

## FIELD NOTES

---

### The Elephant Ethogram: a library of African elephant behaviour

Joyce Poole<sup>1\*</sup> and Petter Granli<sup>1</sup>

<sup>1</sup>ElephantVoices, Buskellinga 3, 3236, Sandefjord, Norway

\*corresponding author: jpoole@elephantvoices.org

#### Introduction

This short paper is intended to alert our colleagues to the existence of The Elephant Ethogram: A Library of African Elephant Behaviour. It describes its purpose, form and scope, and appeals for contributions of undocumented, rare, novel or cultural *Loxodonta africana* behaviour. We do not present descriptions of behaviours, methodologies, results or discussion; these may be found online within *The Elephant Ethogram*.

*The Elephant Ethogram* is an ElephantVoices initiative to document the complex, diverse and nuanced repertoire of behaviour and communication of African savannah elephants (*L. africana*). In a unique, user-friendly, fully searchable and publicly accessible database, *The Elephant Ethogram* chronicles the rich postural, gestural, tactile, chemical and acoustic communication and behaviour of Africa's savannah elephants. It includes commonly displayed, unusual, novel and culturally learned behaviours, as well as those expressed in response to people. *The Elephant Ethogram* is based on published descriptions of behaviour and the decades of behavioural studies and photographic, acoustic and video-graphic collections from Amboseli National Park (NP), the Maasai Mara ecosystem (Mara), Kenya, and Gorongosa National Park, Mozambique conducted by ElephantVoices. It is also built from behaviour captured for documentaries filmed in the Mara and Gorongosa and video clips of unusual

behaviour collected by colleagues and members of the general public.

*The Elephant Ethogram* replaces ElephantVoices' online Elephant Gestures and Elephant Calls Databases originally developed in 2003 and revamped in 2011 (Poole 2011; Poole and Granli 2011), that were based on our elephant studies in Amboseli National Park, Kenya between 1975 and 2009 (Poole 1987; Poole et al. 1988; Poole 1989a; Poole 1989b; Poole et al. 2005) and the work of other scientists (Douglas-Hamilton 1972; Berg 1983; Moss 1983; Kahl and Armstrong 2000; Kahl and Armstrong 2002).

Between 2011 and 2019 we carried out elephant behaviour studies and conservation projects in the Mara, and Gorongosa NP, during which we completed elephant, field notes, images and videos of the behaviour of known individuals. Furthermore, in a ground-breaking collaboration with copyright owners Off the Fence, Gorongosa Media Project and Bob Poole Films, hundreds of hours of raw footage of elephants, originally shot for documentaries in Gorongosa and the Mara, were granted to ElephantVoices for use in science and education. Since we collaborated with the filmmakers on site, the footage primarily depicts known individuals. In 2020 we collected additional footage of behaviour in Amboseli National Park. *The Elephant Ethogram* combines and significantly improves the structure and functionality of the original databases, includes hundreds of additional behaviours, 2,400 annotated video clip examples from three populations, higher-resolution images, additional audio files.

Elephant behaviour has been documented by

hunters, naturalists and scientists for hundreds of years starting with the earliest scholarly notes of Aristotle (1862 translation) to those of Darwin (1872) to Kühme's (1962; 1963) research on captive African elephants. The study of free-ranging elephants by Douglas-Hamilton (1972) stimulated the work of many who followed, including the five decades-long work of Moss and her colleagues, and our own.

From hundreds of published studies, we know that savannah elephants show great richness, variation and flexibility in their behaviour. Some of these publications have described elephant behaviours relevant to the aims of their particular study (Moss 1983 (oestrus); Poole 1987 (musth); O'Connell-Rodwell et al. 2011 (male-male relationships); Goldenberg and Wittemyer 2020 (death)), but only Kahl and Armstrong's work in Hwange National Park, Zimbabwe (2000; 2002) and our own in Amboseli National Park (Poole 2011; Poole and Granli 2011) aimed to document the full repertoire of behaviour of the species. We worked closely with Kahl to share data and to agree on terminology and definitions. Until his untimely death in 2012 Kahl's plan was to publish a detailed elephant ethogram.

