Surveys of Great Crested Grebes Podiceps cristatus and Other Waterbirds on the Kasenda Cluster of Crater Lakes in Western Uganda

Authors: Derek Pomeroy, and Nathaniel E. Seavy

Source: Journal of East African Natural History, 92(1) : 49-62
Published By: Nature Kenya/East African Natural History Society
URL: https://doi.org/10.2982/0012-8317(2003)92[49:SOGCGP]2.0.CO;2

Journal of East African Natural History **92:** 49–62 (2003)

SURVEYS OF GREAT CRESTED GREBES *PODICEPS CRISTATUS* AND OTHER WATERBIRDS ON THE KASENDA CLUSTER OF CRATER LAKES IN WESTERN UGANDA

Derek Pomeroy
Makerere University Institute of Environment & Natural Resources
P.O. Box 7298, Kampala, Uganda
derek@imul.com

Nathaniel E. Seavy
Department of Zoology, University of Florida
223 Bartram Hall, Gainesville, FL 32611-8525, U.S.A.
nseavy@zoo.ufl.edu

ABSTRACT

The african subspecies of the Great Crested Grebe *Podiceps cristatus infuscatus* is limited to scattered populations in eastern and southern Africa. To evaluate their status in the Kasenda cluster of crater lakes in western Uganda in 2000, we visited 28 crater lakes, which include the only known sites for the species in Uganda. At each lake, we counted all waterbirds and recorded data on forest conditions of the crater walls and fishing activities. Deforestation of crater rims was severe; more than half of the craters had lost at least three quarters of their forest cover. Gill net fishing was observed at six of the lakes. Great Crested Grebes were observed at only one lake, although records from the 1990s document them on four other crater lakes in the area. These records include breeding on Lake Kyerabwato, inside Kibale National Park, in 1998. Given the small size of this isolated population, the future of great crested grebes in Uganda is highly uncertain. We recorded 30 waterbird species on these lakes; in addition to Great Crested Grebes, other species of conservation interest included White-Backed Duck *Thalassornis leuconotus* and Giant Kingfisher *Ceryle maxima*.

INTRODUCTION

Groups of small water bodies can, collectively, have as much conservation value as some individual larger ones (Pomeroy & Tengecho, 1982, Froneman *et al.,* 2001). In western Uganda, two such groups are of note: the alkaline crater lakes (Melack, 1976, Pomeroy *et al.,* 2003) in the Queen Elizabeth Conservation Area and the Kasenda cluster (Melack, 1976) of freshwater lakes in the neighbourhood of Fort Portal. The latter, which are the subject of this paper, also support what is believed to be the last population of Great Crested Grebes *Podiceps cristatus* in Uganda.

Three races of Great Crested Grebes are recognized (del Hoyo *et al.,* 1992). Of these,

P.c. infuscatus has a scattered distribution from southern Africa to the highlands of eastern Africa (Brown *et al.,* 1982; del Hoyo *et al.,* 1992). Although not threatened in southern Africa (Harrison *et al.,* 1997), in East Africa it is regionally-listed as critically endangered (Bennun & Njoroge, 1996) and is declining in Kenya (Bennun, 1993), Tanzania (Dodman & Rose, 2000), and Uganda (Carswell *et al.,* in press). This decline may lead to the local extinction of the subspecies; in Kenya there were no breeding records between 1979–1992 and the Kenyan population was thought to total less than 50 individuals in 1995 (Zimmerman *et al.,* 1996). In Uganda, the status of the Great Crested Grebe appears equally precarious. Historically, they were found on a number of lakes in the South-west, including the Kasenda cluster of crater lakes at the foot hills of the Rwenzori Mountains (Carswell *et al.,* in press.). In recent years, observations of Great Crested Grebes in the Kasenda cluster have been infrequent and there has been no systematic survey to determine their abundance. There are no recent records from elsewhere in the country (Carswell *et al.,* in press).

Here, we present results of waterbird surveys at 28 of the 37 crater lakes in the Kasenda cluster of western Uganda and describe current habitat conditions and the waterbird communities that these lakes support. Based on these data and historical records from visits to the lakes by a number of observers during the 1990s, we evaluate the present status of Great Crested Grebes in Uganda. Finally, we comment on fishing activity, deforestation, and other factors that may affect the conservation of Great Crested Grebes and other waterbirds in the Kasenda cluster.

STUDY AREA

The Kasenda cluster of crater lakes (0°23'–0°33'N, 30°10'–30°20'E; figure 1) is in western Uganda, approximately 20–30 km south of Fort Portal (Melack, 1976). The area is characterized by rolling hills, part of the extensive Precambrian basement complex (Government of Uganda, 1967), through which the explosion craters were blown about 11,000 years ago (Osmaston, 1996). Elevation ranges from ca. 1,100 m in the South to 1,400 m asl in the North. Although historically forested, much of the land is now used for subsistence farming, banana fields, and tea plantations that support the growing human population. Within this agricultural landscape forest fragments remain, especially on steep slopes of the volcanic craters, but the only extensive forested area is within the 766 km^2 Kibale National Park (KNP). Yearly rainfall, measured at the Makerere University Biological Field Station in KNP, averaged 1,750 mm between 1990 and 1999 (C. Chapman & L. Chapman, unpubl. data); peak periods of rainfall occur in April and October (Struhsaker, 1997).

