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Fish Species Composition, Abundance and Diversity of Minor Lakes in South Western Uganda/Kigezi Region

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ABSTRACT

Fish is one of the commodities that can reduce poverty and malnutrition in Southwestern Uganda. The presence of rich aquatic bodies in this region is a good resource for capture fisheries. The current study investigated fish species composition, abundance and diversity in six lakes, Mutanda, Mulehe, Chahafi, Kayumbu, Bunyonyi and Nakasanda in the region. Qualitative and quantitative data were collected using structured interview questions and various gears, gill nets, hooks, basket traps and beach seine nets. The results showed that, minor lakes in the region had a diverse fish community consisting of 8 species, Small species of *Barbus*, *Clarias carsoni*, Cray fish, Haplochromines, *Oreochromis leucostictus*, *Oreochromis niloticus*, *Clarias gariepinus* and *Tilapia zilli*. Out of these, only three (3), Barbus, Haplochromines and *Oreochromis niloticus*, appeared in all the lakes. Haplochromines were the most abundant fish species. Nile tilapia was more abundant in Lake Kayumbu. Lake Mutanda had more fish species richness and Lake Nakasanda demonstrated a more species evenness and diversity. The results from the current study, suggest that the minor lakes could serve as important sources of fish for both the riparian communities and the country at large if appropriate management interventions are instituted.

Key Words*: South Western Uganda***,** *Minor Lakes, Fish Species, Composition, Abundance, Richness, Evenness, Diversity*

1. INTRODUCTION

Uganda has a total surface area of around 241,000 km^2 and 20% of this area is covered by aquatic environments [1]; [2]. The aquatic environments comprise of five major productive lakes (Victoria, Albert, Kyoga, Edward and George) and about 160 minor/satellite lakes, rivers and wetlands [2]. Although, most of these major lakes are all productive in terms of fish yields, Lake Victoria is by far the largest and economically most significant of the national fisheries [3]. The dominance of fish production from the major water bodies in Uganda has had the effect of marginalizing production from other water bodies and has thus resulted in little attention being paid to production data from other water bodies such as swamps, rivers, streams and minor lakes [3]. Also, whilst Uganda's major and naturally productive lakes have been the major focus for numerous investigations/research; [4]; [5]; [6]; [7]; [8]; [9];[10]; [11]; [12; [13]; [14]; [15]; [16]; [17]; [18]; [19]; these studies have further provided production data of the water bodies and hence their importance. Although, the minor water bodies in Uganda are individually small, in aggregate, their productivity in terms of fish is fundamental to nutrition and livelihood needs to riparian communities which are mainly the rural poor.

In the current study, we were mainly concerned with the minor lakes of Kigezi region which include; Lakes Bunyonyi in Kabale, Mutanda, Mulehe, Cyahafi and Kayumbu in Kisoro, and Nakasanda/Garubunda in Rukungiri. It must be noted that, although these lakes may be producing some fish species, production data is often unreported and hence yield of fish species is poorly known. The continued growth in fish exports from the major productive lakes in the country and related overexploitation/overfishing resulting from elevated fishing effort has re-awakened fish production from the originally marginalized aquatic minor ecosystems as significant and critical sources of supply of fish to peri-urban areas and urban centers. The minor lakes in the region differ generally from other minor lakes and major lakes in the country because of the geological formation and altitude [20]. Lake Bunyonyi in Kabale District is the biggest and deepest among the minor lakes in the zone with an estimated area of 61 km^2 and depth of 40 to around 900 m [21]; [22], followed by Lake Mutanda (26.4km^2) and then Lake Mulehe (4.1km^2). Lakes Mutanda and Mulehe lie in the central portion of Kisoro District which are close to each other and are connected by approximately 2km long river stretch, Mucha which drains from Lake Mulehe into Lake Mutanda [23]; [24]. Lake Mutanda also drains its waters from Lake Bunyonyi via river Ruhezamyenda and then River Kaku flows out of Lake Mutanda and joins the Rutshuru swamp, which eventually flows into the southern end of Lake Edward [25].