The construction of "exclusive ethograms" to describe a species' behaviour or activity patterns is commonly used in behavioural studies, where the ethogram focuses on the behaviours of interest. It is more unusual to find catalogues that attempt to produce an "exhaustive" ethogram of all known behaviours of a given species. One example is the work of Nishida et al. (1999) on chimpanzees, *Pan troglodytes*, which aims to provide an exhaustive list of behaviours. This body of work defines 515 behaviours, recording whether they were idiosyncratic, limited to a small group, to one population or were, to a greater or lesser extent, cross-cultural. Another example is the work of Bolgan et al. (2014) on the Arctic charr, *Salvelinus alpinus*, a fish species.

A draw-back of these studies is that they are non-searchable, written documents without video-graphic documentation. Nishida et al. (2010) solved this problem for their study of chimpanzees by publishing a book with an accompanying CD. Very few studies; however, have attempted to produce an exhaustive, searchable web-based ethogram of a species with video examples of

behaviour. One example is Mouse Ethogram: An Ethogram for the Laboratory Mouse developed in the Stanford Medical School in the Laboratory of Joseph Garner. Since this study was carried out in a captive environment it is unlikely to be exhaustive for the species.

African elephants (Savannah and Forest) are among the most socially complex non-human species (Moss and Poole 1983; McComb et al. 2000; Archie et al. 2005; Wittemyer et al. 2005), as well as one of the more heavily exploited (Meredith 2001; Wittemyer et al. 2014). As scientists continue to document their extraordinary behaviour, elephants are increasingly impacted by humans to the point where their behaviour is notably affected (Douglas-Hamilton et al. 2005; Gaynor et al. 2018; Wall et al. 2021) and their future survival endangered (Wittemyer et al. 2014; Hart et al. 2021).

### Purpose

Supported by annotated video examples, *The Elephant Ethogram* is an attempt to provide an exhaustive, searchable, publicly available, catalogue of the behaviour of the endangered savannah elephant. Our aim is for *The Elephant Ethogram* to be a repository of the full range of *L. africana* behaviour for scientific study, reference and comparison and for posterity. We hope that it inspires broader interest in elephants—a deeper understanding of their behaviour, cognition and communication, improved protection of their lives and their landscapes and increased concern for their well-being and for Africa's Forest elephants and Asian elephants.

### Form, function and scope

*The Elephant Ethogram* describes the form and, where possible, the function and/or contextual nuances in meaning of the rich behaviour and communication recorded. Entries include common, rare, novel and idiosyncratic behaviours, as well as cultural differences in behaviour documented between groups or populations acquired through social learning. In some cases, these are in response to anthropogenic threats.

The structure of *The Elephant Ethogram* is built upon uniquely observable *Behaviours*. A *Behaviour* is a unique movement or action in response to a particular situation or stimulus (e.g. Chin-In, Ear-Wave, Trunk-Twisting). Each *Behaviour* is documented by a detailed written description, noting: its form, function, if apparent, the age and sex of those observed to engage

in the *Behaviour*, the *Context(s)*, in which it occurs and video examples. When the *Behaviour* occurs in more than one *Context*, we note the age and sex of participants by *Context*. We aim to include video examples of the *Behaviour* as it is expressed in different *Contexts*, wherein the *Behaviour* is highlighted by a moving circle (Fig. 1). Audio examples are included where relevant.

A *Behavioural Constellation*, or *Constellation*, is a suite of *Behaviours* that usually occur together (e.g. Musth-Walk typically includes the *Behaviours*: Ears-Stiff, Head-High, Chin-In, Purposeful-Walk, Musth-Temporal-Gland-Secretion, Urine-Dribbling). Each *Constellation* is documented by a detailed written description (including its form, function, the age and sex of those engaging in the *Constellation*), the *Context(s)* in which it occurs, the *Behaviours* that are likely to be observed, and video examples. Again, when a *Constellation* occurs across more than one *Context*, we note the age and sex of participants by *Context*. Each video highlights the component *Behaviours* as they occur. Where it is relevant, we include audio examples.

