Accounting for the water use by wildlife in Botswana

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Abstract

Use of water by wildlife is not explicitly considered in any of part of the System of Environmental-Economic Accounting (SEEA). Wildlife uses water as habitat (e.g. fish and crocodiles) as well as for drinking. In some cases, and in particular in dry areas, this use may be in conflict with other uses (e.g. drinking water for livestock or irrigation of crops). Information on water use by wildlife could help to assess the magnitude of the issue and allow for better water management in areas where wildlife is abundant and underpin tourism activity (e.g. in national parks and private reserves). This paper proposes a way to account for the use of water by wildlife for drinking in the supply and use tables as a use in the operation of nature reserves (a subcomponent of ISIC Rev 4, Section R, Division 91). This would have flow on effects in the water asset account, with water use by wildlife added to abstraction.

Estimates of water used by wildlife for drinking in Botswana were made for 2012 using published coefficients of water use by animals and information on animal population size from the Department of Wildlife and National Park Botswana. While estimates of water use were not possible for all species owing to a lack of data, the work done showed a significant amount of water use by wildlife – 18,399 ML in 2012: the equivalent to 10.7% of the previously estimated water consumption for 2012-13 and around a third of the water used by cattle in the same year. Most of the use was by elephants, an iconic species worldwide important for tourism in Botswana. The inclusion of water use by wildlife in the water supply-use table would provide water planners and wildlife managers with additional information to help balance competing needs that occur times and places of water shortage.

Outline

1. Introduction

In recent times Botswana in conjunction with the World Bank and Centre for Applied Research has produced three water accounts as part of the Wealth Accounting and Valuation of Ecosystem Service (WAVES) Partnership (DWF and CAR 2013, 2015 and 2016). These accounts are based on the System of Environmental-Economic Accounting (SEEA) with physical supply and tables use being available for 2010-11 to 2014-15. The accounts also include partial monetary information and some information on water assets. The accounts show the major water using industries – agriculture, mining, water supply and electricity – but they do not include the use of water wildlife.

Nature based tourism is an important for Botswana (Botswana Tourism Board 2014) and tourism satellite accounts are being investigated as a way of measuring its contribution to the economy. Some of the water used by the industries supplying the goods and services used by tourists is included in the existing supply-use table as use by "Other Industries" that contains accommodation as well as food and beverage service activities. However, the water used by wildlife on land operated as National Parks or private reserves is not.

Opportunities to see wildlife – elephants, lions, rhino, antelope and wide assortment of birds – is a key component of tourism in Botswana. Without wildlife the number of visitors to National Parks and private reserves would almost certainly decline. Understanding the amount of water currently used by wildlife will enable water planners and wildlife managers to assess the degree to which wildlife numbers, and hence tourism, are susceptible to future changes in water availability due to either natural variation in or human land and water use decisions.

The linkage between water, nature conservation and wildlife management has been known for nearly 50 years (cf Child 1972) and managing water for the benefit of wildlife and to reduce completion with cattle has been the attention of a range of research (e.g. Owen-Smith 1996, Redfern et al 2005, Western 1975).

Wildlife in SEEA

There is little mention of wildlife or wild animals in the System of Environmental-Economic Accounting SEEA. There is no mention of wildlife or wild animals in the water sections of the SEEA-Central Framework (Sections 3.5 or 5.11) and only passing references in the SEEA-Water (UN 2012).

The perspective with which wildlife is view in SEEA Central Framework is key to this were wild animals are included with other biological resources which provide physical inputs to the economy (para 5.24). Wildlife is an uncultivated resource and is considered in terms of the physical goods which they might contribute (e.g. as food, see para. 5.466 for example). In this case, the uncultivated resource of wildlife does not enter the production boundary until they are harvested. The use of wildlife in the production of cultural or recreational services were they are not harvested is not given attention.

In SEEA-Central Framework the distinction between whether the resources is cultivated or natural is critical and based on the extent to which there is "active management over the growth of the resource" (para 5.24). However, this distinction is based exclusively on the

notion that the resource will be harvested. In the case of Botswana (and elsewhere) wildlife is not harvested but is managed within areas set aside for their conservation and enjoyment by people. Because the wildlife is managed for cultural and recreational benefits in specific areas there is a strong case can be made for its inclusion as cultivated and hence the inputs to the management of wildlife (e.g. land and water) included in accounting for consumption and production.

