Title: New record of cannibalism in the common hippo, *Hippopotamus amphibious* (Linnaeus, 1758)

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Introduction

This paper adds to growing documentation of carnivory and cannibalism in common hippos, *Hippopotamus amphibious* (Linnaeus, 1758). Since 1995 the long standing view of hippos as herbivores (Eltringham, 1999; Estes, 1991) has been challenged by observations of carnivory and cannibalism by hippos.

Interspecific Carnivory

Dudley (1998) was the first to report carnivory in hippos. He observed a male hippo kill an impala that had been chased into water by wild dogs, ten hippos proceeded to feed from the carcass. Wild dogs then killed another impala on the water's edge, possibly attempting to feed on this second carcass, five hippos left the first carcass and tried to chase the wild dogs away from their kill. In another instance Dudley (1998) recorded a hippo scavenging an impala carcass alongside crocodiles. Both incidences reported by Dudley (1998) occurred in 1995 in Hwange National Park, Zimbabwe. Dudley (1998; 2004) mentions two unpublished observations of hippo carnivory on common wildebeest (*Connochaetes taurinus*) in East Africa from R.D. Estes and an unpublished video of a hippo feeding on the gut contents and/or internal organs of a buffalo in Luangwa Valley, Zambia. Potential hippo carnivory is also reported in South Africa. Crowther & Whyte (1989) record a hippo appearing to scavenge the carcass of a female kudu killed by crocodiles in Crocodile River at Malelane and a case from Kruger National Park where a hippo killed a young eland and played with the carcass, though if any feeding occurred is uncertain.

Cannibalism

Eltringham (1999) reports the first observation of hippo cannibalism. In the Shire River, Malawi, a hippo was filmed and photographed feeding alongside crocodiles on a male hippo which had died from fight wounds the previous day. There has also been speculation that an anthrax outbreak in Uganda's Queen Elizabeth National Park, that killed over 300 hippos, in 2004/05 was linked to cannibalism (Dudley, 2004). In a National Geographic documentary about the outbreak Dr. Fabian Leendertz reported a hippo feeding on the entrails of an anthrax-killed hippo carcass (Cannibal Hippos,

2009). However, this was the only report of cannibalism in the park and cannibalism is not mentioned in subsequent papers outlining the outbreak's spread and management so cannibalism is unlikely to have been widespread (Mburo et al., 2007). A photo of an adult hippo with the thigh of what appears to be the intact carcass of a juvenile hippo in its mouth in Withers & Hosking (2002) is another potential cannibalistic record. However, as there are no details on the event it is unclear if the hippo was feeding or investigating the carcass for other reasons.

Materials and Methods

The sighting occurred at 14.07 on 25th of April 2014 in the Sabie River in Kruger National Park, South Africa. Observations were made from the Lower-Sabie bridge at a distance of approximately 50 metres.

Results and Discussion

A hippo was observed feeding from the decayed carcass of another hippo (Fig. 1) while intermittently breaking away from feeding to defend the carcass from crocodiles; a second hippo was resting nearby but did not interact with the carcass. Feeding by the hippo was ongoing when observers arrived and continued for approximately 20 minutes after which both hippos moved away and waiting crocodiles began feeding. The carcass appeared to be well decayed and have already been fed from extensively, though whether by hippos or other scavengers is unknown. Definite aging and sexing of the cannibalistic hippo was not possible however its size and lack of obvious male genitalia indicate a sub-adult female (Dr. Rebecca Lewison, pers. comm.). This observation is only the second fully documented and published case of cannibalism in common hippos and the first record from Southern Africa.