A *Context* refers to the particular setting, situation or circumstances in which a *Behaviour* or *Constellation* occurs. We define 23 *Contexts*. Most *Behaviours* and many *Constellations* occur in more than one *Context*, and many have different functions or signal different meanings in different *Contexts*. For example, Trunk-to-Genitals may be a form of assessing sexual or physical state, a way to solicit suckling, a gesture of reassurance or of conciliation, depending upon the *Context* in which it is performed. Likewise, Periscope-Trunk may be used to detect scents carried on the wind, to signal to others to pay attention in a particular direction, a sign that a calf wants to suckle, or a signal that an individual is awaiting a partner's next move during social play, sparring or fighting. Ear-Folding may be a threat or be part of a suite of affiliative *Behaviours* associated with high social arousal.

*The Elephant Ethogram* includes an [Introduction](#), a [User Guide](#), the [Ethogram Table](#), a [Search Portal](#), [The Science](#), [References](#) that have been cited throughout *The Elephant Ethogram* and [Acknowledgements](#). Its contents may be accessed via the Ethogram Table or the Search Portal. The [Ethogram Table](#) (Fig. 2) provides

an overview of all *Behaviours*, *Constellations* and *Contexts* contained in *The Elephant Ethogram*.

The [Search Portal](#) (Fig. 3) offers four search alternatives that return *Behaviours* and *Constellations*: Two Free-Text Searches, an Alphabetical Search and a Combined Dropdown Search, which allows the user to select more than one search criteria (e.g. to find behaviours typical of musth males that involve the ears, or how the feet are used for signalling in a leadership context, or vocalizations made by infants). Clicking on a returned linked *Behaviour/Constellation* takes the user to a page where it is described and where annotated video and audio examples may be accessed. The Search Portal also offers a slideshow of linked images of a limited selection of *Behaviours/Constellations* (Fig. 4).

The Science page includes an abstract, introduction, methods, a basic set of results and discussion. The methods describe the elephant populations represented in *The Elephant Ethogram*, the terminology and naming conventions that we use. We also describe the procedures used to: collect the data (e.g. elephant identification, group sightings records and field notes, audio, video and images and the separate apps and databases used to collect and house them); mine the collections of audio, video and images; extract, edit and annotate clips; upload material to SoundCloud and Vimeo; and code and populate the database. Once *The Elephant Ethogram* has been fully populated with our remaining material, we will expand the results and discussion with conclusions that can be drawn from the data.

The first version of *The Elephant Ethogram* was made available on [www.elephantvoices.org](http://www.elephantvoices.org) in April 2021. As of its launch *The Elephant Ethogram* defined 322 *Behaviours*, 103 *Constellations* and 23 *Contexts* and contained over 3,000 media files, of which over 2,400 were annotated video clips (813 from Amboseli National Park, 940 from the Mara ecosystem, 658 from Gorongosa National Park and 3 from Kruger National Park).

### *Living database*

*The Elephant Ethogram* is a living database. We will continue to supplement it with representative clips of behaviours from our own Gorongosa National Park footage as well as with submissions of currently undocumented behaviour or unusual video clips or photographs.

Creating and populating *The Elephant Ethogram* has been a multi-year endeavour and we acknowledge

### Ear-Wave

A musth male swings the upper portion of the ear stiffly and vigorously forward and backward. The speed and forcefulness of the swinging causes the lower, unsupported portion of the pinnae to flap even further forward and backward and upward. The motion creates a wave appearance across the ear. Ear-Waving is typically associated with Musth-Rumbling and may serve to waft scent of Musth-Temporal-Gland-Secretion toward other elephants.

References: Poole 1982: 86; Poole 1987a: 294 drawing; Poole 1996: 122; Kahl & Armstrong 2002: 162 photo; Poole & Granli 2003; Poole & Granli 2011. (Full reference list)

This behavior occurs in the following context(s): Advertisement & Attraction, Aggressive

Video (19)

Audio (0)

#### Ear-Wave

Context: Advertisement & Attraction (7)

Pascal is in full musth and has been Mud-Splashing. As he walks off he Musth-Rumbles and Ear-Waves and engages in a bout of Trunk-Curling before disappearing from view. (Amboseli, Kenya)