The discussion that follows only considers the water used for drinking by wildlife. The use of water as habitat has not been considered although it is acknowledged that aquatic species (e.g. fish) and many species that venture onto land are dependent on water habitats (e.g. hippos and crocodiles). These none extractive are important but would not be included in supply-use tables but would be picked up in ecosystem accounting.

2. How to record water use by wildlife?

If it is accepted that wildlife is an input to the production of the services in National Parks and private reserves, then water use should be included in the water supply-use table. This would be in the relevant industry as defined by the International Standard Industrial Classification of All Economic Activities, Rev.4 (ISIC Rev. 4). In this case, Section R Arts, entertainment and recreation, Division 91 Libraries, archives, museums and other cultural activities in the most appropriate. This is defined as:

> This division includes activities of libraries and archives; the operation of museums of all kinds, botanical and zoological gardens; the operation of historical sites and nature reserves activities. It also includes the preservation and exhibition of objects, sites and natural wonders of historical, cultural or educational interest (e.g. world heritage sites, etc). This division excludes sports, amusement and recreation activities, such as the operation of bathing beaches and recreation parks (see division 93).[1].

In the existing water supply-use tables produced by Botswana this would be included in "Other Industries" but going forward water use by wildlife would be separated into a new column under the industry heading "Operation of Natural Reserves" (Table 1). All water will be deemed to have been self-extracted surface water unless there is information that indicates another water sources. Note that Botswana uses the SEEA-Water presentation of water supply-use tables

If water use is not accepted as an input to production Section R Arts, entertainment and recreation, then it could be included in ecosystem accounting and as an intermediate input. This would add a further level of complexity to accounting with the ecosystems services of water provisioning and cultural and recreation ecosystem services being used in the production of goods and services Section R Arts, entertainment and recreation.

[1] See ISIC Rev 4 Website http://unstats.un.org/unsd/cr/registry/regcs.asp?Cl=27&Lg=1&Co=91

Table 1. Simplified water supply-use table including water use by wildlife in

		Agriculture	Mining and Quarrying	Electricity	WUC	Sewage	Government	Other Industries	Operation of nature reserves	*Total agriculture & industry*	households	Rest of the world	*Total*
I. Physical use table													
From the environment	1. Total abstraction												
	1i.Surface water												
	1ii.Ground water												
Within the economy	2. Use of water from other economic sectors												
	3. Total use of water (1+2)												
Within the economy	4. Supply of water to other economic units												
Into the environment	5. Total returns												
	6.Total supply of water (4+5)												
	7. Consumption (3-6)												

3. Estimating water use by wildlife

The drinking water used by wildlife can be estimated using coefficients of water use, similar to the way water use by livestock in Agriculture is estimated[2]. The volume of water required by African animals can be found in a range of academic literature, for example: Du Toit (2002a), Epaphras et al (2008), The Heinz-Centre (2012), Young (1970, cited in Cain et al 2011). However, coefficients of water use have not yet been found for all species. Table 2 shows the references and data on water use by species found so far.

Table 2. Water use by wildlife for drinking – volume used for drinking and references

Species	Range of use (L)	Water use per day (L)	Reference
Elephant	150-300	225	Du Toit 2002a,b; Garai 2005
Gemsbok	2.5 - 4	3.25	Skinner and Chimimba 2005
Impala			Nersting and Arctander 2001
Zebra	4.7	4.7	Young 1970
Hartebeest			
Buffalo	30 - 40	35	Du Toit 2005
Ostrich			
Wildebeest		9	Du Toit 2002a
Steenbok			
Springbok			
Eland			
Lechwe			
Kudu	7-9 "when hot"	8	Du Toit et al. 2002a
Duiker			
Giraffe	Mostly from fodder	0	Du Toit 2002a, Skinner and Chimimba 200
Warthog			
Hippo			
Carcass OL			
Tsessebe			
Waterbuck			
Sable	4.6	4.6	Young 1970
Roan			
Sitatunga			

In Botswana the Department of Wildlife and National Parks conducts censuses and surveys of wildlife abundance at national and regional levels. These data are found in Annex 1.