The lakes are typically inside crater kettles with very steep walls, most of which were originally forested. The surface area of these lakes is generally less than 50 ha, and some are as small as a few hectares. Published surface areas for six of the lakes (Melack, 1976, Chapman *et al.*, 1998) range from 3 ha (Nkuruba) to 48 ha (Mwamba), the average being 23 ha. Although some are shallow (5–15 m), most of the lakes, even the small ones, are more than 30 m deep. Published maximum depths for six lakes (Melack, 1976, Chapman *et al.*, 1998) average 58 m, but range from about 4 m (Kifuruka) to 146 m (Katanda). Shallow lakes may have large areas of aquatic macrophytes, including *Nymphaea* spp., *Ceratophyllum* spp., and *Potamogeton* spp. (Kizito *et al.*, 1993). In very shallow lakes this vegetation can cover the water surface (*e.g.* Lake Kifuruka), but generally it is limited to lake margins. Many of the deeper lakes are bounded by walls that descend vertically into the water, leaving no

substrate for littoral vegetation to grow (Kizito *et al*., 1993). This cluster of lakes has a few native fishes (*e.g*. *Barbus neumayeri*), as well as a number of introduced species (*Oreochromis niloticus*, *O. leucostictus*, *Tilapia zilli*).

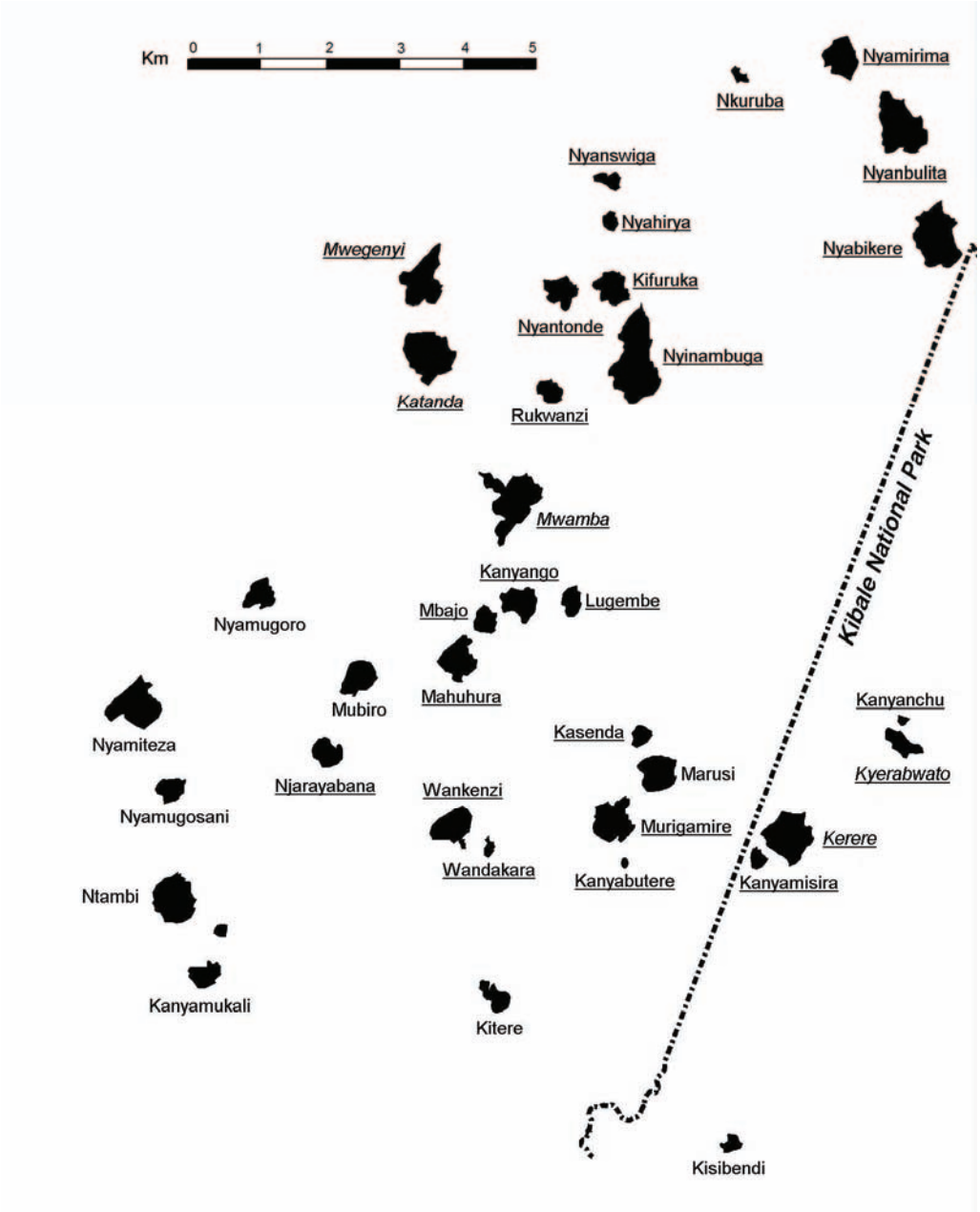

Figure 1. Map of the Kasenda cluster of crater lakes in western Uganda (30°10'–30°20'E, 0°23'–0°33'N). Those underlined were included in the 2000 survey, whilst italicised names are of lakes from which Great Crested Grebes have been recorded.

