species are closely linked to the wetlands of the IND. The Inner Niger Delta hosts nowadays the remnants of a rich fauna of big(ger) mammals. Hippopotamus *Hippopotamus amphibius* and West African Manatee *Trichechus senegalensis* constitute the aquatic mammals, both with populations in regularly monitored parts of the southern delta (around 2000, van der Kamp *et al.* 2005, Wymenga *et al.* 2002). For Hippos this is based on own observations during monthly fieldtrips (Fig. 3.17), whereas the presence of Manatees is mainly based on interviews and other information of local fishermen.

Fig. 3.17 shows the observations of Hippos, mostly in the southern part of the delta. In principal Hippos visit alle flooded parts of the floodplain, depending on the height of the flood. They concentrate in the deeper parts when the flood recedes. We expect them to be present in the river proper, the Diaka and other main branches from north to south, but not in the lakes. Manatee distribution is very global and based on IUCN-information. We expect that they do not occur in the lakes (certainly not in the dry lakes on the east bank) and are confined to the river proper and main branches. We have no recent information and confirmation on the presence of Manatees nor on population size.

Observation of other big mammals are exceptional (Wymenga *et al.* 2002), concerning vagrants like an immature Elephant *Loxodonta africana* at Lac Debo in the early 1980s (S. Konta, WI), and two Giraffe *Giraffa camelopardalis ssp. peralta* (DRCN Goundam) in late 2002 between Timbuctoo and Goundam. Elephants are still roaming the savanna east of the delta (Fig. 3.18); a small population migrates between the Sahel reserve in Burkina to the region of Gourma (*Reserve partielle de Faune pour les Eléphants*). Other scarce but regularly seen mammals are

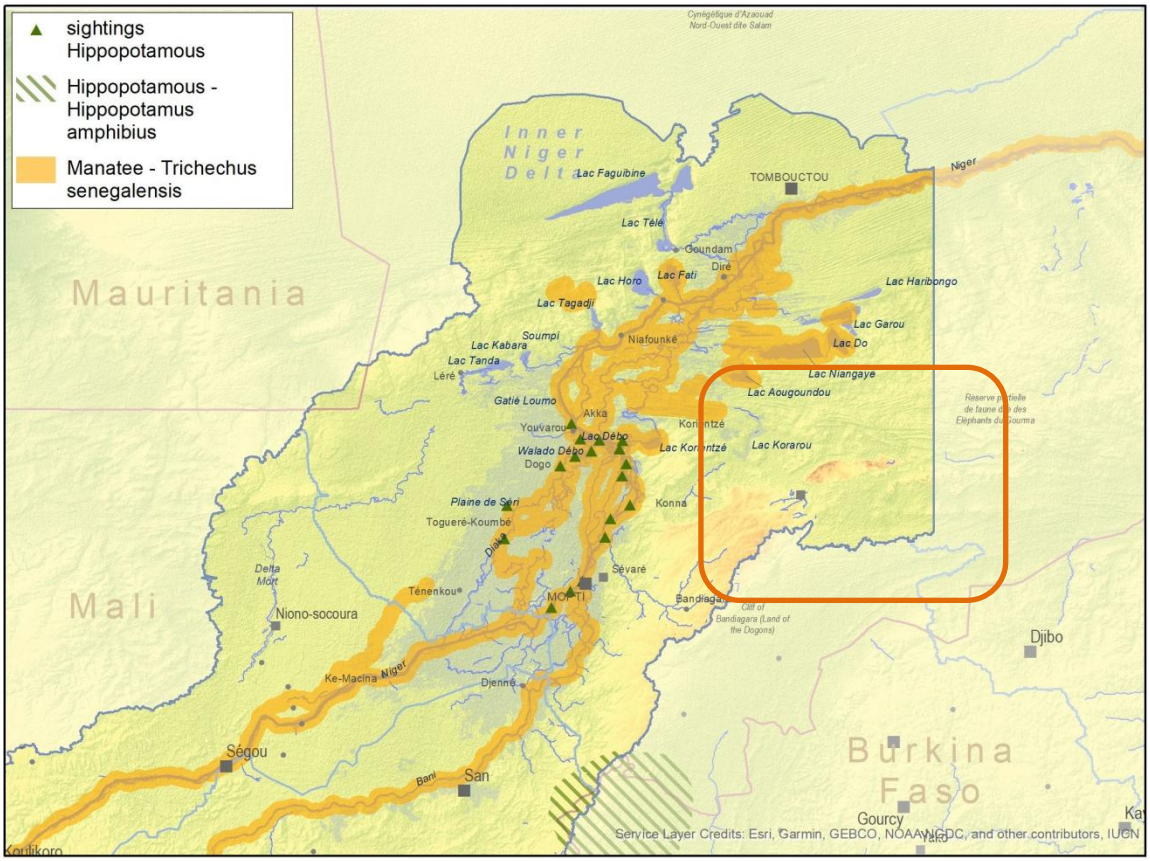


Fig. 3.17. Obervations of Hippopotamous in the Inner Niger Delta and the global distribution as avialble in the IUCN-information. Note that Hippos are expected to roam all deeper parts of the delta which are connected to the river. Manatees are expected to remain in these parts (not in the lakes as indicated in this fig), but recent confirmation on its presence is lacking. The rectangle shows the area where elephants are migrating between areas in the north and south: Fig. 3.18, explanation see text.

Green Monkey *Cercopithecus aethiops* (Mayo Dembé area; observations upstream and north of Akka, Lac Debo) and the Striped Jackal *Canis adustus*, observed in drier habitats. In 2002 a young Patas Monkey was offered for sale in a fishermen's village near Diafarabé.

Buffon's kob (*Kobus kob kob*) was once numerous in the Inner Niger Delta, but is no longer present. This also seems the case for roan antelope (*Hippotragus equinus*), dorcas gazelle (*Gazella dorcas*) and dama gazelle (*Gazella dama*). At least small populations of red-fronted gazelle (*Gazella rufifrons*) are believed to be still present in the northern delta, though little information is present (Wymenga *et al.* 2002). They have never been recorded during several aerial IND waterbird censuses in 1999-2002.