[2] See ftp://ftp.fao.org/docrep/fao/010/a0701e/a0701e04.pdf

By combining information of wildlife abundance and water use by wildlife a simple calculation of water use is possible. For the species for which we have data this is presented for Botswana in 2012 in Table 3.

The return of water to the environment via wildlife urination is considered minimal, with most evaporating rather than adding to surface or soil water.

Table 3. Estimated water use for drinking by large mammals in Botswana 2012

Species	Population size (No.)	Water use per day (L)	Total water use (365 x water use per day x number of individuals) (ML)	Population in nature reserves (no.)	Percentage of population within nature reserves (%)	Water use within nature reserves (Total water use x percentage of population within nature reserve) (ML)
Elephant	207,545	225	17,045	43,990	21.2	3,613
Gemsbok	133,249	3.25	158	88088	66.1	104
Impala	114,900				0.0	-
Zebra	99,077	4.7	170	52560	53.0	90
Hartebeest	62,569				0.0	-
Buffalo	61,105	35	781	10,008	16.4	128
Ostrich	55,916				0.0	-
Wildebeest	53,159	9	175		0.0	-
Steenbok	41,531				0.0	-
Springbok	35,688				0.0	-
Eland	34,735				0.0	-
Lechwe	26,322				0.0	-
Kudu	23,038	8	67	3,318	14.4	10
Duiker	21,608				0.0	-
Giraffe	8,976				0.0	-
Warthog	7,026				0.0	-
Hippo	3,633				0.0	-
Carcass OL	3,426				0.0	-
Tsessebe	2,138				0.0	-
Waterbuck	2,048				0.0	-
Sable	1,989	4.6	3	939	47.2	2
Roan	615				0.0	-
Sitatunga	63				0.0	-
TOTAL	NA	NA	**18,399**	NA	NA	**3,946**

(-) *Not covered by the survey*
Source*: Department of Wildlife and National Parks*

4. Discussion

The total water use by wildlife for which there were data on in 2012 was 18,399 ML or 18.399 million m^3) (Table 3). This is equivalent to 10.7% of total water consumption in

Botswana in 2012-13 when consumption was 170,571 ML (DWA and CAR 2016)[3]. Elephants accounted for 93% of the water used by the animals for which we made estimates.

There are two calculations of water use by wildlife shown in Table 3: the first is for all animals in all of Botswana in 2013, regardless of their location. However, not all of the animals occur in national parks or game reserves, with the percentage of each species found within them differing. For example in 2012, for elephants 43,990 of 207,545 or 21.2% were found in the three park, compared to 56,228 of 99,077 or 58.8% for zebras (Table 3 and Annex 1). If only the amount of water used by animals occurring on the parks is within scope of the water supply-use tables, then the amount of water used in the operation of nature reserves would be just for the animals occurring in the parks which is 3,946 ML.

However, as can be seen from the data in Appendix 1, the abundance of the different species changes over time as does the percentage of animals occurring in the areas surveyed. Animals move between the areas managed for conservation and areas managed for other purposes (e.g. agriculture). One option would be to record use of water by all wildlife against "Operation of nature reserves".

Alternatively a new column "called wildlife" could be added. This treatment would be in line with previous treatments by the Australian Bureau of Statistics which included the "environment" as a sector in the supply-use tables (see ABS 2006) an approach advocated by Edens and Hein (2013) for ecosystem accounting.

If water use by wildlife is included in the supply-use tables then it should also be added to abstraction in the water asset account. Since water use by wildlife has not been explicitly accounted for before this would be a straight addition. In terms of the total flows recorded in the asset account the amount is likely to be very small.

For the supply-use tables of Botswana, the amount of water used by wildlife was equivalent to around 10.7% of total consumption in Botswana in 2012-13. The percentage could be even higher particular places and in times of drought. As such the use of water by wildlife should be considered in land and water planning, particularly if large water diversions are planned (e.g. for agriculture or urban water supply) and hence it is appropriate to include this in the water account for Botswana.

