

# Evidence of predation on aquatic vertebrates by serval in the Okavango Delta, Botswana

Andrew J. Loveridge<sup>1</sup>, Justin L. Seymour-Smith<sup>1</sup>, Robynne Kotze<sup>1</sup>, Andrea L. Sibanda<sup>1</sup>, K. Collins<sup>2,3</sup>.

<sup>1</sup>Trans-Kalahari Predator Programme, Wildlife Conservation Research Unit, Department of Zoology, Oxford University, Recanti-Kaplan Centre, Tubney, OX13 5QL, UK.

<sup>2</sup> Botswana Wild Bird Trust, Sir Seretse Khama Road, Maun, Botswana

<sup>3</sup> Mammal Research Institute, Department of Zoology & Entomology, University of Pretoria, Pretoria, 0002, South Africa

Corresponding author: A.J. Loveridge, [andrew.loveridge@zoo.ox.ac.uk](mailto:andrew.loveridge@zoo.ox.ac.uk)

## Introduction

The serval (*Leptailurus serval*, Schreber 1776) occurs widely in sub Saharan Africa, though is absent from Congo Basin equatorial forest and from highly arid regions of North and South West of the continent (Nowell & Jackson, 1996). Preferred habitats include grassland and savannah woodland mosaics, frequently associated with rivers, wetlands and flood-plains (Hunter & Bowland, 2013). The serval is a specialist rodentivore with rodents, particularly Murids, usually making up between 80 and 90% of their diet across much the species range (Bowland & Perrin, 1993; Geertsema, 1985; Smithers, 1983; Thiel, 2011). They also feed on shrews (*Crocidura* and *Myosorex* spp), small birds, amphibians, insects and small reptiles (Geertsema, 1985; Skinner & Smithers, 1990). There are occasional records of servals hunting young of small antelope (Pienaar, 1969; Ramesh & Downs, 2015), ground (*Xerus* spp) and tree squirrels (*Paraxerus* spp), larger ground and wading birds (e.g. flamingo, *Phoeniconaias* spp), hares (*Lepus* spp), springhares (*Pedetes capensis*), cane rats (*Thryonomys* spp), aquatic vertebrates and invertebrates and small carnivores (Ansell, 1960; Geertsema, 1976; Hunter & Bowland, 2013; Kingdon, 1977; Rowe-Rowe, 1978). Grass culms, leaves and fruit are sometimes consumed (Rahm & Christiaensen, 1963; Verschuren, 1958). Here we present evidence of predation on larger aquatic vertebrates by serval in the Okavango Delta, Botswana.

## Study site and methods

A camera trap survey, primarily designed to detect large carnivores, was run in the western portion of the Moremi Game Reserve (5000 km<sup>2</sup>), situated in the Eastern part of the Okavango Delta, Botswana (central point of survey -19.300 S 23.4666 E). The Delta, covering ~15 000km<sup>2</sup>, is a wetland which is typically seasonally inundated with water levels peaking between the months of June and

August (McCarthy & Ellery, 1998). The survey took place in the early dry season, from 3 April to 16 May 2019, immediately prior to the onset of the annual flood. The survey extended from the margins of the permanent swamp in the west into the dry Mopane woodland to the east (Figure 1) and comprised 40 camera stations, spaced approximately 3-4km apart with each station comprising of paired trail cameras (Cuddeback XChange, white-flash, Cuddeback, WI, USA) mounted at a height of 60cm on steel fencing standards. At each station cameras were sited on roads, trails and paths, with cameras approximately 2.5 – 3.0 meters apart on either side of the trail. Permission to undertake this research was granted by Ministry of Environment, Natural Resources Conservation and Tourism, Botswana, permit number EWT 8/36/4 XXIII (15).

## Results and discussion

Serval were detected at thirteen locations over the study period (Figure 1). One of these detections (2 May 2019) recorded images of a serval carrying a freshly caught fish, identifiable as an African pike (*Hepsetus cuvieri*), a piscivorous species weighing ~2kg, usually living in deep water of channels and lagoons but known to favour ambush sites in emergent vegetation at water margins (Bruton, Merron, & Skelton, 2018). The image was captured in the Bodumatau area of Moremi National Park, at a camera trap station located on a spit of land between a small lagoon and the permanent swamp area (-19.27402 S, 23.43788 E). Examination of the image shows that the pelage of the serval was wet up to the mid flank, suggesting that the serval had been actively foraging in shallow water; a hunting mode previously recorded in this species (Smithers, 1978). While we cannot unequivocally verify that the fish had been actively hunted by the serval, it appears freshly caught (Figure 2, Figure S1, Supplementary material), so it is plausible that this is the case. This period of the survey coincided with rising water levels at the beginning of the seasonal inundation, a time when fish in the Okavango Delta have been shown to experience seasonal hypoxia (Edwards et al., 2020). Fish compromised in this way may be more vulnerable to predation by small predators such as servals.

Although servals are primarily rodentivores, several published observations suggest that hunting of aquatic species is well within the species' behavioural repertoire. Servals have been recorded hunting amphibians in the shallows at margins of wetlands in the Ngorongoro crater, with frogs occurring in 77% of scats examined (Geertsema, 1985). In addition, at a site just South of the survey area on the Gomoti River (-19.44339 S and 23.43206 E) we recorded a supporting observation of another serval predating on a juvenile Nile crocodile (*Crocodylus niloticus*, Figure 3). Again, the pelage was completely wet, indicating that the serval had been actively hunting in water (K. Collins Pers. Obs.).