METHODS

Opportunistic observations were made on several of the crater lakes during the 1990s, by DP and others. A systematic survey was conducted between May and August of 2000, when NES visited 28 of the lakes in the Kasenda cluster. Forest conditions of the crater and fishing activity were recorded for each lake. Forest disturbance was rated as minimal (50–100% of area still forested), moderate (25–50% forest), severe (only small forest patches or scattered trees remaining), or complete (no forest trees). Fishing activity was recorded in terms of the presence or absence of gill nets, either in the lake or on the lake shore. However, because fishermen with nets rotate among lakes, this is at best a crude estimate of fishing pressure. All waterbirds on or around the lake were counted by scanning from the crater rim with 10x40 binoculars and, in some cases, a telescope with magnification to x60. Most surveys lasted between 0.5 and 1.5 hours depending on the size of the lake.

Previous studies of these lakes (Melack, 1976, Kizito *et al.*, 1993) have used alternative spellings for some lake names. This problem is exacerbated by the fact that several of the lakes are either unnamed on topographical maps, or have different names used by local people. We have adhered to spellings used on the topographic maps and have assigned local names to seven lakes that are unnamed on these maps (table 1, figure 1). However, the names, and their spellings, should be considered tentative.

RESULTS

Condition of the lakes

The land around many of the crater lakes has remained forested longer than the surrounding landscape because their steep slopes make them difficult to clear. However, with human populations increasing, even these steep slopes are now being used for farming. Of the 28 lakes, only five (18%) were minimally deforested (table 1), still retaining 50–100% of forest on the crater walls. Three of these five craters were small, thus the absolute area of remaining forest is limited. Moderate deforestation had occurred around six lakes (21%), with only 25–50% of the forest remaining. Deforestation around most of the lakes was either severe (ten lakes, 36%), with only scattered trees or small patches of forest remaining, or for the remaining 5 lakes (18%), complete.

Gill net fishing was recorded at six of the 28 lakes we visited (21%; table 1). Generally, these nets were at least 100 m in length and had a large mesh-size that could potentially entangle diving birds, such as Great Crested Grebes. In some cases only a single net was set, but in others we observed five or six nets at a single lake, often stretching entirely across it. At some lakes (*e.g.* Nyabikere) there is an established fishery and nets are set daily. More commonly, the lakes are probably fished periodically, with nets being moved from lake to lake over the course of the year. Thus, although not all of the lakes are fished with nets simultaneously, it is doubtful if any, with the exception of Lake Nkuruba, are entirely free of gill net activity.

Great Crested Grebes

Great Crested Grebes were observed at only one of the 28 crater lakes we surveyed during 2000 (table 2). This lake, Kerere, is at the southern end of the Kasenda cluster and lies just inside the boundary of Kibale National Park (figure 1). On the 2 August 2000, NES visited this lake with KNP research and monitoring personnel. There were five Great Crested

Table 1. Crater lake names used in this study, in previous publications and maps, and by local people, together with the condition of those visited in 2000.

This study	NBS map	Kizito et al. 1993	Melack 1976	Topo map	Local Name	Deforestation	Gill-net fishing
Kanyabutere[a]	not on map	na	na	unnamed	same	complete	no
Kanyamisira[a,b]	unnamed	na	na	unnamed	same	minimal	no
Kanyamukali	Kanyamukaki	na	Kanyamukali	Kanyamukali	same	-	-
Kanyanchu[a,b]	unnamed	na	na	unnamed	same	minimal	no
Kanyango	Kanyango	na	Kanyango	Kanyango	same	moderate	no
Kasenda	Kasenda	na	Kasenda	Kasenda	same	severe	no
Katanda	Katanda	*Katonda*	Katanda	Katanda	same	moderate	no
Kerere	Kerere	na	Kerere	Kerere	same	minimal	no
Kifuruka	unnamed	Kifuruka	Kifuruka	Kifuruka	same	moderate	no
Kisibendi[b]	Kisibendi	na	Kisibendi	Kisibendi	same	-	-
Kitere[b]	unnamed	na	Kitere	Kitere	same	-	-
Kyerbwato[a.b]	unnamed	na	unnamed	unnamed	same	minimal	no
Lugembe	Lugembe	Lugembe	Lugembe	Lugembe	same	severe	no
Mahuhura	*Muhuhura*	na	Mahuhura	Mahuhura	Rwenjubu (?)	complete	no
Marusi	*Murusi*	na	*Murusi*	Marusi	same	moderate	no
Mbajo	unnamed	na	Mbajo	Mbajo	same	severe	no
Mubiro	Mubiro	na	Mubiro	Mubiro	same	-	-
Murigamire	Murigamire	na	Murigamire	Murigamire	same	complete	yes
Mwamba	Mwamba	na	Mwamba	Mwamba	same	severe	yes
Mwegenyi	Mwegenyi	Mwegenyi	*Mwengenyi*	Mwegenyi	same	severe	no
Njarayabana	unnamed	na	Njarayabana	Njarayabana	same	complete	no
Nkuruba	unnamed	Nkuruba	Nkuruba	Nkuruba	same	minimal	no
Ntambi	Ntambi	na	Ntambi	Ntambi	same	-	-
Nyabikere	Nyabikere	na	Nyabikere	Nyabikere	same	moderate	yes
Nyahirya[a]	unnamed	Nyahirya	Nyahirya	unnamed	same	severe	no
Nyamirima	not on map	na	Nyamirima	Nyamirima	same	moderate	no
Nyamiteza	Nyamiteza	na	Nyamiteza	Nyamiteza	same	-	-
Nyamugoro	Nyamugoro	na	Nyamugoro	Nyamugoro	same	-	-
Nyamugosani	Nyamugosani	na	Nyamugosani	Nyamugosani	same	-	-
Nyanabulita	unnamed	na	Nyanbulita	Nyanbulita	same	severe	no
Nyanswiga[a]	unnamed	Nyanswiga	Nyanswiga	unnamed	same	moderate	no
Nyantonde	unnamed	*Nyantonda*	*Nyantonda*	Nyantonde	same	minimal	yes
Nyinambuga	Nyinambuga	na	Nyinambuga	Nyinambuga	same	severe	no
Rukwanzi	unnamed	Rukwanzi	Rukwanzi	Rukwanzi	same	severe	no
Wandakara[a]	unnamed	na	unnamed	unnamed	same	complete	yes
Wankenzi	Wankenzi	na	Wankenzi	Wankenzi	same	severe	yes