5. Questions to the London Group

We would appreciate comments from the London Group on any aspect of this paper. We are particularly interested in three questions:

1. Is it accepted that the use of water by wildlife is an input to production of the ISIC Rev. 4 Section R Arts, entertainment and recreation, Division 91 Libraries, archives, museums and other cultural activities?
2. Should use of water by wildlife outside of National Parks and private reserves be included in the water supply-use tables? If so, then how?

[3] The comparison of calendar years used for wildlife data and financial years for the water use data indicates a need to reconcile the slightly differing reference periods. The information is provided as an indication of the relative size of the flow and its contribution to the total.

3. Do you know of any other attempts to estimate water use by wildlife or references or other work that may help with estimates for Botswana?

6. Acknowledgement

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Annex 1. Wildlife abundance in Botswana

Table: Aerial Censuses of Wildlife Population Estimates of Selected Species-National Level (2003, 2004 & 2012)

Species	Wildlife Population Estimates		
	2003	2004	2012
Elephant	109,471	151,000	207,545
Gemsbok	101,522	96,943	133,249
Impala	67,040	42,694	114,900
Zebra	39,308	52,162	99,077
Hartebeest	49,978	39,553	62,569
Buffalo	33,305	31,615	61,105
Ostrich	49,406	43,229	55,916
Wildebeest	45,858	35,088	53,159
Steenbok	36,368	26,617	41,531
Springbok	35,811	50,332	35,688
Eland	31,598	21,711	34,735
Lechwe	48,983	35,722	26,322
Kudu	27,440	28,075	23,038
Duiker	9,786	3,892	21,608
Giraffe	9,463	11,090	8,976
Warthog	4,154	2,919	7,026
Hippo	1,466	3,094	3,633
Carcass OL	-	17	3,426
Tsessebe	5,119	2,361	2,138
Waterbuck	950	944	2,048
Sable	2,877	2,249	1,989
Roan	188	391	615
Sitatunga	167	12	63
Crocodile	400	373	-
Rhino (W)	-	24	-
Reedbuck	67	-	-
Baboon	3,720	3,415	-
Jackal	1,985	1,319	-
Wilddog	-	-	-
Spotted Hyaena	119	15	-
Brown Hyaena	75	54	-
Lion	290	621	-
BE Fox	96	394	-
Cheetah	-	308	-

(-) *Not covered by the survey*
Source*: DWNP*

Animal Estimates by Protected Area

Elephant

District	Wildlife Population Estimates						Population Densities					
	2003	2004	2005	2006	2012	2013	2003	2004	2005	2006	2012	2013
Chobe National Park	30,348	32,263	-	39, 404	26,134	26,592	2.960	3.196	-	3.949	4.730	4.370
Moremi Game Reserve	5,862	9,143	19,852	10,146	17,149	5,378	2.960	2.443	5.304	2.816	3.690	1.240
Nxai & Makgadikgadi	453	810	-	1,384	707	2,693	0.082	0.105	-	0.279	0.160	0.610

Note: (-) *not covered by the survey*
Source: *Department of Wildlife & National Parks*

Zebra

District	Wildlife Population Estimates					Population Densities				
	2003	2004	2006	2012	2013	2003	2004	2006	2012	2013
Chobe National Park	2,121	1,151	1,728	596	5,423	0.207	0.114	0.173	0.110	0.890
Moremi Game Reserve	1 500	810	992	3 668	1,600	0.416	0.216	0.275	0.790	0.370
Nxai & Makgadikgadi	11,425	20,257	19,345	51,964	31,451	1.058	2.615	3.301	11.480	7.130

Note: (-) *not covered by the survey*
Source: *Department of Wildlife & National Parks*

Hippo

District	Wildlife Population Estimates					Population Densities				
	2003	2004	2006	2012	2013	2003	2004	2006	2012	2013
Chobe National Park	50	85	271	35	113	0.005	0.008	0.027	0.010	0.020
Moremi Game Reserve	458	593	432	958	2,574	0.127	0.158	0.120	0.210	0.590