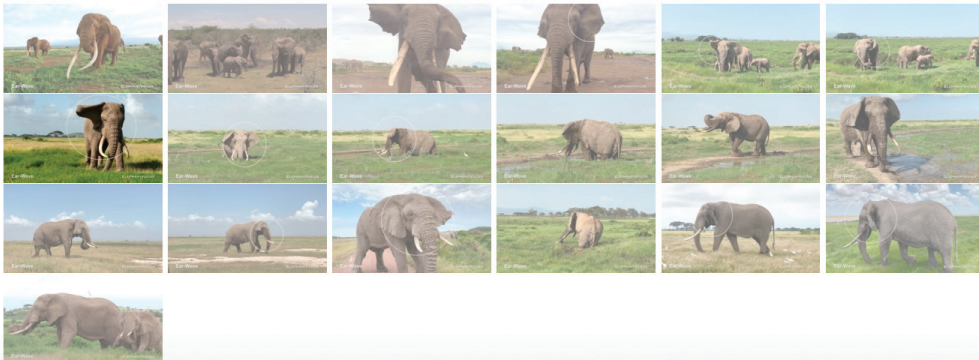


Figure 1. An example of a page describing a Behaviour. The Behaviour, Ear-Wave, is described followed by 19 annotated video examples. Clicking on a video, highlights it so that you may read the caption and play it.

Context	Behaviors	Behavioral Constellations
<b>Advertisement &amp; Attraction</b> <i>Behaviors employed by adult males and adult females in the advertisement of sexual state and the attraction of, and search for, mates.</i>	Bonding-Rumble (0), Casual-Stance (5), Chin-In (1), Ear-Brush (1), Ear-Folding (3), Ear-Slap (1), Ear-Wave (18), Ears-Stiff (2), Estrous-Roar (5), Estrous-Rumble (4), Estrous-Running-Rumble (1), Exaggerated-Splash-with-Foot (2), Female-Chorus-Rumble (6), Flehmen (11), Foot-Scuffing (3), Grasp-Tail (2), Head-High (1), Head-Raising (0), Head-Toss (2), J-Trunk (2), Musth-Rumble (21), Musth-Temporal-Gland-Secretion (5), Musth-Temporal-Gland-Swelling (8), Musth-Trunk-Wrinkle (4), Nasal-Throb (6), Open-Mouth (0), Open-Mouth-to-Open-Mouth (0), Penis-Erection (3), Periscope-Trunk (2), Place (2), Purposeful-Walk (0), Rapid-Ear-Flapping (0), Rubbing (2), Rumble (0), Rump-Present (1), Run-Toward (0), Sniff-Dung (4), Sniff-Ground (1), Sniff-Urine (4), Social-Trumpet (2), Tail-Swatting (2), Temporin (0), Trumpet (0), Trunk-Bounce-Drag (0), Trunk-Curl (5), Trunk-Dragging (10), Trunk-Flick-Down (2), Trunk-Suction (3), Trunk-to-Genitals (9), Trunk-to-Genitals-Suck (1), Trunk-to-Mouth (1), Trunk-Toward (2), Tusk-Ground (4), Urinating (1), Urine-Dribbling (11), Walk-Away (0), Walk-Toward (0).	Estrous-Running-Rumble-Roar (0), Estrous-Walk (7), Female-Chorus (3), Listening (8), Mating-Pandemonium (7), Musth-Display (1), Musth-Walk (13), Roar-Rumble (1), Rumble-Roar (0), Rumble-Roar-Rumble (1), Simulate-Estrus (1), Tracking (9), Wariness (2).

Figure 2. An example of one of 23 rows from the Ethogram Table defines a context and lists the *Behaviours* and *Constellations* that have been observed to occur within it.

**Combined Dropdown Search**

Select one or more dropdown alternative(s). A search will list all matching Behaviors and/or Constellations.

Behaviors & Behavioral Constellations

--Contexts--

--Age/Sex--

--Active Body Part--

--Communication Mode--

--Sounds of Elephants--

Search    Reset

**Free Text Search Name/Description**

Search on any word. All Behaviors and Constellations with that word in the name or description will be listed, with the number of video examples in parentheses.

**Free Text Search Video Captions**

Search on any word. All Behaviors and Constellations with that word in the video caption will be listed; e.g. "Amboseli" will list all videos from Amboseli, Kenya.

**Alphabetical Search**

Click on a letter to see all Behaviors and Constellations starting with that letter.