Notes: a=previously unnamed lakes to which we have assigned names for the purpose of this study. b=craters within Kibale National Park

Grebes, all adults in breeding plumage. We saw no sign of juveniles, nor any signs of nesting. Four birds were using the south end of the lake, which has a narrow littoral zone, with aquatic vegetation that would probably provide a suitable nesting substrate. The fifth bird was on the north-west side of the lake, in front of another area of shoreline with a substantial amount of littoral vegetation. We did not observe any social interactions among the birds, although the four at the south end of the lake were often close to each other.

There are 12 historical records of Great Crested Grebes from the Fort Portal area in western Uganda (table 2). All but one of the observations has occurred at lakes in the Kasenda cluster, the exception being a record from Lake Saka. During 1997 and 1998 NES visited this lake monthly, but never observed Great Crested Grebes. Thus, their occurrence there was probably incidental, and is unlikely to reflect an important site for the species.

Table 2. Summary of all known records of Great Crested Grebes on the Kasenda cluster of crater lakes.

	1991	1995	1996					1998		1992	2000
	03 Mar	19 Oct	03 Dec	21 Jan	24 Mar	10 Aug	17 Aug	24 Jan	27 Apr	17 Aug	02 Aug
Katanda	9	16	10	11			8			1	
Kerere								2			5
Kyebwato									5		
Mwamba					2						
Mwegenyi	5										
Saka						2					

Note that Saka is north of Fort Portal. Data kindly provided by K.D. Dijksta, Thomas, Kuske Frank Walsh and the authors.

In contrast, several lakes in the Kasenda cluster have been used repeatedly during the 1990s. Katanda is the lake with the most records: six, in January, March, August, October, and December. As many as 16 individuals have been seen at one time on this lake (table 2). This species has also occurred more than once on Lake Kerere, but in smaller numbers (only two and five individuals). The only breeding record is from Lake Kyerabwato, where a pair with a young juvenile was observed on 27 April 1998 (NES). This lake is adjacent to Lake Kerere (figure 1), and it is likely that birds move back and forth between these lakes on a regular basis. There is one record of grebes in flight: on 3 December 1995, four took off from Lake Katanda, and circled to a considerable height before disappearing towards the South. Local movements also occur in Kenya (Zimmerman *et al.*, 1996) but there is no evidence of seasonal migrations.

The lakes used by Great Crested Grebes have some common characteristics. All are of medium or large size, none being of less than 6 ha (figure 1); there are no records from any of the small lakes, even those immediately adjacent to larger lakes that are frequently used. They also tend to have either minimal (Kerere, Kyerabwato) or moderate (Katanda) deforestation of the crater walls. The only grebe lake with greater deforestation (severe) was Mwamba. Limnological characteristics of the lakes are diverse (Melack, 1976, Kizito *et al.,* 1993). Both Kerere and Katanda have relatively clear, blue water, indicating that they are not highly productive, whereas Mwamba and Kyerabwato have greenish, murky water, suggesting higher productivity. These observations are supported by secchi disc measurements (depth at which a black and white disc is no longer visible from the surface) reported by Melack (1976): 420 cm in Lake Katanda, but only 105 cm in Lake Mwamba. Additionally, Mwamba and Kyerabwato have more littoral vegetation than either Kerere or Katanda.

Other birds of the crater lakes

Twenty-four species of waterbirds were recorded in the 2000 surveys of the Kasenda cluster lakes (table 3) and an additional six have been recorded on previous visits to these lakes (table 4). Eight additional species have been recorded at Lake Saka (table 4), which belongs to another small group of craters north of Fort Portal. Counts at Lake Saka recorded several species of waterfowl that were not observed in the Kasenda cluster and a large flock of Grey-crowned Cranes. Thus, a total of 38 species have been recorded on crater lakes in the Fort Portal region (*i.e.* Kasenda cluster plus Lake Saka). The Little Grebe and Green-backed Heron were the most widespread species, the former being particularly numerous, as was the Yellow-billed Duck (tables 3 and 4).

Twenty-four of the 31 species are considered to be specialist waterbirds, and a further three are non-specialists. The remaining four species are all characteristic of crater habitats; for example, Palm-nut Vultures and Woodland Kingfishers are not generally considered waterbirds, but in the Fort Portal region they are more or less confined to the immediate area around the crater lakes.

