**Lake Guidimouni: Diversity of vertebrate fauna and its threats**


## Abstract

Lakes provide many services to the humanity. However human activities affect negativity the function of the lakes to deliver its values to the society. It is in this sense, this study tried to assess the effects of human activities on the dryland lake (Lake Guidimouni) mostly, the effects of the human activities on the vertebrate fauna. This study will close the paucity of data about the diversity vertebrate fauna in the West African Sahel Lake. Therefore, this study assessed the diversity of vertebrate fauna and its menaces in the Lake Guidimouni, Niger. We used Field investigations and questionnaires for the data collection. While we used descriptive statistics and number of species, number of families of the different classes of vertebrates recorded in the lake. The study recorded 20 vertebrate fauna species across the four vertebrate classes(Fish species = 6; Bird species = 7; Amphibian species = 2 and reptile species = 5) in the lake Guidimouni based on the field observation and questionnaire. More specifically the study recorded six fish species belonging to the six families in the lake with as Cichlidae dominant family. While we recorded seven bird species with Ardeidae having the high species richness (3 species) belonging to three families. Furthermore, five species of reptile were recorded belonging five families in the lake Guidimouni. Lastly, two amphibian species were identified belonging to two families. Secondly, the study documented the many threats to Lake Guidimouni biodiversity mainly illegal poaching, salinity, the use of the chemicals, overexploitation, invasion by species such as *Typha australis* and *Prosopis juliflora,* destruction of the lake by unsustainable farming practices such as cutting down of trees and drying up of the lake. This study constitutes the baseline reference about the impacts of human activities on the dryland lake (lake Guidimouni) in Zinder region, in Niger. The study recommends some ecological restoration activities of lake Guidimouni such as the removal of the invasive species, enforcement of law and regulation about the use of chemicals in the lake. It also recommends further study which look at socio-economic and ecological benefits of the lake Guidimouni in the context of changing climate.



**Keywords:**Dryland, Lake Guidimouni, invasive species, aquatic biodiversity.


**Comment [MB1]:** words in the abstract are concise, clear and describe the objectives, methods and results of the research

**Comment [MB2]:** In the abstract avoid repetition of words such as lake Guidimouni,

**Comment [MB3]:** The research results do not need to be spelled out, just mention the number of species that still survive there



## 1. Introduction

Lakes play a major role in biodiversity conservation. For instance,15% of the world biodiversity live in the lakes(Vadeboncoeur et al., 2011). Particularly, the lakes play a major role in vertebrate fauna conservation(Arthington et *al.*, 2016; Chenchouni, 2012; Duker and Borre, 2001; Liu and Ouyang, 2019). In addition to that, lakes are known as an area of high levels of unique animal and plant biodiversity(Arthington et *al.*, 2016; Chenchouni, 2012;

Duker and Borre, 2001; Menbere and Menbere, 2018; Schraml, 2018). Lakes are natural brakes on climate change due to its high carbon sequestration potential and its ability to keep carbon for long-tern conservation(Eid and Shaltout, 2013; Mitsch et *al.*, 2013). Lakes are great source of livelihoods such as source of food, forage, medicines and materials for human needs, which help to reduce poverty, food insecurity and malnutrition in the world for climate change adaptation(Gregg et *al.*, 2012; Magee et *al.*, 2019; Musinguzi et *al.*, 2016). The world's lakes are also important for understanding the trend of climate change as reported by (Anneville et *al.*, 2015; Erwin, 2009; Woolway et *al.*, 2020) that lakes are sentinels of climate change.

However the lakes provide a wide range of ecosystem servicesto the society, the human activities constitute a major threat to the lake ecosystems such as the conversion of lake to farmlands, overfishing and poor fishing practices as reported by (Dudgeon et *al.*, 2006; van Soesbergen et al., 2019; Zia et *al.*, 2013) which destroys many animal species in the Lake Victoria Basin. In addition to that, the use of chemical for fishing or farming and invasive species are the agent of destruction of freshwater. For instance the use of pesticides and fertilizers in farming is the great source of water pollution in wetlands in West Africa (Duker and Borre, 2001; Otiang'a-Owiti and Oswe, 2007), A part from these threats, climate change has various and great affects the lake ecosystems (Mooij et *al.*, 2005; Woolway et *al.*, 2020).

Despite their importance, West African Sahel lakes continue to be fairly ignored on the global and regional conservation efforts. In addition to that, there is paucity of data about vertebrate fauna in a wetland of West African Sahel region. For instance,biodiversity data from lakes in Sahel region as Niger are seriously underrepresented both in the conservation literature. Therefore this study tries to close this gap by the determining the vertebrate fauna and threats of lake Guidimouni, Niger. This completes the international and national efforts to identify lake biodiversity for its sustainable management.



