



Behavioural inventory of the giraffe (*Giraffa camelopardalis*)

Seeber *et al.*

SHORT REPORT

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Behavioural inventory of the giraffe (*Giraffa camelopardalis*)

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Abstract

Background: Numerous factors like continuous habitat reduction or fragmentation for free-ranging giraffes (*Giraffa camelopardalis*) as well as e.g. suboptimal housing conditions for animals in captivity might lead to behavioural alterations as part of the overall adaptation process to the changing living conditions. In order to facilitate current and future studies on giraffe behaviour, a comprehensive ethogram was compiled based on existing literature, as well as observations on giraffes in the wild (Hwange National Park, Zimbabwe; Entabeni Game Reserve, South Africa), and in captivity (National Zoological Gardens of South Africa, Pretoria).

Findings: The resulting ethogram lists 65 different behavioural patterns, which were described and grouped into seven categories: General activities, Abnormal repetitive behaviours, General interactions, Bull-Cow behaviour, Bull-Bull behaviour, Cow-Bull behaviour, Maternal behaviours, and Interactions by calves. The behaviours were further described regarding a presumed purpose, particularly with respect to social interactions and sexual behaviour. Contradictory descriptions from previous studies were considered and discussed in comparison with our own observations.

Conclusions: This ethogram provides a basis for current and future studies by suggesting a terminology which can be used for harmonizing behavioural observations, thus helping to facilitate comparability of future results. Subsequently, a better understanding of the behavioural ecology of giraffes in the wild as well as in captivity could aid future conservation efforts.

Keywords: *Giraffa camelopardalis*, Ethogram, Behavioural activity, Abnormal repetitive behaviour, Social interaction, Hwange National Park, Entabeni Game Reserve, National Zoological Gardens of South Africa

Background

The giraffe (*Giraffa camelopardalis*) is the tallest land-living animal and the only extant species of its genus [1]. Although there is still uncertainty about the exact number and distribution of subspecies within *Giraffa*, a division into nine subspecies are generally accepted [2]. Two of these subspecies are currently listed as endangered by the International Union for Conservation of Nature and Natural Resources [3]. The giraffe naturally inhabits a variety of habitats, from deserts to more heavily vegetated bush- and tree savannah [4,5], and there is evidence for habitat-related adjustments of occurring social structures and of particular behaviours, such as stable social

structures and dominance hierarchies instead of fission-fusion structures [6].

Over the past couple of decades, the number of giraffes has declined considerably across Africa, presumably due to direct and indirect anthropogenic impact, such as extensive poaching, habitat destruction, and rinderpest [7-9]. As a consequence, several of today's giraffe populations are isolated and live in detached habitat fragments or fenced reserves [7,8]. By restricting the natural tendency of giraffes to roam vast areas in search for conspecifics, further implications in terms of behavioural alterations are easily conceivable [6,10,11]. These alterations might even have long-term effects on e.g. intraspecific competition, predator-prey relationships, or parasite transmission amongst other factors [6,10,11], and might have to be considered in future conservation plans for affected populations. However, data on the giraffe's ethology and its variation should be available in order

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to provide information for an integrated conservation approach [12].

Monitoring of wildlife behaviour is also a valuable and frequently used tool to provide information about the health and welfare status of animals in captivity [13,14]. However, the interpretation of behavioural data is not robust, and relies heavily on preliminary defined criteria [15]. In order to obtain reliable results, the respective behavioural patterns must be adequately defined [16]. To allow cross-institutional comparison of collected data and to contribute to a reliable base of information, behaviour must be measured in a distinct and standardised way. Thus, the use of an accurate established ethogram is highly recommendable, not least because it helps to prevent 'drift' during the course of observation and also in order to facilitate methodology and results [17].

In terms of available behavioural data for the giraffe, many of the contributing studies only cover specific behavioural classes and at times, these studies use inconsistent terminology or innovate purpose-built definitions for certain behaviours e.g. [18-23]. Hence, data to build upon is rather limited. In this paper, we therefore aim to provide a full descriptive catalogue of the giraffe's behavioural repertoire for observations of wild and captive animals. The compiled ethogram is structured into several categories, which are, in the case of intraspecific interactions, subdivided by sex and roughly predefined age classes of the acting individuals, as well as the animals the behaviour is presumably directed to. The definitions and general remarks provided will hopefully be of practical value in terms of producing more comparable ethological data in the future.

Observations were conducted at three different study sites: Hwange National Park (HNP), Zimbabwe, Entabeni Game Reserve (EGR), South Africa, and at the National Zoological Gardens of South Africa (NZG) in Pretoria.