None of the waterbirds that occur on the Kasenda cluster of lakes is globally-listed as a Red Data species, *i.e.*, threatened with extinction (Birdlife International, 2000)). However, seven are regionally listed (table 4), including the critically endangered Great Crested Grebe and the vulnerable White-backed Duck. The latter was once not uncommon in Uganda, but apart from Lake Kifuruka, records in Uganda between 1991 and 2000 are from only three other localities (Carswell *et al.*, in press), and the record of 22 birds in 1997 makes this easily the most important site for this species in western Uganda (Carswell *et al.*, in press).

DISCUSSION

Despite declining populations throughout East Africa, Great Crested Grebes have not yet vanished from the crater lakes of western Uganda. They bred successfully as recently as 1998, when a pair was observed with a juvenile, but of the 12 observations noted in table 4, this was the only occasion with any sign of breeding activity. In 2000, we located only five individuals on one lake. The largest number observed recently was a group of 16 in 1995 (table 2). Thus, it seems unlikely that there can be many more than a dozen individuals remaining in the region.

A recent decline of Great Crested Grebes in Germany has been linked to a reduction in the reed beds where they nest (Marxmeier & Duttmann 2002). However, in East Africa, the decline of this species has been linked to entanglement in gill nets (Bennun, 1993; Brown *et al.*, 1982; Zimmerman *et al.*, 1996). We observed gill nets in use at several lakes, and suspect that they are used to fish most (if not all) of the lakes at some time during the year. These nets may pose a threat to other diving birds. It is interesting to note that we did not observe the Darter (*Anhinga rufa*) during the 2000 surveys, despite the fact that the species has been recorded previously in the area. In the Kenyan highlands, Darters have declined drastically since the 1980s. Although this decline is poorly understood, gill nets and pesticides have been suggested as likely causes (Zimmerman *et al.,* 1996). Gill nets may explain the absence of Darters as well as the decline of Great Crested Grebes. The regionally threatened White-backed Duck may also be at risk, since it dives when feeding. But since evidence implicating gill nets in the decline of Great Crested Grebes is circumstantial, alternative hypotheses merit consideration. One notable change in some crater lakes of western Uganda is eutrophication, an increase in lake productivity. This has been associated,

Table 3. Waterbird survey results from 28 crater lakes in Western Uganda. Species names are in accordance with Carsewell et al. *(in press).*

Crater Lake	Total Individuals	Total Species	Little Grebe *Tachybaptus ruficollis*	Great Crested Grebe *Podiceps cristatus*	Great Cormorant *Phalacrocorax carbo*	Long-tailed Cormorant *P. africanus*	Pink-backed Pelican *Pelecanus rufescens*	Squacco Heron *Ardea (Ardeola?) ralloides*	Cattle Egret *Bubulcus ibis*	Green-backed Heron *Butorides striatus*	Little Egret *Egretta garzetta*	Grey Heron *Ardea cinera*	Hamerkop *Scopus umbretta*	Open-billed Stork *Anastomus lamelligerus*	Hadada Ibis *Bostrychia hagedash*	Sacred Ibis *Threskiornis aethiopicus*	Yellow-billed Duck *Anas undulata*	Fish Eagle *Haliaeetus vocifer*	Palm-Nut Vulture *Gypohierax angolensis*	Common Moorhen *Galinula chloropus*	Grey-crowned Crane *Balearica regulorum*	Jacana *Actophilornis africanus*	Woodland Kingfisher *Halcyon senegalensis*	Malachite Kingfisher *Alcedo cristata*	Giant Kingfisher *Megaceryle maxima*	Pied Kingfisher *Ceryle rudis*
Kanyabutere	2	1	2																							
Kanyamisira	18	5	4												2		10			1					1	
Kanyanchu	10	4	1							2							4						3			
Kanyango	5	4									1		1												1	2
Kasenda	8	6						1		2			2						1				1	1		
Katanda	31	11	2		2	2			7	1			2					3	9				1	1	1	
Kerere	20	5	10	5						1												3	1			
Kifuruka	58	9	4			2				1							42		1	3	2	2	1			
Kyerbwato	26	11	1			1				3			4				6	1	3			3	2		1	1
Lugembe	15	6	2										1				7		1				2			2
Mahuhura	13	5	6		2													1	1							3
Marusi	13	4	8					1									2									2
Mbajo	6	5								1									1			1	1			2
Murigarime	5	3													2			1					2			
Mwamba	12	7	1								1			2	2		2	3								1
Mwegenyi	16	9	4				1			1			1				2	1	1		4					1
Njarayabana	14	4	1				1		1					11												
Nkuruba	11	6	2							2			2									1		3	1	
Nyabikere	21	9	1				2		9					1			2		2				1		1	2
Nyahyri	5	4											1						1				2		1	
Nyamirima	12	6	4		3					1		1	2										1			
Nyanswiga	5	5								1			1										1	1	1	
Nyantonde	4	2																					3	1		
Nyinabulita	21	9	3				1			1							8		2			2	1	1		2
Nyinambuga	16	8	3		2												2	2	2				2		1	2
Rukwanzi	6	4	3		1					1														1		