Wild Cats *Felis sylvestris* are seen (once found dead, Mayo Dembé) now and then (mostly singles, rarely two), while in the mid-nineties we once found a freshly dead (drowned?) African Civet *Civettictis civetta*, just downstream Akka, on the riverbank. Species like clawless otter (*Aonyx capensis*), spotted-neck otter (*Lutra maculicollis*), caracal (*Felis caracal*), serval (*Felis serval*), striped hyena (*Hyaena hyaena*) and spotted hyena (*Crocuta crocuta)* – once recorded from these regions - seem to have vacated the area, but accurate information on the status of these species is not available.

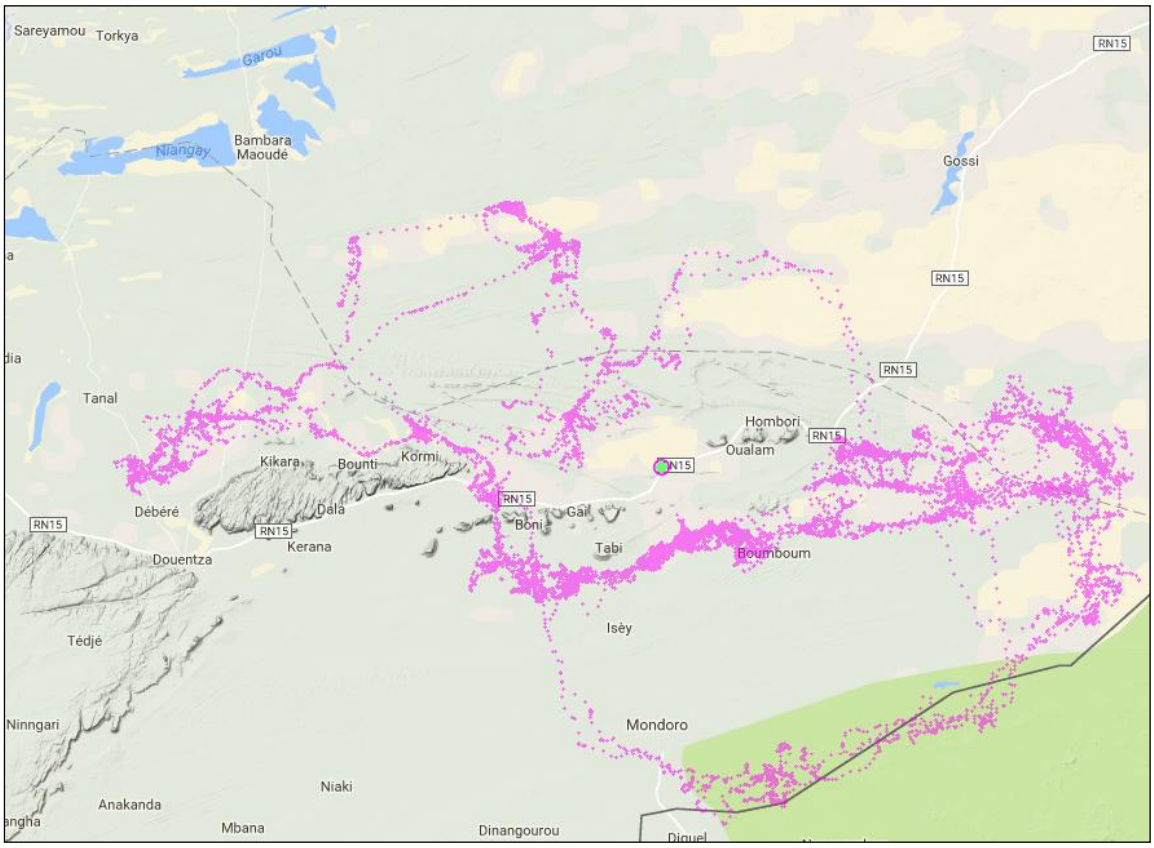


Fig. 3.18. Track of a bull elephant in the Gourma region from 2008-2010 (see rectangle in Fig. 3.17 for location). Data http://www.movebank.org/panel_embedded_movebank_webapp and Wall et al. (2014).

Reptiles

Big reptiles like Nile Crocodile *Crocodylus niloticus* do not seem to occur any more; Akka people -centre of the Delta- report to have seen their last one in the 1970s. Monitor Lizard *Varanus niloticus* are still fairly common, but their meat and skin are appreciated. Also *Python sebae* occurs, but both nile monitor and python are facing heavy human pressure (Wymenga *et al.* 2002).

Information gaps and data need

As obviuous from this short description of fauna, quantitative and actual data on population sizes and spatial distribution is lacking for the delta. Updated information is needed for all species groups, with special attention to fish species and mammals and reptiles bound to water:

- Information on fish species on the market in Mopti, with information on size in relation to the flood season, and in completion to the data collected by Opération Peche Mopti;
- Field missions to map the presence and prime areas for Hippos and other fauna in the Delta, including updated information on the occurrence of Manatees.