The minor lakes in the region, especially Bunyonyi, Mutanda and Mulehe, have been studied; [22]; [26] [23] [27]; [20]; [25]. However, it is important to note that, the herein mentioned authors focussed mainly on limnology. Other lakes; Chahafi (1 km^2) and Kayumbu (2.2 km^2) in Kisoro and Nakasanda/Garubunda in Rukungiri, have not been studied at all. Although, grey literature stipulates that, decades ago some restocking programmes were implemented in these lakes [28], a holistic fish species composition from the minor lakes of the region is poorly understood. The little work or much less attention that has been directed to the satellite or minor Lakes in the country [29], is probably related to the perceptions that their fisheries are not economically viable although productivity from them if enhanced would ultimately improve the livelihoods of the local communities and reduce the fishing pressure on the major and naturally productive lakes in the country. The current study in principle was designed to determine the fish species composition, abundance and diversity of the six (6) minor lakes of South Western Uganda so that a sustainable foundation for their fishery contribution in the region and country at large is devised.

2. METHODS AND MATERIALS

The current study was conducted in South Western Uganda/Kigezi region, in the Districts of Kabale, Kisoro and Rukungiri, in the months of February and May 2014. These months were selected because of varying season; February being dry and May wet. Fish samples were collected in Lakes, Bunyonyi, Mutanda, Mulehe, Chahafi, Kayumbu and Nakasanda, using gill nets of varying mesh sizes (1’’, 2’’, 3’’, 3.5’’, 4’’, and 5’’), hooks, basket traps, and a mosquito seine net. Gill nets and hook were always set overnight in open waters, whereas basket traps were set in shallow water areas colonized by macrophytes. Beach seining was always done during the day. Fish samples were sorted and identified according to genus and species where possible, weighed, measured and counted. Fish identification was done using external morphological characteristics and identification keys according to [30]; [31]; [32], to mainly genus level, especially for Haplochromines and small species of Barbus. Fish species relative abundance was determined according to the number of fish species as a percentage of the total number of the fish of a given lake [33]. Fish species diversity was determined using Shannon-Weiner’s Diversity index (H') as follows:

$$H' = -\sum_{i-1}^{s} \text{pi} \ln \text{pi}$$

Where H' is the species diversity index, s is the number of species, and pi is the proportion of individuals of each species belonging to the i[th] species of the total number of individuals [34]; [35]; [36]. Because Shannon-Wiener index consists of two components, richness and evenness/equitability [36], richness was determined according to [37]; [35]. Equitability ($E_{H)}$ was determined according to, [38]; [39], from the expression;

$$E_H = \frac{H}{\ln S}$$

Where H is Shannon Diversity index, S is the number of species in the habitat (Species Richness). Shannon-Wiener’s equitability (E_H) was used to determine whether the fish population was evenly distributed among the individual species present. However, prior to fish sampling, more data regarding the fishery in the zone was obtained from interview structured questions and field observation. Structured interview questions were administered to the fisheries stakeholders in the zone. These included local government officials (especially fisheries departments), fishermen, and boat owners, among others.

3. RESULTS

The fish species community structure/composition of the minor lakes/water bodies in South Western Uganda constituted 8 species; Small species of *Barbus* (Plate 1), *Clarias carsoni*, Cray fish, Haplochromines, *Oreochromis leucostictus*, *Oreochromis niloticus*, *Clarias gariepinus* and *Tilapia zilli* (Table 1). Only three fish species; Small species of Barbus, Haplochromines and *Oreochromis niloticus*, occurred in all the lakes in the zone. On the other hand, *Tilapia Zilli*, was found only in Lake Mutanda.

Table 1. Fish species community structure/composition from Lakes in southwestern Uganda

Fish species	Lakes					
	Bunyonyi	Chahafi	Nakasanda	Kayumbu	Mulehe	Mutanda
Barbus sp.	x	x	x	x	x	x
Clarias carsoni	x	-	-	x	x	x
Cray fish	x	-	-	x	x	x
Haplochromines	x	x	x	x	x	x
Oreochromis leucostictus	x	x	x	-	x	x
Oreochromis niloticus	x	x	x	x	x	x
Clarias gariepinus	-	-	x	-	x	x
Tilapia zilli	-	-	-	-	-	x

Haplochromines were the most abundant fish in all the lakes, with Lake Mulehe having the highest abundance of 99.70% followed by Lake Bunyonyi with 98.93% and the least was Lake Nakasanda with 15.79% (Table 2). The total catch/count in numbers of Nile tilapia, the fish species considered to be of high commercial importance, compared to the rest in the zone, was found to be higher (495) in Lake Kayumbu compared to less than 60 in each of the other lakes. In a similar trend, Cray fish was found to be more abundant only in Lake Bunyonyi (0.15%) compared to Kayumbu, Mulehe and Mutanda. Cray fish was not found in Chahafi and Nakasanda (Table 2).