Note: (-) *not covered by the survey*
Source: *Department of Wildlife & National Parks*

Warthog

District	Wildlife Population Estimates							Population Densities						
	2003	2004	2005	2006	2007	2012	2013	2003	2004	2005	2006	2007	2012	2013
Chobe National Park	170	167	-	16	-	91	-	0.017	0.017	-	0.002	-	0.020	-
Moremi Game Reserve	208	206	36	192		194	430	0.058	0.055	0.010	0.053	-	0.040	0.100
Central Kalahari Game Reserve	23	89	84		332	171	-	0.001	0.002	0.002	-	0.006	0.010	-
Kalahari Transfontier park	-	-	67	-	-	-	-	-	-	0.003	-	-	-	-

Note: (-) *not covered by the survey*
Source: *Department of Wildlife & National Parks*

Giraffe

District	Wildlife Population Estimates							Population Densities						
	2003	2004	2005	2006	2007	2012	2013	2003	2004	2005	2006	2007	2012	2013
Chobe National Park	999	1, 044		793	-	545	638	0.097	0.103		0.080	-	0.100	0.100
Moremi Game Reserve	958	1,101	1,629	1,088	-	1,047	584	0.266	0.294	0.435	0.302	-	0.230	0.130
Central Kalahari Game Reserve	703	1,148	1, 210	-	1,183	923	-	0.0130	0.0220	0.0230	-	0.0230	0.0300	-
Nxai & Makgadikgadi	327	867		129	-	92	62	0.044	0.122	-	0.026	-	0.020	0.010
Khutse Game Reserve	-	154	219	-	-	348	-	-	0.058	0.083	-	-	0.180	

Note: (-) *not covered by the survey*
Source: *Department of Wildlife & National Parks*

Eland

District	Wildlife Population Estimates							Population Densities						
	2003	2004	2005	2006	2007	2012	2013	2003	2004	2005	2006	2007	2012	2013
Chobe National Park	115	218	-	240	-	234	13	0.011	0.022		0.024		0.040	0.000
Moremi Game Reserve	-	-	448	-	-	-	-	-	-	0.120	-	-	-	-
Central Kalahari Game Reserve	6,344	8,321	1,937	-	2,809	8,981	-	0.121	0.159	0.037	-	0.054	0.300	-
Nxai & Makgadikgadi	-	-	-	-	-	30	-	-	-	-	-	-	0.010	-
Kalahari Transfontier park	10,352	4,133	25,237		3,108	12 ,537	-	0.391	0.156	0.956		0.117	0.520	-
Khutse Game Reserve	943	51	137	-	-	-	-	0.356	0.019	0.052	-	-	-	-

Note: (-) *not covered by the survey*
Source: *Department of Wildlife & National Parks*

Kudu

District	Wildlife Population Estimates							Population Densities						
	2003	2004	2005	2006	2007	2012	2013	2003	2004	2005	2006	2007	2012	2013
Chobe National Park	205	434		254	-	132	7	0.020	0.043	-	0.026	-	0.020	0.000
Moremi Game Reserve	458	85	251	192	-	842	392	0.127	1.023	0.067	0.053	-	0.180	0.090
Central Kalahari Game Reserve	2,941	5,762	2,907	-	1,340	2,000	-	0.056	0.110	0.037	-	0.026	0.070	-
Nxai & Makgadikgadi	514	1,029	-	418		120	374	0.091	0.133	-	0.084	-	0.030	0.080
Kalahari Transfontier park	274	345	594		485	120	-	0.010	0.013	0.022		0.018	0.000	-
Khutse Game Reserve	288	-	27	-	-	104	-	0.109	-	0.010	-	-	0.050	-

Note: (-) *not covered by the survey*
Source: *Department of Wildlife & National Parks*