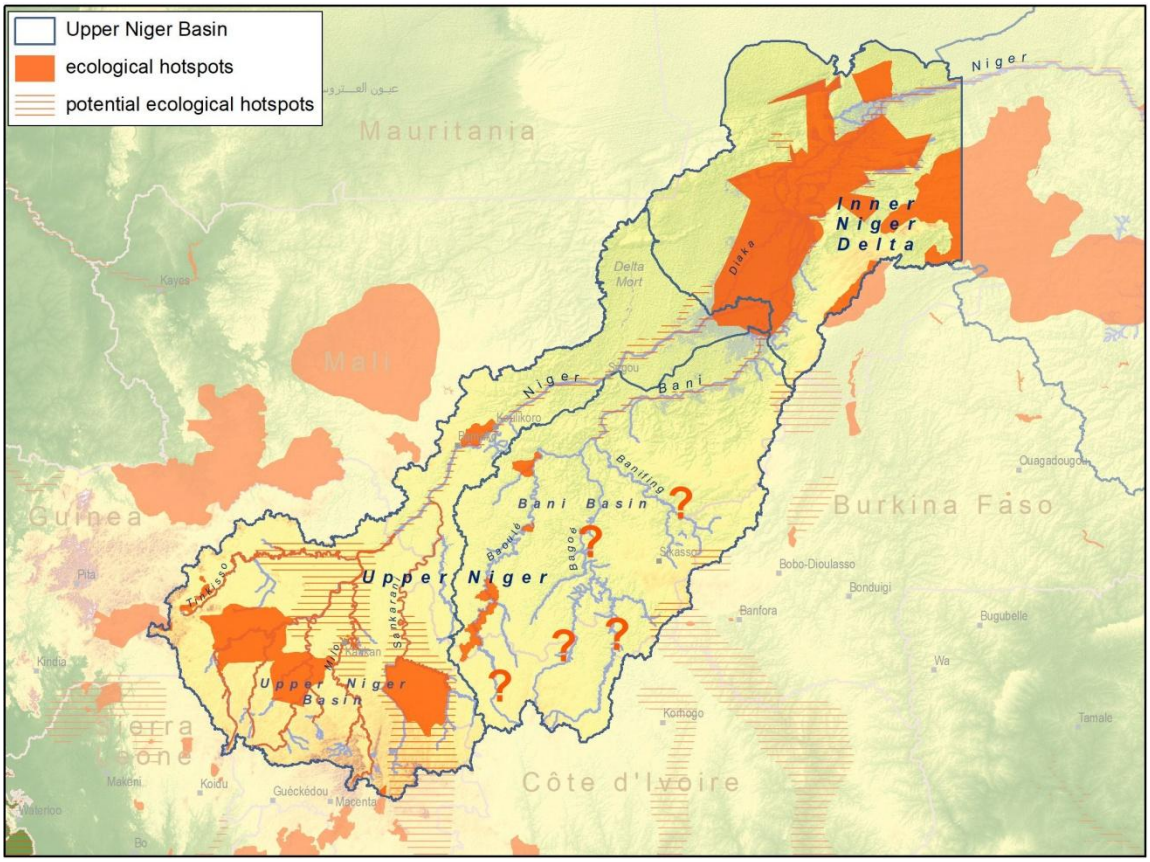


Fig. 4.1. Ecological hotspots and potential hotspots in the Upper Niger Basin and the Inner Niger Delta. See text for explanation. ? refers to areas where information is not sufficient to give an indication of status.

4 Knowledge gaps

4.1 Upper Niger Basin

Based on the previous chapters, as well as the preliminiary map of (potential) ecological hotspots (Fig. 4.1., see Wymenga *et al*. 2017), we can identify priroities in the need for filling knowledge gaps and collect additional data.

a) Collect (and digitise) spatial data on vulnerable habitats in the Upper Niger Basin, using (national) inventories and site inventories. Focus lies on the (riverine) zones which may be affected by changes in water management, and which has been included in the preliminary assessment of ecological hotspots.

b) Field missions to these habitats and areas for ground thruthing and to collect additional information on the role and function of these habitats, their quality and threats. This includes all spatial data and observations (of local communities) in the Upper Niger Basin on vulnerable large mammal species, reptiles, endemic fish species and data on (colonially) breeding water birds, roosts and other bird concentrations.

4.2 Inner Niger Delta

Based on the previous chapters, as well as the preliminiary maps with key ecological structures, we can identify priroities in the need for filling knowledge gaps and collect additional data.

- Spatial analysis and additional field data on key habitats in the IND, including dry forests (see for more information Section 3.3).
- Flooding map with separation in connected and unconnected areas tot the river system.
- Monitoring of waterbird concentrations (aerial census) and colonially breeding water birds including the northern lakes (see for more information Section 3.4).
- Information on fish species on the market in Mopti, with information on size in relation to the flood season, in completion to the data collected by Opération Peche Mopti;
- Field missions to map the presence and prime areas for Hippos and other fauna in the Delta, including updated information on the occurrence of Manatees.

5 References

ABN 2007. Atlas du Bassin du fleuve Niger. Autorité du Bassin du Niger ABN, Niamey.

Arbonnier M. 2007. Trees, shrubs and lianas of West African dry zones. Markgraf, Weikersheim.

Bahaa-el-din, L., D. Mills, L. Hunter & P. Henschel. 2015. *Caracal aurata*. The IUCN Red List of Threatened Species 2015.

Bauer, H., C. Packer, P.F. Funston, P. Henschel & K. Nowell 2016. Panthera leo. The IUCN Red List of Threatened Species 2016: e.T15951A107265605.

Beintema, A.J., J. van der Kamp & B. Kone (éds.). 2007. Les forêts inondées: trésors du Delta Inté- rieur du Niger au Mali. A&W-report 964. Altenburg & Wymenga conseillers écologiques, Veenwouden. Wetlands International, Sévaré. Pays-Bas / Mali.

BirdLife International 2014. *Important Bird and Biodiversity Areas: A global network for conserving nature and benefiting people*. Cambridge, UK: BirdLife International. http://www.birdlife.org/datazone/userfiles/file/IBAs/pubs/SOWIBAs2014.pdf

Birnbaum, P. 2012. Biodiversité au Sahel. Les forêts du Mali. Editions Quae, Cedex, France.

Borrow, N. & R. Demey, 2001. Field guide of the birds of Western Africa. Helm Field Guides. Bloomsburry.

Broxton, P.D., X. Zeng, D. Sulla-Menashe, & P.A. Troch 2014. A global land cover climatology using MODIS data. J. Appl. Meteor. Climatol. 53: 1593-1605. Doi: http://dx.doi.org/10.1175/JAMC-D-13-0270.1

Brugiere, D. & R. Kormos 2009. Review of the protected area network in Guinea, West Africa, and recommendations for new sites for biodiversity conservation. In: Biodiversity Conservation (2009) 18:877-868.

Cecchi G., Mattioli R.C., Slingenbergh J. & De La Rocque S. 2008. Land cover and tsetse fly distributions in sub-Saharan Africa. Med. Vet. Entomol. 22: 364–373.

CILSS 2016. Les Paysages de l'Afrique de l'Ouest : Une Fenêtre sur un Monde en Pleine Évolution. U.S. Geological Survey EROS, 47914 252nd St, Garretson, SD 57030, UNITED STATES.

Diagne L.K. 2016. African manatees. Transboundary challenges and conservation planning. In Aguirre A.A. & R. Sukamar (eds). Tropical Conservation: perspectives on local and global priorities. Oxford University Press New York.