Table 2. Total count/catch in numbers and % relative abundance of different fish species from the minor lakes in south western Uganda.

Fish species	L.Bunyonyi		L. Chahafi		L.Nakasanda		L.Kayumbu		L.Mulehe		L.Mutanda	
	Nos.	%	Nos.	%	Nos.	%	Nos.	%	Nos.	%	Nos.	%
Barbus sp.	91	0.83	20	0.54	2	5.16	26	0.32	3	0.02	73	3.53
C.c	3	0.03	-	-	-	-	2	0.02	7	0.04	4	0.19
Cray fish	17	0.15	-	-	-	-	1	0.01	1	0.01	1	0.05
Haplo	10,881	98.93	3,620	97.84	6	15.79	7,560	93.52	18,187	99.70	1940	93.77
O.l	1	0.01	6	0.16	4	10.53	-	-	9	0.05	14	0.68
O.n	6	0.05	54	1.46	23	60.53	495	6.12	31	0.17	23	1.11
C.g	-	-	-	-	3	7.89	-	-	3	0.02	10	0.48
Tilapia zilli	-	-	-	-	-	-	-	-	-	-	4	0.19

'Dashes' represent no catches; '*C.c*' *Clarias carsoni*; 'Haplo' Haplochromines; '*O.l*' *Oreochromis leucostictus*; '*O.n' Oreochromis niloticus*; '*C.g*' *Clarias gariepinus*

The number of fish species (species richness) caught per lake varied, with Lake Mutanda contributing all the 8 species, followed by Lake Mulehe with 7 species and Lake Chahafi being the least with only 4 species (Table 2 and Figure 1). Total catch of all the fish species was found to be greater in Lake Mulehe (18,241), followed by Bunyonyi (10,999) and least by Lake Nakasanda (38) (Figure 1). Despite the fewer total count of fish species caught from Lake Nakasanda, they exhibited greater evenness and diversity than in the rest of the lakes, followed by lakes; Chahafi, Kayumbu and Mutanda in that order (Figure 1).