## 2. Materials and Methods

### 2.1 Study Area

Lake Guidimouni (13°42'N 09°31'E) is was the site study site which is located in the rural commune of Damagaram-Takaya in the Zinder Region (Figure 1), with a total population of 84 649inhabitants(INS, 2020). Lake Guidimouniruns along the National Route in the vicinity

**Comment [MB4]:** In the research method using interviews, how do you do it, what are the variables and indicators of this research. should be added to this section

of 500m on its right bank with land area of 338.4 hectares. Lake Guidimouni is of the Ramsar sites in Niger republic. Themain activities of the people in the commune of Guidimouni are agriculture with a predominance of market gardening, livestock, trade and fishing practiced. Lake Guidimouni is located in Sahel agro-climatical zone of Niger which receives 300-500mm of rain annually (Fick and Hijmans, 2017).

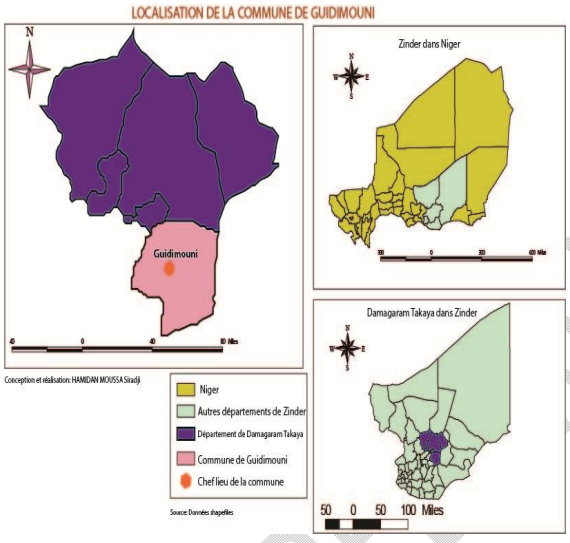


Figure 1. Map of the Commune of Guidimouni

### 2.2 Data Collection

Comment [MB5]: To find out each species that exists using what method? described in this section

Field investigations and questionnaires were carried out during 2016 in order to collect the data of Lake Guidimouni. The study was mainly based on field survey of vertebrates at the lake and at its surrounding areas. The lake Guidimouni users administered the questionnaires (individuals or focus group discussion). The pictures of vertebrate fauna of the lake were taken. For the fish species inventory, we followed the legal anglers (those who have the permit of fishing) during the collection of their fish trap early in the morning during 10 days. We took only the pictures, local names of the fish from the fish trap every day. For the bird inventory, we took only the pictures of the birds that we found in the water and near the lake. We collected also some vertebrate fauna indicators such as faeces.

### 2.3 Data Analysis

Vertebrate species were recorded then species richness (S) was assessed for each class as the total number of species occurring along a given number of class.To be able to determine the

different families of species of fish encountered: the key to identifying families of freshwater fish: case of the lake of Ayamé, which we were taught in the systematic module of fish was used, (Manual practice of identifying fish from Lake Ayamé (Rivière Bia, Côte d'Ivoire). Nevertheless, we used recent binomial name by putting the name of species.

## 3. Results

### 3.1 Diversity of vertebrate fauna of the Lake Guidimouni based

The study recorded 20 vertebrate fauna species across the three vertebrate classes in the lake Guidimouni (Table 1) based on the field observation and questionnaire. More specifically the study recorded six fish species belonging to the six families in the lake with as Cichlidae dominant family (Table 1). While we recorded seven bird species with Ardeidae having the high species richness (3 species) belonging to three families (Table 1). Furthermore, five species of reptile were recorded belonging five families in the lake Guidimouni (Table 1). Lastly, two amphibian species were identified belonging to two families (Table 1).

**Table 1: Diversity of vertebrate fauna of the Lake Guidimouni**

| **Fish species and richness (S = 6)** | **Families (F = 6)** |
|---|---|
| *Coptodon zillii* Gervais | Cichlidae |
| *Oreochromis niloticus* Linnaeus | Cichlidae |
| *Clarias gariepinus*Burchell | Clariidae |
| *Protopterus annectens*Owen | Protopteridae |
| *Lates niloticus* Linnaeus | Latidae |
| *Bagrusbajad*Forsskål | Bagridae |
| *Auchenoglanis occidentalis* Valenciennes | Claroteidae |
| **Bird species and richness (S = 7 )** | **Families (F = 3)** |
| *Ardea cinerea* Linnaeus | Ardeidae |
| *Bubulcus ibis* Linnaeus | Ardeidae |
| *Egretta garzetta* Linnaeus | Ardeidae |
| *Ephippiorhynchus senegalensis* Shaw | Ciconiidae |
| *Ciconia nigra*Linnaeus | Ciconiidae |
| *Plectropterus gambensis* Linnaeus | Anatidae |
| *Sarkidiornis melanotos* Pennant | Anatidae |
| **Amphibian species and richness (S = 2 )** | **Families (F = 2)** |
| *Rhinella marina* Linnaeus | Bufonidae |
| *Pelophylaxlessonae*Camerano | Ranidae |
| **Reptile species and richness (S = 5 )** | **Families (F = 5)** |
| *Crocodylusniloticus*Laurenti | Crocodylidae |
| *Bungarus niger* Wall | Elapidae |
| *Aparallactus niger* Boulenger | Lamprophiidae |
| *Pelusiosniger*Duméril&Bibron | Pelomedusidae |
| *Varanus niloticus* Linnaeus | Varanidae |