[A](#) [B](#) [C](#) [D](#) [E](#) [F](#) [G](#) [H](#) [I](#) [J](#) [K](#) [L](#) [M](#) [N](#) [O](#) [P](#) [Q](#) [R](#) [S](#) [T](#) [U](#) [V](#) [W](#) [X](#) [Y](#) [Z](#)

Figure 3. The Search Portal offers a Combined Dropdown Search, two Free Text Searches and an Alphabetical Search.



Perpendicular-Walk

Figure 4. An example from the slideshow: Iphigenia engages in a Perpendicular-Walk, Gorongosa National Park.

its inevitable shortcomings and potential mistakes. We invite our colleagues to inform us of any amendments to be made, references to be included or terminology previously used to refer to a particular behaviour.

In conclusion, we hope to expand *The Elephant Ethogram* with selected files from additional populations as well as to note the occurrence of behaviours in African forest elephants (*Loxodonta cyclotis*). We appeal to our colleagues or members of the public to share with us interesting, unusual or cultural behaviour for inclusion in *The Elephant Ethogram*. We invite you to contact us via [ethogram@elephantvoices.org](mailto:ethogram@elephantvoices.org) to submit descriptions, photographs, audio or video recordings. All contributions will be credited.

The concept and structural design of *The Elephant Ethogram* was developed by Joyce Poole and Petter Granli of ElephantVoices. Programming and database coding and maintenance is handled by Derrick Joel, Nairobi, Kenya, in collaboration with Petter Granli. *The Elephant Ethogram* is coded in open-source software PHP and MySQL in Joomla! CMS, and is currently hosted on Cisco servers as a section of elephantvoices.org. Video and audio files are hosted on [Vimeo](#) and [SoundCloud](#), respectively.

## Acknowledgements

*The Elephant Ethogram* is made possible by support from Crystal Springs Foundation, WildiZe Foundation, Marshall Frankel Foundation, The Elephant Sanctuary, Gorongosa Project, Oakland Zoo, National Geographic Society, Spur–The Perenchio Family Fund and individual donors. We thank Off the Fence, Carr Foundation/Gorongosa Media Project and Bob Poole Films for granting hundreds of hours of raw elephant footage to us for use in science and education and cinemaphotographers and editors Emre Izat, Kate Bradbury, Bob Poole, Gina Poole, Carla Rebai, Jennie Vazquez. We are grateful to our friends and colleagues at the Amboseli Trust for Elephants, the Gorongosa Project, and in the Maasai Mara. We thank Lucy Bates, Andy Dobson and Cynthia Jensen for their helpful comments on aspects of *The Elephant Ethogram*. We thank Kenya Wildlife Service, Narok County Council, Maasai

Mara National Reserve, Amboseli National Park and Gorongosa National Park for permission to work in these amazing ecosystems.

## References

- Aristotle. 4<sup>th</sup> C. BC. *History of animals*. Translated by Richard Cresswell, London, 1862.
- Berg JK. 1983. Vocalizations and associated behaviours of the African elephant (*Loxodonta africana*) in captivity. *Z. Tierpsychol* 63: 63–79.
- Bolgan M, O’Brien JM, Gammell M. 2015. The behavioural repertoire of Arctic charr (*Salvelinus alpinus* (L.)) in captivity: a case study for testing ethogram completeness and reducing observer effects. In: *Ecology of freshwater fish*. John Wiley & Sons A/S. Published by John Wiley & Sons Ltd. <https://doi.org/10.1111/eff.12212>
- Darwin C. 1872. *The expressions of the emotions in man and animals*. London: John Murray.
- Douglas-Hamilton I. 1972. On the ecology and behaviour of the African elephant. D. Phil. Thesis. University of Oxford.
- Douglas-Hamilton I, Krink T, Vollrath F. 2005. Movements and corridors of African elephants in relation to protected areas. *Naturwissenschaften* 92: 158–163. DOI 10.1007/s00114-004-0606-9.
- Gaynor KM, Branco PS, Long RA, Gonçalves DD, Granli PK, Poole JH. 2018. Effects of human settlement and roads on diel activity patterns of elephants (*Loxodonta africana*). *African Journal of Ecology* 56: 872–881. <https://doi.org/10.1111/aje.12552>
- Goldenberg SZ, Wittemyer G. 2020. Elephant behavior toward the dead: A review and insights from field observations. *Primates* 61: 119–128 <https://doi.org/10.1007/s10329-019-00766-5>
- Hart J, Gobush K, Maisels F, Wasser S, Okita-Ouma B, Slotow R. 2021. African forest and savannah elephants treated as separate species. *Oryx* 55 (2): 170–171. <https://doi.org/10.1017/S0030605320001386>
- Kahl MP, Armstrong BD. 2000. Visual and tactile displays in African elephants, *Loxodonta africana*: A progress report (1991-1997). *Elephant* 2 (4): 19–21.
- Kahl MP, Armstrong BD. 2002. Visual displays of wild African elephants during musth. *Mammalia* 66: 159–171.
- Kühme VW. 1961. Beobachtungen am africanschen Elephanten (*Loxodonta africana* Blumenbach 1797).