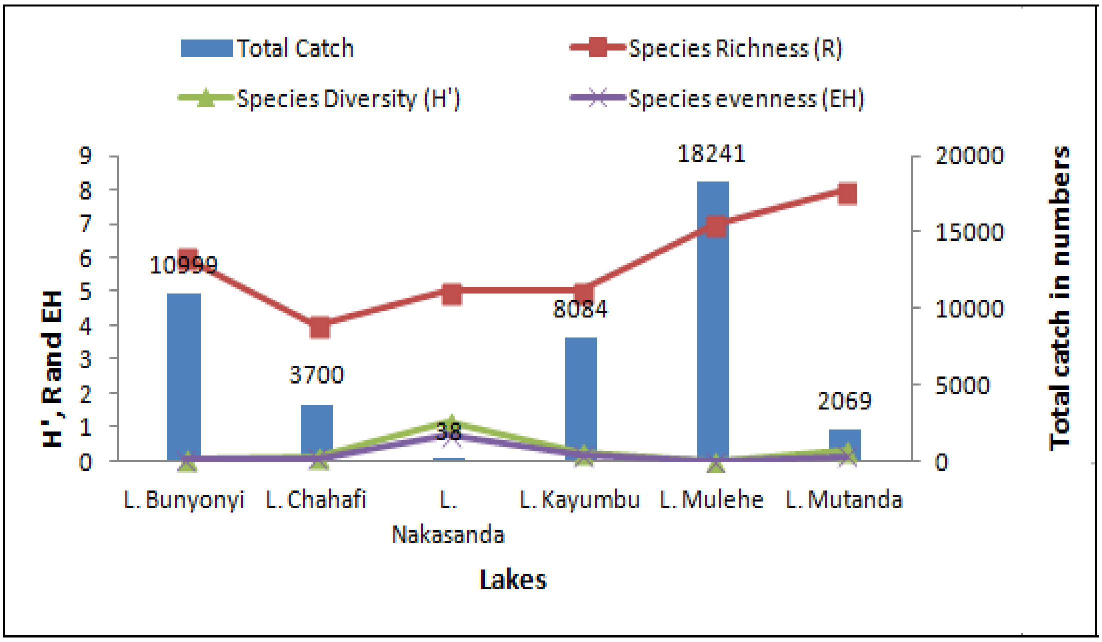

Figure 1. Fish community indices; Shannon Wiener Index (H'), Species richness (R), Species evenness (E_H), and total catch per lake

Plate 1. Small species of Barbus from South Western Uganda's minor lakes (Author's photo)

Fish restocking programmes in the natural water bodies in the region were recorded to have taken place at varying years, sources and funding (Table 3). However, it seemed that at certain intervals, the fish species stocked, numbers, year, source and funding, were unknown/unrecorded.

Table 3. Fish species restocked, numbers, year, source and funding

Lakes	Fish species restocked	Number stocked	Year of stocking	Source of seed	Funding
Bunyonyi	-	320,000	2004	-	-
	Nile tilapia	40,000	2004	-	-
	Cray fish	-	-	-	-
	Common carp	-	-	-	-
	Mirror carp	-	-	-	-
	Nile tilapia	20,000	2000	Bagena Kisoro	KDLG
	Nile tilapia	31,000	2002	Bagena Kisoro	KDLG
	Tilapia & Catfish	-	1968	-	-
	Carp	-	1968	-	-
	Black bass	-	1960	Sagana Kenya	-
Mulehe	Nile tilapia	30,000	2000	Bagena A.	NaFIRRI (NARO)
	Catfish	30,000	2002	Digo's Sun fish farm Kanjjansi	Fisheries Department MAAIF-Entebbe
	Nile tilapia	30,691	2000	Digo's Sun fish farm Kajjansi	Fisheries Department. MAAIF-Entebbe
	Catfish	75,544	2000	Digo's Sun fish farm Kajjansi	Fisheries Department MAAIF-Entebbe

	Tilapia, Catfish &Mirror carp	-	1962 &1964	-	-
Chahafi	-	18,000	2000	ARDC and Digo's Sun Fish farm Kajjansi	NaFIRRI (NARO)
Mutanda	Nile tilapia	1,233	2000	Bagena Kisoro	Fisheries Department MAAIF-Entebbe
	Nile tilapia	25,574	2002	Digo's Sun fish farm Kajjansi	Fisheries Department MAAIF-Entebbe
	Nile tilapia	25,600	2003	Ibanda	KDLG
	Nile tilapia	40,000	20004	Lweza	Eco-trust/NEMA
	Black bass	-	1967	-	-
	Cray fish	-		-	-
	Tilapia	-	2003	-	-
	Mirror carp	-	1968	-	-
Kayumbu	*Clarias carsoni*, Nile tilapia	-		-	-
	Mirror carp	-	1968	-	-
	Cray fish	-	2000	-	-
	Nile tilapia	-	2004	-	-
	Carp	-	1959	-	-
		-		-	-
	Catfish	-	2004	-	-

'Dashes' represent unknown fish species stocked, numbers, year, source and funding (Source: structured interview questions). Note that Lake Naksanda was not indicated because it did not have any records. KDLG (Kisoro District Local Government), NaFIRRI (National Fisheries Resources Research Institute), NARO (National Agricultural Research Organization), MAAIF (Ministry of Agriculture Animal Industry and Fisheries) and NEMA (National Environment Management Authority)

4. DISCUSSION

Fish productivity from lakes, rivers/streams, ponds reservoirs, oceans and estuaries vary due to; ecologically, morphologically, historical nature of formation and anthropogenic activities like dredging, filling, swamp reclamation, damming, road building, pollution and introduction of alien species [40]. It must also be realized that, even in the absence of human activities, aquatic systems may exhibit considerable variations in the abundance of individual fish species. For instance, there may be prolific spawning success in some years and in other years no spawning success or no production. Therefore, the dynamicity in the aquatic environment makes it challenging to predict the likely biological consequences of a given fishery.