Findings

Methods

General method

In a similar approach to other studies e.g. [24,25], the behaviours reported in this paper were compiled from several sources. In order to assess as many of the behaviours shown by giraffes as possible, numerous peer-reviewed articles, dissertations and theses, and other publications (Appendix), focussing on descriptions of giraffe behaviour or at least partly addressing the topic, were reviewed for behavioural descriptions and definitions e.g. [2,4,5,9,16,18-23,26-50]. In addition, observations were conducted in three different environments, in order to confirm, refine, and if necessary extend existing descriptions of giraffe behaviour. In case of future observations though, variations in methodology and flexibility of the research has to be noted.

All behaviours were described as brief and definite as possible, according to the descriptions by other authors and our own observations. In this regard, we tried to comment regarding the behaviours apparent social and/or ecological context, and assumed purpose. The resulting list of behaviours is divided into two main groups; *Activities* (characterised by the absence of any social context) and *Interactions* (characterised by the presence of some kind of interaction between animals).

Literature review

In total, 104 publications (93 scientific articles, 2 books, 3 PhD theses, 2 MSc dissertations and 4 other publications) on giraffe behaviour, ecology, and general biology were reviewed for descriptions of behavioural patterns in wild and captive giraffes, listed in the Appendix.

Original observations

Giraffes were predominantly observed using *ad-libitum* and *all-occurrence* sampling [51]. As an example of a near-natural environment, wild giraffes were observed in HNP for thirteen weeks, between November and December 2010, and from March to April in 2011. During a total observation time of 272 hours, 1264 sightings were recorded (345 sightings of mature males, 752 of mature females, 159 of juveniles / subadult individuals). HNP covers 14,650 km² in western Zimbabwe and is entirely unfenced. A presumably stable population of roughly 2800 giraffes are estimated to live in HNP and adjacent areas [3]. Lions as the giraffe's main predators are abundant [52], and also other large predators such as spotted hyenas, cheetahs and leopards are present. Observations were conducted at several water holes and open plains in the Main Camp area, ranging from Guvalala Pan to Ngweshla Pan.

About 40 giraffes were additionally observed on a daily basis in EGR for three weeks in September 2011. EGR is a private game reserve, covering 250 km² and is entirely fenced. An otherwise unmanaged population of about 45 giraffes were kept in the reserve during the time of observation. Lions, cheetahs, and leopards are also present.

In order to collect data on an abnormal repetitive behaviour in a captive animal, two adult giraffes (1 male, 1 female) housed at NZG, were also briefly observed for 7 hours in February 2011.

Results and Discussion

A total of 65 different behaviours could be identified. These behaviours were subdivided into 30 *Activities* and 35 *Interactions*. Activities were subdivided further into *General activities* (Additional file 1: Table S1) and *Abnormal repetitive behaviours* (Additional file 2: Table S2). Interactions were structured by sex and age class of the acting animal, and of the animals the behaviour is

presumably directed to. This resulted in *General interactions* (Additional file 3: Table S3), *Bull-Cow behaviour* (Additional file 4: Table S4), *Bull-Bull behaviour* (Additional file 5: Table S5), *Cow-Bull behaviour* (Additional file 6: Table S6), *interactions by calves* (Additional file 7: Table S7), and *maternal behaviours* (Additional file 8: Table S8). No behaviours were found being performed exclusively between cows.

Activities

As mentioned above, behaviours allocated to the category *Activities* are not related to any type of interactive behaviour and also not restricted to one sex or age class. Behaviours of the *Activities* category were further subdivided into *General Activities* (Additional file 1: Table S1) and *Abnormal repetitive behaviours* (Additional file 2: Table S2).

Abnormal repetitive behaviours

As in other species, it is assumed that abnormal repetitive behaviours often develop in captive animals due to a time budget shift in the daily activity pattern [46,47]. Giraffes in captivity spend considerably less time feeding compared to the amount of time giraffes *browse* in the wild [16,20].

Interactions

This section includes behaviours which are characterised by any type of direct or indirect social interaction between individual giraffes. Behaviours of the *Interactions* category were further subdivided into *General Interactions* (Additional file 3: Table S3), *Bull - Cow Behaviour* (Additional file 4: Table S4), *Bull - Bull Behaviour* (Additional file 5: Table S5), *Cow - Bull Behaviour* (Additional file 6: Table S6), *behavioural Interactions by Calves* (Additional file 7: Table S7) and *maternal behaviours* (Additional file 8: Table S8). All behaviours performed between cows (*cow-cow*) were also observed between other constellations of sex and age, thus listed under *general interactions*.