Gemsbok

District	Wildlife Population Estimates							Population Densities						
	2003	2004	2005	2006	2007	2012	2013	2003	2004	2005	2006	2007	2012	2013
Chobe National Park	55	-	16	-	-	-	-	0.005	-	0.002	-	-	-	-
Central Kalahari Game Reserve	29,609	30, 601	29,196		21,985	22,650		0.565	0.584	0.561	-	0.420	0.770	
Nxai & Makgadikgadi	1,717	2, 326		1, 963		1,324	2,957	0.305	0.300	-	0.396		0.290	0.670
Kalahari Transfontier park	27,926	30,262	47,307	-	22,582	62,396	-	1.054	0.300	1.791	-	0.852	2.590	-
Khutse Game Reserve	1,232	642	657	-	394	1,718	-	0.464	0.584	0.248	-	0.149	0.890	-

Note: (-) *not covered by the survey*
Source: *Department of Wildlife & National Parks*

Roan

District	Wildlife Population Estimates							Population Densities						
	2003	2004	2005	2006	2007	2012	2013	2003	2004	2005	2006	2007	2012	2013
Chobe National Park	68	20	-	421	-	161	91	0.007	0.002	-	0.042	-	0.030	0.020
Moremi Game Reserve	-	18	-	-	-	-	-		0.000	-	-	-	-	-

Note: (-) *not covered by the survey*
Source: *Department of Wildlife & National Parks*

Sable

District	Wildlife Population Estimates							Population Densities						
	2003	2004	2005	2006	2007	2012	2013	2003	2004	2005	2006	2007	2012	2013
Chobe National Park	1,117	116	-	427	-	939	104	0.109	0.011	-	0.003	-	0.170	0.020

Note: (-) *not covered by the survey*
Source: *Department of Wildlife & National Parks*

Waterbuck

District	Wildlife Population Estimates							Population Densities						
	2003	2004	2005	2006	2007	2012	2013	2003	2004	2005	2006	2007	2012	2013
Chobe National Park	27	175	-	-	-		15	0.003	0.017	-	-	-	-	0.000
Moremi Game Reserve	111	157	90	272	-	49	-	0.031	0.042	0.024	0.076	-	0.010	-

Note: (-) *not covered by the survey*
Source: *Department of Wildlife & National Parks*

Lechwe

District	Wildlife Population Estimates							Population Densities						
	2003	2004	2005	2006	2007	2012	2013	2003	2004	2005	2006	2007	2012	2013
Chobe National Park	362	197	-	333	-	19	-	0.035	0.020	-	0.033	-	0.000	-
Moremi Game Reserve	6,682	5,793	6,498	3,825	-	13,779	21,902	1.854	1.458	1.736	1.062	-	2.970	5.030

Note: (-) *not covered by the survey*
Source: *Department of Wildlife & National Parks*

Wildebeest

District	Wildlife Population Estimates							Population Densities						
	2003	2004	2005	2006	2007	2012	2013	2003	2004	2005	2006	2007	2012	2013
Chobe National Park	-	145	-	236	-	1,951	382	-	0.014		0.024	-	0.350	0.060
Moremi Game Reserve	236	980	1,736	848	-	194	609	0.066	0.262	0.464	0.235	-	0.040	0.140
Central Kalahari Game Reserve	989	1,521	446	-	1, 431	997	-	0.019	0.029	0.009	-	0.027	0.030	-
Nxai & Makgadikgadi	4,609	1,371	-	6,242		10,727	2,738	0.818	0.177	-	1.261		2.370	0.620
Kalahari Transfontier park	202	2,523	4, 385	-	1,326	6,114	-	0.008	0.095	0.166	-	0.050	0.250	-

Note: (-) *not covered by the survey*
Source: *Department of Wildlife & National Parks*

Impala

District	Wildlife Population Estimates							Population Densities						
	2003	2004	2005	2006	2007	2012	2013	2003	2004	2005	2006	2007	2012	2013
Chobe National Park	-	1,645	-	2,024	-	2,303	1,880	-	0.163	-	0.203	-	0.420	0.310
Moremi Game Reserve	10,071	7,341	12,029	13,747	-	39,298	33,102	2.795	1.961	3.214	3.815	-	8.460	7.600

Note: (-) *not covered by the survey*
Source: *Department of Wildlife & National Parks*