In the current study only 8 fish species; *Burbus, Clarias carsonii (C.c)*, Cray fish, Haplochromines, *Oreochromis leucostictus (O.l)*, *Oreochromis niloticus (O.n)*, *Clarias gariepinus (C.g)* and *Tilapia zilli T.z)*, were observed and recorded from the highland lakes of South Western Uganda. The numbers of fish species exhibited in the current study is low and deviates from those of [28]; [41], despite similarities in species. In the catches of [28]; [41], fish species like; Lung fish (*Protopterus aethiopicus*), Mirror carp, Common carp (*Cyprinus carpio*), edible frogs (*Xenopus kigesiensis*) and red shrimps (*Caridina nilotica*) were reported. Also, Black bass (*Micropterus salmoides*), an exotic fish species introduced from Sagana, a fish culture station from Lake Naivasha (Kenya) is reported to have been restocked in the lakes [28]. The present study suggests that, there could be a steady and gradual decline in the fish species from the natural waters in the zone. The decline/collapse of the capture fisheries in the region could be attributed to many theories including, management, fish predators, water chemistry and inadequate and irregular fish restocking. During our survey and discussions from relevant stakeholders, it was revealed that fisheries law enforcement in the region is not regular and quite often, not available compared to for instance in Lake

Victoria. An explanation from this is that, because the lakes are not commercially productive, little attention is provided to them even when during allocation of resources by government. This leaves the District Fisheries Officers (DFOs) incapacitated to extend their roles/services. This scenario is further explained by [3] report which elaborated that, management of fisheries from minor lakes/water bodies are normally left to communities who endeavor continuity of their existence. This, although may sound perfect for the communities, unless enforced by the Local Government authorities, sustainability of the fishery in the minor lakes may never be evidenced for other generations as overfishing has been pointed out.

Predation pressure from numerous Otters across all the lakes was evidenced physically at the time of our fish sampling. In fact, Otters became a menace during our experimental gill net survey to the extent that zero catches would be landed, other than unrecognized skeletons. In this context, beach seine nets provided remedies for this. However, this indicated that the combined efforts of anthropogenic activities (especially overfishing) and predation from Otters may never spare the standing crops of all the fish species in the minor lakes intact and hence the gradual decline of the fish species exhibited in the present study.

The other factor that could have led to the decline of fish species in the mountainous minor lakes of the zone might be linked to limnological conditions of the lake water. South Western Uganda's minor lakes are characterized by low water temperatures (14-20^{o}C) and some lakes for instance Bunyonyi, is permanently stratified throughout the year [23]; [27]; [42]. Low water temperatures and prolonged stratification may not favor ideal growth rates and survival of tropical fish species. [23]; [27]; [42], further reported that, Lake Bunyonyi of depth 45m, is completely anoxic beyond 15 m, although [43] reported 7 m from the surface, and that at some stage when fish were stocked, massive mortalities of fish arose as a result of violent mixing of the deeper anoxic waters with the surface waters. The effects of stratification to fish are described in details by, [44]; [45]; [46]. Other unpublished theories related to the decline of fish species in the region are reported to be linked to volcanic gas emissions.

Furthermore, the other theories related to the decline of the fish species as exhibited in the current study could be attributed to inadequate and irregular restocking programmes. Some of the South Western Uganda Highland lakes, for instance Bunyonyi, were originally fishless [25]. Other lakes, Mutanda, Mulehe, Chahafi, Kayumbu and Nakasanda are poorly known to whether some fish existed originally. Although, fish originality in the herein mentioned water bodies is unknown, the fishery of these lakes seemed to have been rare. It is for this matter that, restocking programmes were initiated. Restocking programmes were commenced in 1919, with the introduction of small catfish (*Clarias carsonii*) and in 1928 other fish species like *O.n*, Haplochromines and Cary fish in Lake Bunyonyi [25]. Later in the 1930s to 1960s also introductions were made in Lakes Mutanda (*O.n*, Black bass, Carp), Mulehe, Kayumbu and Chahafi [28]; [41]. During this time, it is reported that the fishery was booming, but with Lake Mulehe reportedly more productive in the region despite Lakes Bunyonyi and Mutanda being the biggest. Later on, restocking programmes became erratic and inadequate. We therefore reckon that, the inadequacy and inconsistency in fish restocking programmes could have contributed to current decline of fish species in the lakes of South Western Uganda.