Diallo, M.S. 2011. Evolution de la gestion des aires proteegeees en Guineee : la diffcile cohabitation des politiques publiques et des systemes traditionnels : cas du Parc National du Haut Niger. Domain stic. educ. Universite du Maine.

Fatogoma, B. D. Famoussaba, E. Wymenga, L. Breenzeel & M. Diallo 2006. Stratégie pour le Développement de Systèmes de Passage des Poissons à travers les barrages. Wetlands International, Sévaré, Mali.

Fishpool, L.D.C. and Evans, M.I., eds. 2001. *Important Bird Areas in Africa and associated islands: priority sites for conservation*. Cambridge UK: BirdLife International (BirdLife Conservation Series No. 11).

Fleury-Brugiere, MC. & Brugiere, D. 2010. High Population Density of Pan troglodytes verus in the Haut Niger National Park, Republic of Guinea: Implications for Local and Regional Conservation Int J Primatol (2010) 31: 383. doi:10.1007/s10764-010-9391-9.

Gallais, J. 1967. Le Delta Intérieur du Niger. Etudes de géographie régionale. Paris: Larose.

Hamerlynck, O. & S. A. Moulaye Zeine 2011. Evaluation des Services Rendus par les Ecosytèmes Inondables du Faguibine. Rapport des missions du 25 Novembre au 14 Décembre 2010 et dus 15 au 31 mars 2011. IUCN.

Henschel P, L. Coad, C. Burton, B. Chataigner, A. Dunn *et al.* 2014. The Lion in West Africa Is Critically Endangered. PLoS ONE 9(1): e83500. doi:10.1371/journal.pone.0083500.

Henschel, P., H. Bauer, E. Sogbohoussou & K. Nowell 2015. *Panthera leo* (West Africa subpopulation). The IUCN Red List of Threatened Species 2015: e.T68933833A54067639.

Hiernaux, P. & L. Diarra 1986. Bialnd des cinq années de recherches (sept 1979 – sept 1984) sur le production végétale des parcours des plaines d'inondation du fleuve Niger au Mali central. CIPEA. Document de programme AZ 142.

Hiernaux, P. 1982. La carte des resources fourragères des parcours du Delta intérieur du Niger. Notice CIPEAODEM, Bamako.

Hiernaux, P., M.I. Diarra & L. Diarra 1983. Les paturages naturels. In: R.T. Wilson, P.N. de Leeuw & C. de Haan (eds.). recherches sur les systèmes des zones arides du Mali; résultats préliminaires. CIPEA Rapport de recherche 5, pp. 33-46.

Hughes, R. H. & J. S..Hughes 1992. A directory of African wetlands. Gland, Switzerland, Nairobi, Kenya, and Cambridge, UK: IUCN, UNEP, and WCMC.

IUCN (2016) *A Global Standard for the Identification of Key Biodiversity Areas*, Version 1.0. https://portals.iucn.org/union/sites/union/files/doc/a_global_standard_for_the_identification_of_key_biodiversity_areas_final_web.pdf

IUCN SSC Antelope Specialist Group. 2008. Tragelaphus derbianus ssp. derbianus. The IUCN Red List of Threatened Species 2008: e.T22056A9354316.

Jacobson et al. (2016), Leopard (Panthera pardus) status, distribution, and the research efforts across its range. PeerJ 4:e1974; DOI 10.7717/peerj.1974.

Kamp van der, J., Diallo, M. & Fofana, B. 2002. Dynamique des populations d'oiseaux d'eau. - In: Wymenga, E., Kone, B., Kamp van der, J. & Zwarts, L. (eds.), Delta intérieur du fleuve Niger: ecologie et gestion durable des ressources naturelles. A&W/Wetlands International/Rijkswaterstaat, pp. 87-138. http://www.altwym.nl/uploads/file/392_1294302275.pdf

Kamp van der, J., Fofana, B. & Wymenga, E. 2005. Ecological values of the Inner Niger Delta. - In: Zwarts, L., Beukering van, P., Kone, B. & Wymenga, E. (eds.), The Niger, a lifeline. Rijkswaterstaat/IVM/Wetlands International/A&W, pp. 156-176. http://www.altwym.nl/uploads/file/361_1289481552.pdf

Kamp, J. Van der & M. Diallo 2012. Inner Niger Delta: water birds on the move or trapped? Report of the waterbird census in the Lake Debo area, February 2012. A&W-report 1796. Altenburg & Wymenga ecologisch onderzoek, Feanwâlden / Wetlands International, Sévaré, Mali.

Kamp, J. van der, M. Diallo & B. Fofana 2005. Ecological evaluation of man-made habitats (Sélingué reservoir, irrigation zone of the Office du Niger) and floodplain habitats in the Upper Niger Basin, Mali. Wetlands International, Sévaré / A&W conseillers écologiques, Veenwouden.

Laë, R. 1992. Impact des barrages sur les pêcheries artisanales du delta central du Niger. Cahiers Agricultures 2: 14-21.

Laë, R. 1995 – Climatic and anthropogenic effects on fish diversity and fish yields in the Central Delta of the Niger River. Aquat. Living Resour. 8: 43-58.

Leeuw de & P.N. & Milligan K. 1983. Ressources anaimales. In: R.T. Wilson, P.N. de Leeuw & C. de Haan (eds.). recherches sur les systèmes des zones arides du Mali; résultats préliminaires. CIPEA Rapport de recherché 5, pp. 33-46.

Lewison, R. & W. Oliver 2008. Hippopotamus amphibius. The IUCN Red List of Threatened Species 2008:

Lowe-McConnell, R.H. 1985. The biology of the river systems with particular reference to the fishes. In: A.T. Grove (ed.). The Niger and its neighbours: Environmental history and hydrobiology, human use and hazards of the major West African rivers, pp. 101- 141. A.A. Balkema. Rotterdam.

Mallon, D.P., Hoffmann, M., Grainger, M.J., Hibert, F., van Vliet, N. and McGowan, P.J.K. (2015). An IUCN situation analysis of terrestrial and freshwater fauna in West and Central Africa. Occasional Paper of the IUCN Species Survival Commission No. 54. Gland, Switzerland and Cambridge, UK: IUCN. x + 162pp.