Duiker

District	Wildlife Population Estimates							Population Densities						
	2003	2004	2005	2006	2007	2012	2013	2003	2004	2005	2006	2007	2012	2013
Chobe National Park	-	-	-	35	-	-	-	-	-	-	0.003	-	-	-
-Central Kalahari Game Reserve	571	506	557	-	1,909	2,202	-	0.011	0.010	0.011	-	0.036	0.070	-
Kalahari Transfontier park	-	68		-		105	-	-	0.009	-	-	-	0.020	-
Khutse Game Reserve	79	51	27	-	53	170	-	0.030	0.019	0.010	-	0.030	0.090	-

Note: (-) *not covered by the survey*
Source: *Department of Wildlife & National Parks*

Steenbok

District	Wildlife Population Estimates							Population Densities						
	2003	2004	2005	2006	2007	2012	2013	2003	2004	2005	2006	2007	2012	2013
Chobe National Park	42	93	-	16	-	-	69	0.004	0.009	-	0.002	-	-	0.010
Moremi Game Reserve	-	12	-	-	-	19	89	-	0.003	-	-	-	0.000	0.020
Central Kalahari Game Reserve	2,940	3, 590	2, 970	-	4, 672	2,536	-	0.056	0.069	0.057	-	0.089	0.090	-
Nxai & Makgadikgadi	352	199	-	-	-	363	187	0.035	0.026	-	-	-	0.080	0.040
Kalahari Transfontier park	4,418	4,242	5,226	-	1,891	7,894	-	0.167	0.160	0.198	-	0.071	0.330	-
Khutse Game Reserve	367	51	110	-	79	163	-	0.138	0.019	0.041	-	0.030	0.080	-

Note: (-) *not covered by the survey*
Source: *Department of Wildlife & National Parks*

Buffalo

District	Wildlife Population Estimates						Population Densities					
	2003	2004	2005	2006	2012	2013	2003	2004	2005	2006	2012	2013
Chobe National Park	3,773	10,603	-	6,922	5,830	3,486	0.368	1.050	-	0.694	1.060	0.570
Moremi Game Reserve	597	1,089	4,296	176	4,178	2,687	0.368	0.291	1.148	0.049	0.900	0.620

Note: (-) *not covered by the survey*
Source: *Department of Wildlife & National Parks*

Baboon

District	Wildlife Population Estimates				Population Densities			
	2003	2004	2005	2006	2003	2004	2005	2006
Chobe National Park	-	282	-	-		0.028	-	-
Moremi Game Reserve	667	629	591	272	0.185	0.168	0.158	0.076

Note: (-) *not covered by the survey*
Source: *Department of Wildlife & National Parks*

Tsessebe

District	Wildlife Population Estimates							Population Densities						
	2003	2004	2005	2006	2007	2012	2013	2003	2004	2005	2006	2007	2012	2013
Chobe National Park	77	-	-	-	-	41	30	0.008	-	-	-	-	0.010	0.000
Moremi Game Reserve	778	665	1, 128	1, 200	-	713	634	0.216	0.178	0.301	0.333	-	0.150	0.150

Note: (-) *not covered by the survey*
Source: *Department of Wildlife & National Parks*

Ostrich

District	Wildlife Population Estimates							Population Densities						
	2003	2004	2005	2006	2007	2012	2013	2003	2004	2005	2006	2007	2012	2013
Chobe National Park	369	78		362	-	128	166	0.036	0.008		1.036	-	0.020	0.030
Moremi Game Reserve	125	-	107	32	-	31	107	0.035	-	0.029	0.009	-	0.010	0.020
Central Kalahari Game Reserve	3,807	4, 527	4, 264	-	2, 811	2,618	-	0.073	0.086	0.082	-	0.054	0.090	-
Nxai & Makgadikgadi	1,165	530		1, 062		1,216	1,173	0.119	0.068		0.071		0.270	0.270
Kalahari Transfontier park	2,779	2,889	5,015	-	5,364	6,451	-	0.105	0.109	0.190	-	0.202	0.270	-
Khutse Game Reserve	157	205	110	-	368	290	-	0.059	0.077	0.041	-	0.139	0.150	-

Note: (-) *not covered by the survey* ***Source:*** *Department of Wildlife & National Parks*