Although eight (8) species have been reported in the current study, not all of them appeared in all the lakes apart from the only three species; Barbus, Haplochromines and *O.l.* Our results differ partly from those of [41] who did not find Haplochromines in Lakes Kayumbu and Chahafi. Furthermore, in the current study, red shrimps were not landed contrary to findings as reported by [41]; [28], from Lakes Kayumbu and Chahafi. Possible explanation for the current presence of Haplochromines in the lakes could be related to restocking programmes. During the periods when restocking programmes became erratic and inadequate, many agencies were involved in supplying the fish seed. To our understanding and from various interviews with stakeholders, some Haplochromine fish species from Lake Victoria would be stocked in the lakes misidentifying them to be Nile tilapia. It is also reported that some restocking would be done at night by some agencies without the supervision from experts (personal communication from various stakeholders). The disappearance of red shrimps (*Caldina nilotica*) from Lakes Kayumbu and Chahafi in the present study could be attributed to predacious pressure that arose from Haplochromines after their introductions. The feeding nature of Haplochromines is elaborated by [47] who reported that Haplochromine fish species feed on several types of food and hence regarded as, detritivores/phytoplanktivores, zooplanktivores, insectivores, piscivores, molluscivores, paedophages, prawn-eaters, parasite-eaters and others unknown.

Haplochromines were the most abundant fish species across all the lakes in the region. The current results differ from those of [41], who got only 11% of Haplochromine catches. Our study indicated that over time, Halochromines have gradually colonized the lakes. The possible explanation for the high abundance of Haplochromines could be attributed to overfishing that has seen most fish species of commercial importance decline/dwindled. Overfishing on fish species, Nile tilapia, African catfish, Black bass and Carp, which originally contributed to commercial catches from the lakes [28] (Kamanyi *et al*, 2006), could have paved way for a rich natural food resource for the Haplochromines success. It must also be noted that, the fishery of Haplochromines in the region is not preferred by fishermen as it fetches low demand for both local consumption and market. For example, a stick of 24 fried Haplochromine pieces on market, fetched 200/= (two hundred Uganda Shillings), which is equivalent to 0.08$, despite high labour and equipment inputs. The undesired Haplochromine fishery in the zone might as well be contributing to their high abundance encountered in the present study. Although intense fishing pressure on the herein mentioned species coincided with the Haplochromine faunal abundance in the lakes, it is also possible that other aquatic environmental parameters could have contributed to the observed current Haplochromine patterns. For example, all the lakes in the current study are characterized by intense papyrus wetlands. These wetlands around the lakes might have provided refugia and protection from predators (Otters), thus contributing to their abundance. This adaptability is referred to as habitat shift in response to predator risks. Several studies in response to habitat shifts by fishes have been reported in details by [48]; [49]; [50].

Regarding to the fish species of commercial importance, total catch/count in numbers of Nile tilapia was encountered higher in Lake Kayumbu than in other lakes of the region. This suggested that Lake Kayumbu was more productive in terms Nile tilapia fishery. The higher numbers of Nile tilapia caught in Lake Kayumbu is attributed to proper managerial options at the Lake. During the current study, it was observed physically that the community around the Lake Kayumbu formed a group of people (Headed by a chairman) to oversee and regulate all activities including fishing on the lake. In addition, unlike other lakes in the region, Lake Kayumbu had an assistant fisheries officer (Mr. Mutabazi Ananias) who was responsible for providing technical guideline responding to the fishery of the Lake, for example, the size of gear (gill net) to employ on the lake. Furthermore, unlike other lakes, there was no open access to the lake. This implied that, all the fishermen from Lake Kayumbu were known and no external fishermen were allowed on the lake. It was a bit strange for the immediate and close ranged, neighbor lake (Chahafi) not to have similar fish in terms of numbers as in Kayumbu. Possible reason for this was linked to management. We were informed that, there was a lot of fish smuggling by fishermen from Rwanda. Note that, Lake Chahafi neighbors Rwanda. Besides this, the lake has open access to everyone. The results from the current study concur with those of [28] who recorded higher catches of Nile tilapia (7.4 kg) in Lake Kayumbu than in Lake Chahafi. It must be noted that management alone is not a conclusive factor on the productivity of any water body in terms of fish abundance. Best understanding of a productive water body could be outlined with the help of limnology. Therefore, a comprehensive limnological study in the region should be conducted for the proper characterization and understanding of the herein mentioned lakes.