Marie, J. 2000. DELMASIG: hommes, milieux, enjeux spatiaux et fonciers dans le delta intérieur du Niger (Mali). Paris, Université de Paris X Nanterre; UFR SSA - Departement de Geographie.

Marie, J. 2002. Enjeux spatiaux et fonciers dans le delta intérieur du Niger (Mali). In: D. Orange, R. Arfi, M. Kuper, P. Morand & Y. Poncet (eds.) Gestion intégrée des ressources naturelles en zones inonables tropicales, pp. 557-586. IRD, Paris.

Marie, J., P. Morand, & H.N. 'Djim (eds.) 2007. Avenir du fleuve Niger. The Niger River's Future. IRD editions. Collection Expertise collégiale Paris. http://horizon.documentation.ird.fr/exl-doc/pleins_textes/ed-06-08/010041819.pdf.

Moorehead, R. 1997. Structural Chaos : Community and State management of Common Property in Mali. London, IIED.

Myers, N., R.A. Mittermeier, C.G. Mittermeier, G.A.B. da Fonseca & J. Kent 2000. *Biodiversity hotspots for conservation priorities.* Nature 403 : 853-858.

Oates, J.F. 1999. Myth and reality in the Rain Forest : how conservation strategies are failing in West Africa. University of California Press.

Oates, J.F., S. Gippoliti & C.P. Groves 2008. *Colobus polykomos*. The IUCN Red List of Threatened Species 2008: e.T5144A11116648.

Orange, D, Arfi, R., Kuper, M., Morand, P. & Poncet, Y. (eds.) 2002. Gestion intégrée des ressources naturelles en zones inonables tropicales. IRD, pp. 431-453. http://horizon.documentation.ird.fr/exl-doc/pleins_textes/divers09-03/010030381.pdf.

PNUD 2010. Extension et renforcement du système d'AP du Mali. Programme stratégique du FEM pour l'Afrique de l'Ouest – SPWA. Sous-composante biodiversité. PNUD FEM PIMS n° 3926. Pp 1-156.

Quensière, J (ed.), 1994. La Pêche dans le Delta Central du Niger. Karthala, Paris.

Schmidt R.C., H. L. Bart Jr. & F. Pezold 2016. High levels of endemism in suckermouth catfishes (Mochokidae:Chiloglanis) from the Upper Guinean forests of West Africa. In: Molecular Phylogenetics and Evolution 100(2016) 199-205.

Skinner, J., P. J. Wallace, W. Altenburg & B. Fofana 1987. The status of heron colonies in the Inner Niger Delta, Mali. Malimbus 9: 65-82.

Smith, K.G., Diop, M.D., Niane, M. and Darwall, W.R.T. (Compilers). 2009. The Status and Distribution of Freshwater Biodiversity in Western Africa Gland, Switzerland and Cambridge, UK : IUCN. x+94pp+4pp cover. ISBN: 978-2-8317-1163-8.

Tappan GG, Sall M, Wood EC, Cushing M – 2004. Ecoregions and land cover trends in Senegal. J. Arid.

Thieme, M. L. et al 2005. Freshwater Eco-regions of Africa and Madagascar: a conservation assessment. Island Press. Includes bibliographical references and index, 430 p.

UICN/BRAO (2008). Evaluation de l'efficacité de la gestion des aires protégées : parcs et réserves du Mali. ISBN: 978-2-8317-1041-9.

Wall J, Wittemyer G, Klinkenberg B, LeMay V, Douglas-Hamilton I (2013) Characterizing properties and drivers of long distance movements by elephants (Loxodonta africana) in the Gourma, Mali. Biological Conservation, v. 157, p. 60–68.

Welcomme, R. L. 1986. Fish of the Niger system. In: B. R. Davies & K. F. Walker (eds.). The ecology of river systems, pp. 25-47. Dordrecht: Junk.

Wint, W. & Robinson, T. 2007. Gridded livestock of the world 2007. FAO, Rome.

Wright, H.E. and J. McCullough et M.S. Diallo. (eds). 2006. A Rapid Biological Assessment of the Boké Préfecture, Northwestern Guinea. RAP Bulletin of Biological Assessment 41. Conservation International, Washington, DC.

Wymenga, E. & L. Zwarts 2010. Use of ricefields by birds in West Africa. Waterbirds, 33(sp1):97-104.

Wymenga, E., Kone, B., Kamp van der, J. & Zwarts, L. (eds.) 2002. Delta intérieur du fleuve Niger: écologie et gestion durable des ressources naturelles. A&W/Wetlands International/Rijkswaterstaat, pp. 87-138. http://www.altwym.nl/uploads/file/392_1294302275.pdf .

Wymenga, E., M.L. Diawara, W. Bijkerk & F. Hoekema 2017. Ecological hotspots in the Upper Niger Basin and Inner Niger Delta. I. Methods and preliminary assessment. A&W-report 2253a. Altenburg & Wymenga ecological consultants, Feanwâlden.

Ziegler S, Nicholaus G, Hutterer R (2002) High mammalian diversity in the newly established National Park of Upper Niger, Republic of Guinea. Oryx 36:73–80. doi:10.1017/S003060530200011XCrossRefGoogle Scholar.

Zwarts L., Bijlsma R.G., van der Kamp J., Sikkema M. & Wymenga E. 2015. Moreau's paradox reversed, or why insectivorous birds reach high densities in savanna trees. Ardea.

Zwarts, L, Grigoras I. & J. Hanganu 2005b. The vegetation of the lower inundation zone of the Inner Niger Delta. In: Zwarts L, Beukering van P, Kone B, Wymenga E, editors. The Niger, a lifeline. Lelystad: RIZA/Wetlands International/IVM/A&W.p 109-119.

Zwarts, L, Grigoras I. 2005 – Flooding of the Inner Niger Delta. In: Zwarts L, Beukering van P, Kone B, Wymenga E, editors. The Niger, a lifeline. Lelystad: RIZA/Wetlands International/IVM/A&W.p 43-77.

Zwarts, L. & F. S. Hoekema, 2013. Atlas: Les plaines inondables du Delta Intérieur du Niger. A&W-rapport 1908. Altenburg & Wymenga conceillers écologique, Feanwâlden, Pays-Bas.