Crater Lake	Total Individuals	Total Species	Little Grebe *Tachybaptus ruficollis*	Great Crested Grebe *Podiceps cristatus*	Great Cormorant *Phalacrocorax carbo*	Long-tailed Cormorant *P. africanus*	Pink-backed Pelican *Pelecanus rufescens*	Squacco Heron *Ardea (Ardeola?) ralloides*	Cattle Egret *Bubulcus ibis*	Green-backed Heron *Butorides striatus*	Little Egret *Egretta garzetta*	Grey Heron *Ardea cinera*	Hamerkop *Scopus umbretta*	Open-billed Stork *Anastomus lamelligerus*	Hadada Ibis *Bostrychia hagedash*	Sacred Ibis *Threskiornis aethiopicus*	Yellow-billed Duck *Anas undulata*	Fish Eagle *Haliaeetus vocifer*	Palm-Nut Vulture *Gypohierax angolensis*	Common Moorhen *Galinula chloropus*	Grey-crowned Crane *Balearica regulorum*	Jacana *Actophilornis africanus*	Woodland Kingfisher *Halcyon senegalensis*	Malachite Kingfisher *Alcedo cristata*	Giant Kingfisher *Megaceryle maxima*	Pied Kingfisher *Ceryle rudis*
Wakenzi	10	5								1			4			2		1				2				
Wandakara	2	2								1																1
No. of lakes present	na	na	19	1	5	3	4	2	3	15	2	1	11	3	3	1	11	8	12	2	2	7	16	7	9	12
Total individuals	na	na	62	5	10	5	5	2	17	20	2	1	21	14	6	2	87	13	25	4	6	14	25	9	9	21

Table 4. Maximum numbers of waterbirds recorded on the six most frequently-visited lakes between 1992 and 2000.

	Waterbird category[b]	Conservation status[c]	Katanda	Kifuruka	Mwegenyi	Nyantonde	Nyinambuga	Saka[d]
Number of visits			7	11	6	6	5	7
Little Grebe	W		10	10	4[s]	1	3[s]	3
Great Crested Grebe	W	R-CR	16					
Greater Cormorant	W		2				3	
Long-tailed Cormorant	W		2[s]	5	5		2	1
Pink-backed Pelican	W				3			4
Night Heron[a]	W					2		
Squacco Heron	W			3				1
Cattle Egret			20	1	7		9	1
Green-backed Heron	W	R-NT	1[s]	2	3	2		
Little Egret	W		8	2	2			
Purple Heron[a]	W	R-NT		1				
Grey Heron	W	R-NT		2				1
Black-headed Heron[a]	w			1				2
Hamerkop	w		2[s]	1	1[s]	1		1
Open-billed Stork	w							4
Abdim's Stork[a]								30
Hadada	w							3
Egyptian Goose[a]	W							1
Knob-billed Duck[a]	W							11
White-backed Duck[a]	W	R-VU		22				
Yellow-billed Duck	W			60	2[s]		2[s]	8
Hottentot Teal[a]	W			1				
Osprey[a]	W			1				
Fish Eagle	W		3[s]	2	1[s]		2[s]	1
Palm-nut Vulture			9[s]	2	2		2[s]	4
Black Crake[a]	W			1				
Common Moorthen	W			7				
Grey-Crowned Crane	W	R-NT		3	4[s]			56
Jacana	W			7	2			
Wattled Plover[a]	W							2
Wood Sandpiper[a]	W			1				
Grey-headed Gull[a]	W							1
White-winged Black Tern[a]	W			1				2
Woodland Kingfisher			1	1		3	1	1
Malachite Kingfisher	W		1[s]	1		1[s]	1	
Giant Kingfisher	W	R-NT	1[s]	1			1[s]	
Pied Kingfisher	W			4	4	2	2[s]	8
TOTAL species			13	26	13	7	11	22

Notes: a Scientific names of species not listed in table 2: Night Heron *Nycticorax nycticorax,* Purple Heron *Ardea purpurea*, Black-headed Heron *Ardea melanocephala,* Abdim's Stork *Ciconia abdimii*, Egyptian Goose *Alopochen aegyptiacus,* Knob-billed Duck *Sarkidiornis melanotos,* White-backed Duck *Thalassornis leuconotus*, Hottentot Teal *Anas hottentota*, Osprey *Pandion haliaetus,* Black Crake *Amaurornis flavirostris*, Wattled Plover *Vanellus senegallus,* Wood Sandpiper *Tringa glareola,* Grey-headed Gull *Larus cirrocephalus,* and White-winged Black Tern *Chlidonias leucopterus*.

b as categorised by Wilson (1995): W = specialist species, w = non-specialist, often found near water

c Bennun & Njoroge (1996)

d Data from seven counts between July 1997 and April 1998; see text.

s Records from the 2000 survey

at least in part, with conversion of forested crater rims into agricultural land and the associated increase in the runoff of inorganic matter and nutrients. Such conversion may have increased input of inorganic matter and nutrients into the lakes leading to greater productivity and reduced clarity. Such "cultural eutrophication" has been documented at Lake Saka (Crisman *et al*., 2002) as well as crater lakes in Ethiopia (Zinabu, 1994).