Records of carnivory (interspecific carnivory and cannibalism) now spread through Eastern and Southern Africa show it is not restricted to certain individuals or populations but, while uncommon, is a widespread part of hippo's behavioural repertoire. Carnivory may be underreported as hippos are nocturnal feeders, however, it is unlikely to occur frequently as their gut anatomy is unsuited to digesting meat (Eltringham, 1999). Nutrient deficiencies drive carnivorous behaviour, such as bone chewing, in other herbivore species (Denton et. al, 1986) and may play a role in hippo carnivory. Dudley's (1998) observations occurred during a severe drought when hippos were seen consuming other unusual foods like elephant dung and woody plants. Unlike previous records of carnivory (Dudley, 1998) there was no shortage of fodder in Kruger due to heavy rains in March. If nutritional stress was driving our observation of carnivory it is likely to be because of a deficiency in a specific dietary component and not a chronic food shortage.

Cannibalism has been observed less frequently than interspecific carnivory. Understanding drivers of cannibalism is difficult due to lack of observations and information on individuals involved. However, of common drivers of cannibalism in mammals (reproductive strategy, environmental stress, nutritional stress, high conspecific density, natural predatory behaviour and population regulation) (Polis et al., 1984) nutritional stress, as in interspecific carnivory, is the most likely driver.

In recent years reports of human mortalities and human-hippo conflict has risen in many countries (Lewison & Oliver, 2008). Better understanding of the frequency of hippo carnivory and its drivers will help mitigate any role it might play in human-hippo conflict. Understanding hippo carnivory, especially cannibalism, may help manage the spread of diseases, such as anthrax, where infected meat can be a vector of infection and has caused large die-offs in the past (Mburo et al., 2007; Turnbull et al., 1991). This is especially the case if carnivory occurs when individuals are nutritionally stressed as their weakened condition will make them less resilient to infections that carnivory may expose them too. The IUCN lists hippos as vulnerable due to habitat loss and exploitation across its range (Lewison & Oliver, 2008), better management of disease outbreaks and human-hippo conflict may be vital to the species' longer term survival.

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References

Cannibal Hippos (2009) Tigress Productions, distributed by National Geographic. Unknown original broadcast date.

Crowther, R., & Whyte, I. (1989) Hippos interfere. *Custos*, 18(1), 10.

Denton, D.A., Blair-West, J.R., McKinley, M.J., & Nelson, J.F. (1986) Problems and paradigms: Physiological analysis of bone appetite (Osteophagia). *BioEssays*. 4(1), 40–43.

Dudley, J.P. (1998) Reports of carnivory by the common hippo Hippopotamus amphibious. *South African Journal of Wildlife Research*. 28(2), 58–59.

Dudley, J.P. (2004) Anthrax, hippopotamus, human – Uganda (02). ProMED-MAIL 2004; 13 Dec: 20041214.3308. http://www.promedmail.org/direct.php?id=ph21499 [22 October 2014]

Eltringham, S.K. (1999) *The Hippos: Natural History and Conservation*. T & AD Poyser Ltd, London.

Estes, R. (1991) *The Behaviour Guide to African Mammals*. University of California Press, California.

Lewison, R., & Oliver, W. (2008) *Hippopotamus amphibius. The IUCN Red List of Threatened Species. Version 2014.2* [Online]. Available from: www.iucnredlist.org/details/10103/0. [02 August 2014]

Mburo, L., Parks, N., Wafula, M.M., Patrick, A., & Charles, T. (2007) Managing the 2004 / 05 anthrax outbreak in Queen Elizabeth and Lake Mburo National Parks, Uganda. *African Journal of Ecology*. 46(1), 24–31.

Polis, G.A., Myers, C.A., & Hess, W.R. (1984) A survey of intraspecific predation within the class mammalia. *Mammal Review*. 14 (4), 187-198.

Turnbull, P., Bell, R., Saigawa, K., Munyenyembe, F., Mulenga, C., & Makala, L. (1991) Anthrax in wildlife in the Luangwa Valley, Zambia. *Veterinary Record*. 128(17), 399–403.

Withers, M., & Hosking, D. (2002) *Wildlife of East Africa*. Collins, London

Figure Legends

Fig 1 Hippo feeding on a decayed hippo carcass in the lower reaches of the Sabie River, Kruger National Park.

Figures.

Fig 1.