Zwarts, L. 2012. L'impact d'un faible débit du fleuve sur l'inondation, la végétation et l'utilisation des terres dans le Delta Intérieur du Niger. A&W-rapport 1877.

Zwarts, L. 2012. The impact of a lower river flow on the inundation, vegetation and land use in the IND. A&W-rapport 1868. A&W-rapport 1868. http://www.altwym.nl/uploads/file/489_1369388731.pdf

Zwarts, L., Beukering van, P, Kone, B. & Wymenga, E. 2005. Le Niger, une artère vitale. Gestion de l'eau efficiente dans le bassin du Niger Supérieur. 304 p. http://www.altwym.nl/uploads/file/361_1289481552.pdf

Zwarts, L., Beukering van, P., Kone, B. & Wymenga, E. 2005. The Niger, a lifeline: effective water management in the Upper Niger Basin. - Rijkswaterstaat/IVM/Wetlands International/A&W. http://www.altwym.nl/uploads/file/361_1289481552.pdf

Zwarts, L., Bijlsma, R., van der Kamp, J. & Wymenga, E. 2009. Living on the Edge: Wetlands and bird in a changing Sahel. KNNV Publishing. 564 p. http://www.altwym.nl/uploads/file/540_1433753005.pdf

Appendix 1 Summarised information on Protected areas and Important Bird Areas

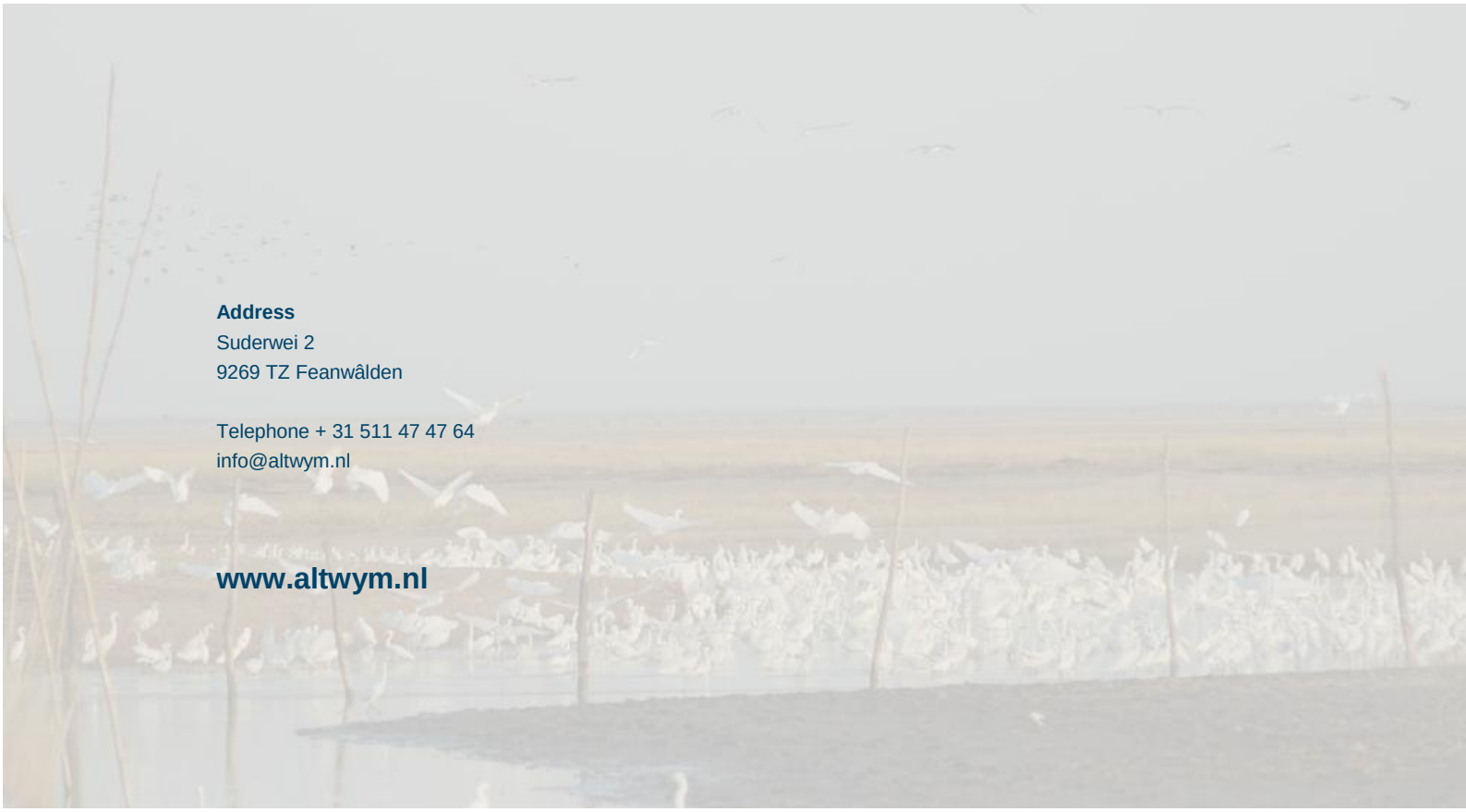
In this Appendix information on species reported from Protected Areas and Important Bird Areas in the Upper Niger Basin and the Inner Niger Delta are listed. Sources mentioned in the text and I) Datazone Birdlife International and II) information on Red list species from IUCN. For nearly all sites recent information is lacking. More information Chapter 4-5.

For each protected area or important bird area it is indicated whether it is connected to the river system, and whether it is situated within the river basin. *Blue areas* are part of the UBN or IND and part of, or connected to the river system.