Fish have only very rarely been recorded in the diet of wild servals (Smithers, 1971), although Kingdon (1977) observed captive raised servals capturing fish from a tank and feeding on them. To our knowledge this is the first recorded incidence of predation on crocodiles by this species. Only two Felid species, the South East Asian Fishing cat (*Prionailurus viverinus*) and flat headed cat, (*P. planiceps*) are known to be a specialist piscivores. However, several other Felid species, the South East Asian Rusty-spotted cat (*P. rubiginosus*) and the South American ocelot (*Leopardus pardalis*) and Geoffroy's cat (*L. geoffroyi*), when associated with wetland habitats and aquatic margins, opportunistically feed on fish and aquatic vertebrates (Nowell, Loveridge, & Macdonald, 2010). Given the known association of servals with wetland habitats it seems likely this species is also well adapted to opportunistic hunting and capture of aquatic species and, where there is high availability of aquatic prey, such dietary items may occur more frequently in serval diet.

#### Data Availability Statement

All data are made available in the manuscript and supplementary material.

#### Acknowledgements

We thank the Botswana Department of Wildlife and National Parks, Ministry of Environment for permission to undertake this research. The study was funded by the Robertson Foundation. This article benefitted from comments from Michael Hoffmann and an anonymous reviewer.

#### References

- Ansell, W. F. H. (1960). *The mammals of Northern Rhodesia*. Lusaka: The Government Printer.
- Bowland, J. M., & Perrin, M. R. (1993). Diet of serval *Felis serval* in a highland region of Natal. *South African Journal of Zoology*, 28, 132-135.
- Bruton, M., Merron, G., & Skelton, P. (2018). *Fishes of the Okavango Delta and Chobe River, Botswana*. Cape Town, South Africa: Struik Nature.
- Edwards, T. M., Mosie, I. J., Moore, B. C., Lobjoit, G., Schiavone, K., Bachman, R. E., & Murray-Hudson, M. (2020). Low oxygen: A (tough) way of life for Okavango fishes. *PLoS ONE*, 15(7), e0235667. doi:10.1371/journal.pone.0235667
- Geertsema, A. (1976). Impressions and observation on serval behaviour in Tanzania, East Africa. *Mammalia*, 40(1), 13-19.
- Geertsema, A. (1985). Aspects of the ecology of the serval *Leptailurus serval* in the Ngorongoro crater, Tanzania. *Netherlands Journal of Zoology*, 35(4), 527-610.
- Hunter, L., & Bowland, J. (2013). *Leptailurus serval*, Serval. In J. Kingdon & M. Hoffmann (Eds.), *Mammals of Africa* (Vol. V, pp. 179-186). London: Bloomsbury.
- Kingdon, J. (1977). *East African mammals. An atlas of evolution in Africa. Vol. IIIA. Carnivores*. London: Academic Press.
- McCarthy, T. S., & Ellery, W. N. (1998). The Okavango Delta. *Transactions of the Royal Society of South Africa*, 53(2), 157-182. doi:10.1080/00359199809520384
- Nowell, K., & Jackson, P. (1996). *Wild cats: a status survey and conservation action plan*. Gland, Switzerland: IUCN/ SSC Cat Specialist Group.

- Nowell, K., Loveridge, A. J., & Macdonald, D. W. (2010). Dramatis personae: an introduction to the wild felids. In D. W. Macdonald & A. J. Loveridge (Eds.), *Biology and Conservation of Wild Felids* (pp. 3-58). Oxford: Oxford University Press.
- Pienaar, U. d. V. (1969). Predator-prey relationships amongst the larger mammals of the Kruger National Park. *Koedoe*, 12, 108-176.
- Rahm, U., & Christiaensen, A. (1963). Les mammifères de la région occidentale du Lac Kivu. *Annales du Musée Royal de l'Afrique Centrale. Sciences Zoologiques*, 118, 1-83.
- Ramesh, T., & Downs, C. T. (2015). Diet of serval (*Leptailurus serval*) on farmlands in the Drakensberg Midlands, South Africa. In *Mammalia* (Vol. 79, pp. 399).
- Rowe-Rowe, D. T. (1978). The small carnivores of Natal. *Lammergeyer*, 25, 1-48.
- Skinner, J. D., & Smithers, R. H. N. (1990). *The mammals of the southern African subregion*. Pretoria, Republic of South Africa: University of Pretoria.
- Smithers, R. H. N. (1971). *The mammals of Botswana* (Vol. 4): Museum Memoirs, National Museums and Monuments, Rhodesia.
- Smithers, R. H. N. (1978). The serval *Felis serval* Schreber, 1776. *South African Journal of Wildlife Research*, 8, 29-37.
- Smithers, R. H. N. (1983). *The mammals of the southern African subregion*. Pretoria, Republic of South Africa: University of Pretoria Press.
- Thiel, C. (2011). *Ecology and population status of the Serval (Leptailurus serval, Schreber 1776) in Zambia*. (Doctorate), Rheimsden Friedrich-Wilhelms, Bonn, Germany.
- Verschuren, J. (1958). Ecologie et biologie des grands mammifères. Exploration du Parc National de la Garamba. *Inst. Parcs Nat. Congo Belge, Brussels*.

## Figure Legends

Figure 1. Map showing location of camera trap survey and record within Botswana (a), within Moremi Game Reserve (b). Main map shows the location of camera traps. Dashed outlined square shows location of the record of fish predation and star icon the crocodile predation event.

Figure 2. Image of serval carrying a freshly caught African pike, Moremi Game Reserve, Botswana, May 2019. Note legs and lower flank of serval are wet indicating the animal had recently been in the water. Image cropped from original camera trap image, original images provided as supplementary material, Figure S1.

Figure 3. Image of serval carrying a juvenile Nile crocodile (*Crocodylus niloticus*). Image taken by hand held camera just west of Moremi Game Reserve, along the Gomoti River, July 2019. The serval's pelage is completely wet indicating that it was actively hunting in the water (Photograph: K. Collins).