Eutrophication may affect grebes by reducing water clarity. If grebes rely on visual detection of prey, then this change may decrease foraging efficiency. Within the last 50 years tilapia have been introduced to many, if not all, of the lakes in the Kasenda Cluster (L.J. Chapman, pers. com.). These introductions may have increased food availability for Great Crested Grebes, especially in lakes without native fish. However, if the introductions have also contributed to eutrophication, then the decrease in water clarity could counteract beneficial aspects of increased food availability. In addition, major kills have been reported in some crater lakes in the region, presumably associated with partial rising and mixing of deep, anoxic water to the surface (Beadle, 1966, 1981; Chapman & Chapman, unpubl. data). In Lake Bunyonyi, a volcanic barrier lake in Uganda, there was a serious fish kill in 1964 associated with partial mixing after which the commercial fishery (based on stocked species) was abandoned (Beadle, 1981). Such die-offs may have severe effects on food availability for grebes and potentially reproduction, as has been the case in some lakes in Europe (J. Fjeldså, pers. com.). Clearly, the impacts of these activities on Great Crested Grebes, and the potential of interactions between increased food availability and decreased water clarity are difficult to evaluate, but will be useful areas for future study.

MANAGEMENT RECOMMENDATIONS

Because two of the lakes (Kerere and Kyerbwato) where Great Crested Grebes have occurred are within Kibale National Park, there is a unique opportunity for the management, conservation, and monitoring of this species. Of the remaining lakes, the two most important are Katanda (also for grebes) and Kifuruka (for its rich diversity of waterbirds). The possibilities of management agreements with the users of these lakes would be well worth investigating. Although fish are an important resource for communities around crater lakes, community sponsored management plans that prohibit fishing are not unprecedented. Since 1993, Lake Nkuruba has been collaboratively managed for eco-tourism by the local community with input and assistance from the Catholic Church, Makerere University Biological Field Station and the University of Florida. Part of this plan has been the exclusion of gill nets from the lake. This management has provided tangible benefits for local people as well as preserving the natural resources of the lake and its surrounding forest. Pursuing this model of management and conservation at other lakes in the Kasenda cluster could help protect Great Crested Grebes and other waterbirds.

Assuming that the grebes are declining, and that gill nets may be at least partially responsible for this, we suggest the following guidelines for the management of lakes that are used by Great Crested Grebes:

1) **Great Crested Grebes should be protected from disturbance during the nesting season**. Like other grebes, this species builds floating nests in the littoral vegetation at the edge of lakes. The risk of failure may be greatly increased if people disturb the nests either from the shore, or in boats. Although we do not have enough information to narrowly define the breeding season, the most vulnerable period is likely to be between March and June.

2) **Use of gill nets on lakes used by Great Crested Grebes should be restricted**. Although entanglement by Great Crested Grebes has not been directly demonstrated to cause mortality in western Uganda, the evidence from other regions of Africa, and for diving birds in general (Evans & Nettleship, 1985), suggests that this may be a significant cause. Limiting the use of gill nets on lakes where Great Crested Grebes commonly occur has the potential to reduce mortality. This measure may be especially important when young birds are learning to forage for themselves. It may also protect the three other diving birds that occur on the crater lakes: Little Grebes, Great Cormorants, and Long-tailed Cormorants. Alternatively, other steps to reduce the likelihood of bird entanglement in nets (*e.g.* limiting the time of day when nets are used) might also be effective (Melvin *et al.*, 1999) if they could be implemented. Nets with smaller mesh sizes are less likely to catch birds, although they may be discouraged as promoting over-fishing.

Although these steps will help to protect grebes, the conservation of the waterbird community of the Kasenda crater lakes may require additional management and protection. Many of the uncommon bird species found on the lakes (such as Giant Kingfishers and Green-backed Herons) are characteristic of wetland habitats that are surrounded by forest. Unfortunately, the remnant forests around the crater lakes are rapidly disappearing; of the 28 lakes we visited, more than half were severely or completely deforested (table 1). This process may be occurring rapidly: of 20 forest fragments surveyed in 1995, 19% had been cleared when they were resurveyed in 2000 (Chapman *et al.*, 2003). At this rate, these authors projected that all existing fragments would be cleared in less than 30 years. The importance of remaining forests adjacent to these crater lakes should be considered in any discussions of regional conservation and land use planning.

RESEARCH PRIORITIES

Understanding the population status of Great Crested Grebes in western Uganda is difficult because we lack even the most basic information on their breeding biology and life history. If this population is really as small as it appears (fewer than a dozen birds) and is isolated from other populations, there may be little hope for their persistence in the region. If, however, there are larger numbers of individuals, or occasional immigration from other populations, then the outlook may be better. To define the status of Great Crested Grebes in western Uganda more accurately, there are three critical questions that need to be answered. First, we must know how many grebes there are and whether or not this number fluctuates during the year. This requires all of the lakes to be checked, including those not visited in 2000 and especially the known ‘grebe lakes’ (table 2). This will not be easy, since some of the lakes are remote from roads. Second, we must know when they breed and how many young are produced. Finally, if there are significant causes of mortality, such as entanglement in gill nets, these threats must be identified. It should then be possible to consider management actions, one of which might be to make the fishermen aware of the rarity of this bird.

ACKNOWLEDGEMENTS

Numerous people have participated in previous surveys of these lakes, including E. Aliganyiri,

C. Apodaca, K. Dijkstra, A. Ermosi, T. Kuske, T. Lawrence, J. Mugenyi, J. Paul, A. Randle, A. Tinkansimire, and F. Walsh. O. Moses and O. George (KNP Research and Monitoring Wardens) participated in the 2000 surveys and helped arrange visits to crater lakes inside KNP. We also thank the staff of Makerere University Biological Field Station and C. and L. Chapman for providing logistical support in Kibale National Park. Financial support was provided by Nature Uganda, a University of Florida Center for African Studies Environmental Conservation Science in Uganda Small Grant, and a University of Florida Grinter Fellowship. We thank Drs Julius Arinaitwe, Colin Chapman and Lincoln Fishpool for kindly commenting on the manuscript.