Name & status	**Information on birds – threathened species or otherwhise important values** **Information on threathened species (VU, NT, EN, CE) – non - avian**
NP Haut Niger / IBA Mafou (part of NP Haut Niger) Part of upper reaches Niger, Milo Information Birdlife: 1997	Violet Turaco (*Musophaga violacea*), Red-throated Bee-eater (*Merops bulocki*), Blue-bellied Roller (*Coracias cyanogaster*), Bearded Barbet (*Pogonornis dubius*), Fox Kestrel (*Falco alopex*), Senegal Parrot (*Poicephalus senegalus*), Yellow-billed Shrike (*Corvinella corvina*), Piapiac (*Ptilostomus afer*), Sun Lark (*Galerida modesta*), *Eremomela pusilla*, Oriole Warbler (*Hypergerus atriceps*), Pied-winged Swallow (*Hirundo leucosoma*), Blackcap Babbler (*Turdoides reinwardtii*), Purple Starling (*Lamprotornis purpureus*), Bronze-tailed Starling (*Lamprotornis chalcurus*), Gambaga Flycatcher (*Muscicapa gambagae*), White-crowned Robin-chat (*Cossypha albicapillus*), White-fronted Black-chat (*Oenanthe albifrons*), Splendid Sunbird (*Cinnyris coccinigastrus*), Chestnut-crowned Sparrow-weaver (*Plocepasser superciliosus*), *Pytilia phoenicoptera*, Black-bellied Firefinch (*Lagonosticta rara*), Bar-breasted Firefinch (*Lagonosticta rufopicta*), Yellow-winged Pytilia (*Pytilia hypogrammica*), Dybowski's Twinspot (*Euschistospiza dybowskii*), Lavender Waxbill (*Estrilda coerulescens*), Grey-headed Oliveback (*Nesocharis capistrata*), Sahel Bush-sparrow (*Gymnoris dentata*) Hippopotamus (*Hippopotamus amphibius*), African Savanna Elephant (*Loxodonta africana*)
Réserve de la Biosphère de la Boucle du Baoulé - Not part of UNB	Red-fronted Gazelle (*Gazella rufifrons*), Hippopotamus (*Hippopotamus amphibius*), African Savanna Elephant (*Loxodonta africana*)
L'aire transfrontalière Mali-Guinée du Bafing Famélé - Not part of UNB	
Réserve de Faune du Sousan Bordering the Baoulé, tributary of the Bani	
IBA Lac Télé Part of Inner Niger Delta - Information Birdlife: 1984	Ferruginous Duck (*Aythya nyroca*): 300 Dorcas Gazelle (*Gazelle dorcas*), Red-fronted Gazelle (*Gazella rufifrons*)
IBA Lac Faguibine Part of Inner Niger Delta Information Birdlife: 1978, 1980, 1983, 1987	White-faced Whistling-duck (*Dendrocygna viduata*): 28400, Fulvous Whistling-duck (*Dendrocygna bicolor*): 67100, Ferruginous Duck (*Aythya nyroca*): 300, Garganey (*Spatula querquedula*): 150000, Northern Pintail (*Anas acuta*): 126800, Great White Egret (*Ardea alba*): 1020, *Himantopus himantopus*: 3060, Ruff (*Calidris pugnax*): 20500, Little Stint (*Calidris minuta*): 10000, Grey-headed Gull (*Larus cirrocephalus*): 2000, White-winged Tern (*Chlidonias leucopterus*): 2000 Dorcas Gazelle (*Gazelle dorcas*), Red-fronted Gazelle (*Gazella rufifrons*)
IBA Lac Fati Part of Inner Niger Delta	Ferruginous Duck (*Aythya nyroca*): 2150, *Gallinula chloropus*: 1800, African Spoonbill (*Platalea alba*): 200

