

Lake Guidimouni: Diversity of vertebrate fauna and its threats

Abstract

Lakes provide many services to the humanity. However human activities affect negatively 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.

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;

Comment [mm1]: 1. an animal of a large group distinguished by the possession of a backbone or spinal column, including mammals, birds, reptiles, amphibians, and fishes.

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Comment [mm3]: Fish species = 6 or 7

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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-term 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 services to 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 84 649 inhabitants (INS, 2020). Lake Guidimouni runs along the National Route in the vicinity

of 500m on its right bank with land area of 338.4 hectares. Lake Guidimouni is of the Ramsar sites in Niger republic. The main 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).

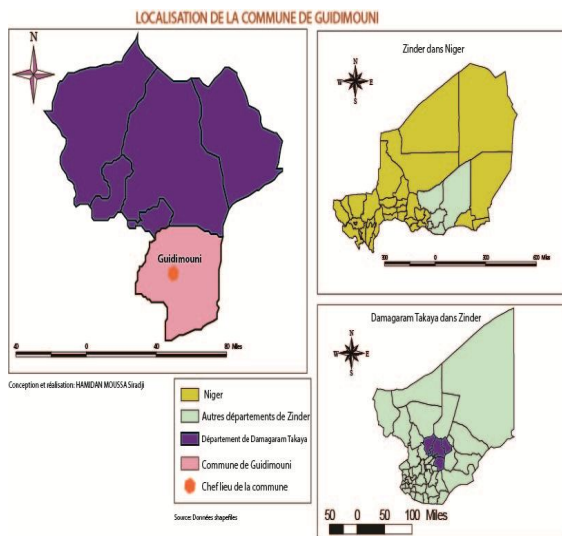


Figure 1. Map of the Commune of Guidimouni

2.2 Data Collection

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

Comment [mm6]: S = 6 or S = 7 ?

- (1) *Coptodon zillii* Gervais
- (2) *Oreochromis niloticus* Linnaeus
- (3) *Clarias gariepinus* Burchell
- (4) *Protopterus annectens* Owen
- (5) *Lates niloticus* Linnaeus
- (6) *Bagrus bajad* Forsskål
- (7) *Auchenoglanis occidentalis* Valenciennes

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 of chemicals (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).



Photos A. *Ciconia nigra* and frog trapped 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).

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Comment [mm11]: there is no data/information about the content of chemical pollution in waters (may exist but not exceed water quality standards)

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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

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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 Abderrahmane Boudoukha 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.

6. References

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