REFERENCES

Beadle, L.C. (1966). Prolonged stratification and deoxygenation in tropical lakes. I. Crater Lake Nkugute, Uganda, compared with Lakes Bunyonyi and Edward. *Limnology and Oceanography* **11**: 152–163.

Beadle, L.C. (1981). *The Inland Waters of Tropical Africa: An Introduction to Tropical Limnology*. Longman, New York.

Bennun, L. (1993). Threatened birds of Kenya. 3. Great Crested Grebe. *Kenya Birds* **2**: 35–36.

Bennun, L. & P. Njoroge (eds) (1996). Birds to watch in East Africa: a preliminary Red Data list. *Research Reports of the Centre for Biodiversity, National Museums of Kenya*: *Ornithology* **23**: 1–16.

BirdLife International (2000). *Threatened Birds of the World*. Lynx Edicions, Barcelona.

Brown, L.H., E.K., Urban & K. Newman (1982). *The Birds of Africa*. Vol. 1. Academic Press, London.

Carswell, M., D.E. Pomeroy, J. Reynolds & H. Tushabe. (in press). *The Bird Atlas of Uganda*. British Ornithologists' Club, London.

Chapman, C.A., M.J. Lawes, L. Naughton-Treves & T.R. Gillespie (2003). Primate survival in community-owned forest fragments: are metapopulation models useful amidst intensive use? In: L.K. Marsh (ed.). *Primates in Fragments: Ecology and Conservation*. Kluwer Academic/Plenum Publishers, New York. Pp 63–78.

Chapman, L.J., C.A. Chapman, T.L. Crisman & F.G. Nordlie (1998). Dissolved oxygen and thermal regimes of a Ugandan crater lake. *Hydrobiologia* **385**: 201–211.

Crisman, T.L., L.J. Chapman, C.A. Chapman & J. Prenger (2002). Cultural eutrophication of a Ugandan highland crater lake: a twenty-five year comparison of limnological parameters. *International Association of Theoretical and Applied Limnology* **27**: 3574–3578.

Del Hoyo, J., A. Elliot & J. Sargatal (eds) (1992). *Handbook of the Birds of the World*. Vol. 1. Lynx Edicions, Barcelona.

Dodman, T. & P. Rose (2000). Distribution and abundance of African waterfowl: examples from the African waterfowl census. *Ostrich* **71**: 235–243.

Evans, P., G.H., & D.N. Nettleship (1985). Conservation of the Atlantic Alcidae. In D.N. Nettleship & T.R. Berkhead (eds). *The Atlantic Alcidae*. Academic Press, New York. Pp. 428–488.

Froneman, A., M.J. Mangall, R.M. Little & T.M.Crowe (2001). Waterbird assemblages and associated habitat characteristics of farm ponds in the Western Cape, South Africa. *Biodiversity and Conservation* **10**: 251–270.

Government of Uganda (1967). *Atlas of Uganda,* 2nd edition. Department of Lands and Surveys, Entebbe.

Harrison, J.A., D.G. Allan, L.G. Underhill, M. Herremans, A.J. Tree, V. Parker & C.J. Brow (eds.). (1997). *The Atlas of Southern African Birds*. Vols. 1 & 2. BirdLife South Africa, Johannesburg.

Kizito, Y.S., A. Nauwerck, L.J. Chapman & W. Koste (1993). A limnological survey of some western Uganda crater lakes. *Limnologica* **23**: 335–347

Marxmeier, U. & H. Duttmann (2002). Reed die-back affects breeding biology of the Great Crested Grebe (*Podiceps cristatus*) at Lake Dummer (Lower Saxony, Germany). *Journal für Ornithologie* **143**(1): 15–32.

Melack, J.M. (1976). *Limnology and Dynamics of Phytoplankton in Equatorial African Lakes*. Ph.D dissertation, Duke University, North Carolina.

Melvin, E.F., J.K. Parrish & L.L. Conquest (1999). Novel tools to reduce seabird by catch in coastal gill net fisheries. *Conservation Biology* **13**:1386–1397.

Osmaston, H. (1996). Glaciations, volcanism and vegetation change; lakes, bogs and pollen analysis in the Rwenzori area. Unpublished manuscript.

Pomeroy, D.E. & B. Tengecho (1982). The importance of dams. *Bulletin of the East Africa Natural History Society* 1982: 77–85.

Pomeroy, D., A. Byaruhanga & M. Wilson (2003). Birds of alkaline lakes in western Uganda. *Journal of East African Natural History* **92**:63–79.

Struhsaker, T.T. (1997). *Ecology of an African Rainforest: Logging in Kibale and the Conflict Between Conservation and Exploitation*. University Presses of Florida, Gainesville.

Wilson, S.E. (1995). *Bird and Mammal Checklists for Ten National Parks in Uganda*. National Biodiversity Data Bank, Kampala.

Zimmerman, D.A., D.A. Turner & D.J. Pearson (1996). *Birds of Kenya and Northern Tanzania*. Princeton University Press, Princeton, New Jersey.

Zinabu, G.M. (1994). Long term changes in indices of chemical and productive status of a group of tropical Ethiopian lakes with differing exposure to human influence. *Archiv für Hydrobiologie* **132**: 115–125.