Information Birdlife: 1978, 1985, 1987	Dorcas Gazelle (*Gazelle dorcas*), Red-fronted Gazelle (*Gazella rufifrons*)
IBA Lac Horo Part of Inner Niger Delta Information Birdlife: 1978, 1979, 1980, 1984, 1985, 1987, 1999	Fulvous Whistling-duck (*Dendrocygna bicolor*): 23000, Ferruginous Duck (*Aythya nyroca*): 5600, Garganey (*Spatula querquedula*): 31270, Northern Pintail (*Anas acuta*): 27600, Great White Egret (*Ardea alba*): 560,*Himantopus himantopus*: 1600, Black-tailed Godwit (*Limosa limosa*): 6200, Ruff (*Calidris pugnax*): 32000, Caspian Tern (*Hydroprogne caspia*): 2000, White-winged Tern (*Chlidonias leucopterus*): 3000, Dorcas Gazelle (*Gazelle dorcas*), Red-fronted Gazelle (*Gazella rufifrons*)
IBA Lac Débo - Lac Oualado Débo Part of Inner Niger Delta Information Birdlife: 1983, 1986, 1992, 1994, 1996, 1997, 1998, 1999, 2000, - see Chapter 5	Fulvous Whistling-duck (*Dendrocygna bicolor*):19100, Spur-winged Goose (*Plectropterus gambensis*): 11000, Garganey (*Spatula querquedula*): 272500, Northern Pintail (*Anas acuta*): 150000, African Collared-dove (*Streptopelia roseogrisea*): present, Purple Swamphen (*Porphyrio porphyrio*): 580 , African Spoonbill (*Platalea alba*): 765, Glossy Ibis (*Plegadis falcinellus*): 16000, *Egretta (garzetta*): 40002 , *Mesophoyx intermedia*: 1501, *Nycticorax nycticorax*: 6750 , Squacco Heron (*Ardeola ralloides*): 5120, Cattle Egret (*Bubulcus ibis*): 12000 breeding pairs, Cattle Egret (*Bubulcus ibis*): 260000, Purple Heron (*Ardea purpurea*): 4171, Great White Egret (*Ardea alba*): 630 breeding pairs, Great White Egret (*Ardea alba*): 4563, Black Heron (*Egretta ardesiaca*): 510, Great White Pelican (*Pelecanus onocrotalus*): 5500, Long-tailed Cormorant (*Microcarbo africanus*): 4400 breeding pairs, Long-tailed Cormorant (*Microcarbo africanus*): 59000, *Himantopus himantopus*: 52999, Common Ringed Plover (*Charadrius hiaticula*): 6057, Kittlitz's Plover (*Charadrius pecuarius*): 11834, Black-tailed Godwit (*Limosa limosa*): 26852, Ruff (*Calidris pugnax*): 45000, Little Stint (*Calidris minuta*): 17666 , Spotted Redshank (*Tringa erythropus*): 4431, Collared Pratincole (*Glareola pratincola*): 8254, *Sterna nilotica*: 1948, Grey-headed Gull (*Larus cirrocephalus*): 1000, Caspian Tern (*Hydroprogne caspia*): 3193, Whiskered Tern (*Chlidonias hybrida*): 3600, White-winged Tern (*Chlidonias leucopterus*):3800, Sahelian Woodpecker (*Dendropicos elachus*): present, Cricket Warbler (*Spiloptila clamans*): present, Chestnut-bellied Starling (*Lamprotornis pulcher*): present , Black Scrub-robin (*Cercotrichas podobe*): present , Sudan Golden (Sparrow *Passer luteus*): present Dorcas Gazelle (*Gazelle dorcas*), Red-fronted Gazelle (*Gazella rufifrons*)
IBA Timisobo – Képagou Part of Inner Niger Delta Information Birdlife: 1977, 1978, 1986	Garganey (*Spatula querquedula*): 150000, Cattle Egret (*Bubulcus ibis*): 15500, Great White Egret (*Ardea alba*): 800, Black-tailed Godwit (*Limosa limosa*): 30000, Ruff (*Calidris pugnax*): 31000 Dorcas Gazelle (*Gazelle dorcas*), Red-fronted Gazelle (*Gazella rufifrons*)
IBA Plaines de Séri Part of Inner Niger Delta Information Birdlife: 1978, 1986, 1987, 1995	*Sarkidiornis melanotos*: 12500, Ferruginous Duck (*Aythya nyroca*): 350, Garganey (*Spatula querquedula*): 57000, Northern Pintail (*Anas acuta*): 63000 , Great White Egret (*Ardea alba*): 1750, Great White Pelican (*Pelecanus onocrotalus*): 2000, Collared Pratincole (*Glareola pratincola*): 9000 Dorcas Gazelle (*Gazelle dorcas*), Red-fronted Gazelle (*Gazella rufifrons*)
IBA Koumbé Niasso Part of Inner Niger Delta Information Birdlife: 1985, 1999, 2000	Glossy Ibis (*Plegadis falcinellus*): 2800, *Mesophoyx intermedia*: 530 breeding pairs, *Nycticorax nycticorax*: 3000, Cattle Egret (*Bubulcus ibis*): 17000 breeding pairs, Cattle Egret (*Bubulcus ibis*): 54662, Great White Egret (*Ardea alba*): 1600 breeding pairs, Long-tailed Cormorant (*Microcarbo africanus*): 14000 breeding pairs Dorcas Gazelle (*Gazelle dorcas*), Red-fronted Gazelle (*Gazella rufifrons*)
IBA Falaise de Bandiagara Important Bird Area Not part of UNB Information Birdlife: 1997	Arabian Bustard (*Ardeotis arabs*), Bearded Barbet (*Pogonornis dubius*), Sahelian Woodpecker (*Dendropicos elachus*), Fox Kestrel (*Falco alopex*), Senegal Parrot (*Poicephalus senegalus*), Yellow-billed Shrike (*Corvinella corvina*), Piapiac (*Ptilostomus afer*), Yellow Penduline-tit (*Anthoscopus parvulus*), Sun Lark (*Galerida modesta*), *Eremomela pusilla*, Cricket Warbler (*Spiloptila clamans*), Chestnut-bellied Starling (*Lamprotornis pulcher*, Purple Starling (*Lamprotornis purpureus*), Black Scrub-robin (*Cercotrichas podobe*), Gambaga Flycatcher (*Muscicapa gambagae*), Black-rumped Waxbill (*Estrilda troglodytes*), Sudan Golden Sparrow (*Passer luteus*), Sahel Bush-sparrow (*Gymnoris dentata*) Dorcas Gazelle (*Gazelle dorcas*), Red-fronted Gazelle (*Gazella rufifrons*)
IBA Kouakourou Not part of UNB - Information Birdlife: 1986	Cattle Egret (*Bubulcus ibis*): 12500 breeding pairs, Great White Egret (*Ardea alba*): 290 breeding pairs

	Dorcas Gazelle (*Gazelle dorcas*), Red-fronted Gazelle (*Gazella rufifrons*)
Sirakoroni – Tyènfala Important Bird Area Information Birdlife: 1997	Violet Turaco (*Musophaga violacea*), Bearded Barbet (*Pogonornis dubius*), Fox Kestrel *Falco (alopex*), Senegal Parrot (*Poicephalus senegalus*), Yellow-billed Shrike (*Corvinella corvina*), Piapiac (*Ptilostomus afer*), Yellow Penduline-tit (*Anthoscopus parvulus*), *Eremomela pusilla*, Red-pate Cisticola (*Cisticola ruficeps*), Rufous Cisticola (*Cisticola rufus*), Blackcap Babbler (*Turdoides reinwardtii*), Bronze-tailed Starling (*Lamprotornis chalcurus*), White-crowned Robin-chat (*Cossypha albicapillus*), White-fronted Black-chat (*Oenanthe albifrons*), *Lagonosticta larvata*, *Pytilia phoenicoptera*, Mali Firefinch (*Lagonosticta virata*), Lavender Waxbill (*Estrilda coerulescens*), Black-rumped Waxbill (*Estrilda troglodytes*), Sahel Bush-sparrow (*Gymnoris dentata*)
Réserve spéciale des éléphants de Douentza (Gourma) - No direct connection or hydrological connection to the river system	Dama Gazelle (Gazelle dama), Dorcas Gazelle (Gazelle dorcas), Red-fronted Gazelle (Gazella rufifrons), African Savanna Elephant (Loxodonta africana)
IBA Tombouctou Part of Inner Niger Delta Information Birdlife: 1997	African Collared-dove (Streptopelia roseogrisea), Yellow-breasted Barbet (Trachyphonus margaritatus), Sahelian Woodpecker (Dendropicos elachus), Sennar Penduline-tit (Anthoscopus punctifrons), Eremalauda dunni Kordofan Lark (Mirafra cordofanica), Cricket Warbler (Spiloptila clamans), Chestnut-bellied Starling (Lamprotornis pulcher), Black Scrub-robin (Cercotrichas podobe), Sudan Golden Sparrow (Passer luteus) Dorcas Gazelle (Gazelle dorcas), Red-fronted Gazelle (Gazella rufifrons)



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