### 3.2 Different threats to the fauna of Lake Guidimouni

The study documents the following emerging menaces to the Lake Guidimouni which are: (i) overexploitation; (ii) microplastic pollution (Presence of the plastic waste in the lake); (iii) illegal poaching as documented by the photo (a) which shows the black stork (*Ciconia nigra*) and frog in the trap of illegal poacher as reported to us by the people we met during the field observation. (iii) salinization; (iv) chemical pollution caused by the use ofchemicals (pesticide and chemical fertilizers) which come from irrigated farming activities near the lake(Photo b); (v) climate change represented by drought as reported by the respondents; (vi) plant invasion (*Typha australis*and *Prosopis juliflora*(Photo c)), (vii) deforestation which leads to silting up of the lake as illustrated in the photo (d).

**Comment [MB6]:** Is this statement obtained from direct observation or from interviews with the community?

**Photos A**. Ciconia*nigra*and frogtrapped by a poacher by the lake. (Source: Hamidan, August 2017)


**Photo B.**Pesticides and fertilizer used by crop producers irrigate around Lake Guidimouni (Source Hamidan, 2017).


**Photo C.***Typha australis* in the Lake Guidimouni*Prosopis juliflora*in the lake basin

Photo d. shows deforestation near the lake which leads to the silting.

## 4. Discussion

Lake Guidimouni fishery is dominated by Cichlidae. The dominance of this fish family in the Lake Guidimouni may be due to the presence of the species such as *Clarias gariepinus*, *Oreochromis niloticus* which play a major role in combating malnutrition and poverty (Adebayo et al., 2013; Waithaka et al., 2015). This dominance is key for the aquaculture and fisheries production in lake as the fish recorded in this family in the Lake Guidimouni. This confirms the finding of (Makwinja et al., 2021) who reported such dominance in the Lake Malombe.Our study provides the diversity of vertebrate in the lake Guidimouni which demonstrates also the role of lake in the biodiversity conservation as highlighted by (Duker

**Comment [MB7]:** the discussion in this research is made systematically and explains the parts of each result obtained. For example: 1. diversity of fauna... 2. threats.....

and Borre, 2001; Liu and Ouyang, 2019; Schraml, 2018). Furthermore, our study reported that Cichlidae as the dominant family in Lake Guidimouni.

Our study reported the presence of plastic waste in the lake Guidimouni. This may have negative ecological effects such as concentrating contaminants (Rios, Moore & Jones, 2007) and ingestion by animals, which reduces fitness and increases mortality (Sigler, 2014; Provencher, Bond & Mallory, 2015) as it was observed in the in marine environments. furthermore, It has been reported that microplastics are consumed by freshwater biodiversity such as birds ((Holland, Mallory &Shutler, 2016), fish species (Campbell, Williamson & Hall, 2017), reptiles and amphibians. In addition to that, microplastics in the fresher water are known to be stagnant in benthic zone, which exposes benthic biodiversity (Ballent et al., 2016; Vermaire et al., 2017). For sustainable management of the lake Guidimouni, there is need to educate and sensitize the lake users about the effects of plastic wastes to the biodiversity conservation and their socio-economic livelihood that they get from the lake. In addition to that there is need to respect the legislation of Niger that interdicts the use of microplastics.*Prosopis juliflora* and *Typha australis* blocks the fisherman installation of the fish traps. These species are a major threat to the environment, because they can: (1) suppress or replace native biodiversity, (2) alter ecosystem functions and services, and (3) cause significant economic damage, costing economies millions of dollars [3]. T.Australis had an effect on water quality by altering the calcium and causing the high bicarbonate rate and pH and confirms the results of AbderrahmaneBoudoukha et al, 20122 (source Garba). The study observed the presence of one exotic tree species (*Prosopis juliflora*) which is colonizing the lake Guidimouni, from our field observation, *Prosopis juliflora* has invasive behaviour in the lake which may have various negative impact on the lake as it has been reported that invasive species destroy the aquatic environments such as the freshwater ecosystems (Gallardo et al., 2016).

However, it must not be ignored that some non-native species can now play important ecological roles in human-altered environments, such as supporting lake food webs (Twardochleb& Olden, 2016) and riverine ecosystem functions (Moore & Olden, 2017). Species have been repeatedly and deliberately introduced outside their native ranges with the aim to support food security, recreation opportunities and ecosystem rehabilitation.



## 5. Conclusions

This study determined the diversity of the vertebrate fauna of the Lake Guidimouni which could serve as the baseline study. It has also determined the different threats on the lake which are mainly anthropogenic. This study provides the data about the Lake Guidimouni related to the vertebrate fauna and its threats for sustainable management of this Ramsar site.

**Comment [MB8]:** the conclusion should describe the fauna species and how the threats are clear from the results of the research

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