Species richness (R) in the current study was recorded higher for Lake Mutanda (8 species) followed by Lake Mulehe (7 species) and the least in R was recorded in Lake Chahafi (4 species). The higher R in Lake Mutanda and Mulehe could be attributed to restocking regimes that took place in these lakes. [23], reported that Tilapia and *Clarias* species restocked in Mulehe and Mutanda were by both design and accident. This suggests that, in the event of accidental restocking, some other fish species not intended for stocking would as well be introduced. This is why *T.z* was probably only reported for Lake Mutanda which in fact made it more R than other lakes. Total catches for all the fish species were indicated higher in Lakes Mulehe, Bunyonyi and lower in Nakasanda. It must be realized that, these catches were dominated by Haplochromines to a greater extent, to a level that where Haplochromines were more abundant, the total catches were higher. This pattern is related to the level of Haplochromine fishery in the region. It seemed that where Haplochromine fishery was intense, total catches were minimal. Apart from Lake Nakasanda where there was no sign of Haplochromine fishery, Lake Mutanda in Kisoro is the main supplier of Haplochromine, locally called 'Ebigangari'. Since Haplochromines are the most abundant fish species in all the minor lakes and major contributor of the total catches of all the species in the current study, it is imperative that an elevated fishing effort on Haplochromine fishery might have significantly impacted of the total catches of any given lake.

Although Lake Nakasanda in Rukungiri recorded lower total catch of fish species than in other lakes, there was a more evenness and more diversity of fish species compared to the rest of the lakes in the region. Increased evenness of organisms in a given habitat is a major parameter that contributes to high species diversity. This is further emphasized by [35] who reported that Shannon index increases when species evenness of the community increases. The higher species diversity and evenness recorded from Lake Nakasanda may be linked to anthropogenic activities on the lake. Most water bodies in Uganda are public and therefore open for use. This is contrary to Lake Nakasanda, where the lake at the moment is almost owned and controlled/managed by an individual. Apart from the fewer numbers of fish species currently in lake, the proportions of the species in Nakasanda are evenly distributed and intact. Findings from Lake Nakasanda suggest that, if the lake would be adequately restocked with ideal fish species, there could be high chances of it having a sustainable and productive fishery resulting from the current proper management interventions.

5. CONCLUSION

The results presented in the current study demonstrated that, the lakes in the region are capable of a pronounced fishery. This can be through regular/consistent restocking regimes with adequate and suitable fish seed supervised by subject matter specialists. Decline in the fish species was found to be arising from a combination of many players including, poor management interventions. Haplochromine fish species are the most abundant fish species in the region. On the other hand, Lake Kayumbu was found out to be very productive in terms of fish species (Nile tilapia) of high commercial importance mainly resulting from proper management interventions. Lake Mutanda was pointed out to be having higher species richness mainly because of unrealistic restocking programmes. Lake Nakasanda in Rukungiri recorded a higher species evenness and diversity basically because of limited anthropogenic activities on the lake fishery.

Recommendations

1. Further understanding of the dynamics of the fish species in the region should be done by conducting limnological studies.

2. Measures should be devised by combined efforts of local communities and local governments to align sustainable management options of the aquatic resources in the region. In this context, solutions for the predators (Otters) should as well be spelled out

3. High Haplochromine abundance in the lakes should be harvested and utilized for providing feeds to aquaculture

4. Regular and adequate restocking programmes with suitable fish seed should be revisited to enhance capture fisheries in the region

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