Gefangenschaft Zeitschrift für Tierpsychologie 18: 285–96.

Kühme W. 1963. Ergänzende Beobachtungen an afrikanischen Elefanten (*Loxodonta africana* Blumenbach 1797) im Freigehege (2. Teil). Zeitschrift für Tierpsychologie, 20 (1): 66–79.

Meredith M. 2001. *Africa's elephants: A biography*. London: Hodder and Staughton.

Moss C. 1983. Oestrous behaviour and female choice in the African elephant. *Behaviour* 86: 167–96.

Moss CJ, Poole J. 1983. Relationships and social structure in African elephants. In R. A. Hinde (ed.), *Primate social relationships: An integrated approach* Oxford: Blackwell Scientific pp. 315–325.

McComb K, Moss C, Sayialel S, Baker L. 2000. Unusually extensive networks of vocal recognition in African elephants. *Animal Behavior* 59: 1103–1109.

Nishida T, Kano T, Goodall J, McGrew WC, Nakamura M. 1999. Ethogram and Ethnography of Mahale Chimpanzees. *Anthropological Science* 107 (2): 141–188.

Nishida T, Zamma K, Matsusaka T, Inaba A, McGrew C. 2010. *Chimpanzee Behavior in the Wild: An Audio-Visual Encyclopedia*. Springer Japan.

Poole JH. 1987. Rutting behaviour in African elephants: the phenomenon of musth. *Behaviour*. 102: 283–316.

Poole JH. 1989a. Announcing intent: the aggressive state of musth in African elephants. *Animal Behavior* 37: 140–152.

Poole JH. 1989b. Mate guarding, reproductive

success and female choice in African elephants. *Animal Behavior* 37: 842–849.

Poole JH. 2011. Behavioral contexts of vocal communication of African savannah elephants. In: *The Amboseli elephants: A long-term perspective on a long-lived mammal*. Eds. Moss CJ, Croze HJ, Lee PC. University of Chicago Press, Chicago.

Poole JH, Payne KB, Langbauer WR Jr, Moss CJ. 1988. The social contexts of some very low frequency calls of African elephants. *Behavioral Ecology and Sociobiology* 22: 385–92.

Poole JH, Tyack PL, Stöeger-Horwath AS, Watwood S. 2005. Elephants are capable of vocal learning. *Nature* 434: 455–456. <https://doi.org/10.1038/434455a>

Poole JH, Granli PK. 2011. Signals, gestures and behaviors of African elephants. In: *The Amboseli elephants: A long-term perspective on a long-lived mammal*. Eds. Moss CJ, Croze HJ, Lee PC. University of Chicago Press, Chicago.

Wall J, Wittemyer G, Klinkenberg B, Maisels F, Ferwerda J, Douglas-Hamilton I. 2021. Human footprint and protected areas shape elephant range across Africa. *Current Biology* 31: 11. <https://doi.org/10.1016/j.cub.2021.03.042>

Wittemyer G, Douglas-Hamilton I, Getz WM. 2005. The socioecology of elephants: Analysis of the processes creating multitiered social structures. *Animal Behaviour* 69: 1357–1371.

Wittemyer G, Northrup JM, Blanc J, Douglas-Hamilton I, Omondi P, Burnham, KP. 2014. Illegal killing for ivory drives global decline in African elephants. *PNAS* 111 (36) 13117–13121 <https://doi.org/10.1073/pnas.1403984111>