This ethogram was compiled to serve as a basis for current and future studies designed to further examine the complex behavioural patterns of the species. Based on our own observations, several often older descriptions could be verified and even new insights added to what is stated in literature.

The classification of the described behaviours into *activities* and *interactions* might appear rather clear from a definition point of view, but should be used with precaution, because the complete intention and purpose of an observed behaviour always remains an interpretation based on a projection of the observer's conception. The animal's behaviour can not be reduced to the sum of different behavioural acts, which is why clear and precise terminology is essential to create a common language

understandable among human observers and to contribute to the understanding of wildlife behaviour.

Regarding social interactions not restricted to one sex or age class (*General Interactions*), it is worth noting that many of these behaviours were originally described as exclusively exaggerated by one sex, or by a specific age class. However, during our observations, we also register the performance of these behaviours by the respective opposite sex, or across age classes, respectively.

The section on play behaviour was kept rather short and comprehensive. For the sake of brevity, all behaviours of the same obvious (play) intention were summarised. Nevertheless, future studies might be able to reveal various forms of play behaviour in giraffe, similar to that of other ungulates, although probably not as pronounced as e.g. in horses [24].

Several behaviours, although often only observed in form of an attempt (e.g. mounting, mating, nursing) are classified as separate behaviours in this ethogram, because attempts seem to be distinct and important, therefore these behaviours might be considered as a separate sub-section in an ethogram used for observations.

It must be also mentioned, that for the visual communication of dominance, contradictory descriptions are given in literature. Pratt and Anderson [5] report that a dominant bull will walk towards an opponent with its head held high, intending to look as big as possible. On the contrary, Dagg [9] states that a dominant bull, threatening an opponent will carry his head deep with the neck parallel to the ground, as if assuming a fighting position. We suggest that both observations are adequate and that communication of dominance might vary with the distance between opponents. In this regard, the "head-high" posture could be assumed for a distance of more than two body lengths, while the "fight" posture would be assumed with the opponent in close proximity, as it has been seen during our own observations. The typical intention of a threatening giraffe bull is often expressed by an arched and tensed neck (see *Dominance gesture*), as it is also seen in other ungulates, e.g. horses [53] or reindeer [54]. The visual communication of submission is contrary to that of *dominance* and thus is also described contradictory in literature. According to Pratt and Anderson [5,27], the subdominant individual will carry its head low to look smaller than it is, in order to not provoke aggression. Dagg [9] reports that inferior giraffe bulls stand with an erect neck and the nose pointed upwards, assuming a feeding position and thereby exposing the body to attacks. As well as for *dominance*, a distance dependent expression for submission might be considered. In this regard, the plasticity of social behaviour and communication patterns should be borne in mind during conduction and interpretation of behavioural observations.

Conclusions

Observed behaviours should be interpreted carefully and the researcher should consider the animal's intention not only for the moment and place of observation but also on a larger temporal and spatial scale. An animal's original intention is in many cases difficult to evaluate and rather oblique, which applies particularly to large animals like the giraffe with its rarely assessable visual facilities [26]. Furthermore, olfactory cues and insufficient recognition regarding long distance communication via infrasound make it sometimes difficult to unequivocally relate a certain observed behavioural event to a specific category (von Muggenthaler, Baes, Hill, Fulk, Lee, unpublished results), therefore the division of interactions and activities not related to a social context remain somewhat arbitrary.

A comprehensive and reliable tool to monitor giraffe behaviour in the wild as well as in captivity is a necessity to gain a better understanding of the giraffe's life-history requirements. Subsequently, gaining a better understanding of giraffe behaviour will help to develop more effective conservation strategies for improving giraffe management in the wild and in captivity by creating species-tailored management plans.

Appendix

Sources used for the compilation of the giraffe ethogram

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Additional files

Additional file 1: Table S1. General Activities [2,4,9,16,20,21,23,26-28, 31-35,38-52,55-62].

Additional file 2: Table S2. Abnormal repetitive behaviours [16,20,26,30,45,46].

Additional file 3: Table S3. General Interactions [5,18,19,23,27,42,44, 47-50,59].

Additional file 4: Table S4. Bull Cow Behaviour [19,23,27].

Additional file 5: Table S5. Bull-Bull Behaviour [9,18,23,41,60].

Additional file 6: Table S6. Cow - Bull Behaviour [23,27].

Additional file 7: Table S7. Behavioural Interactions by Calves [5,42,47].

Additional file 8: Table S8. Maternal behaviour [41,42,55].

Competing interests

The authors declare that they have no competing interests.

Authors' contributions

PAS and AG conceived the study and drafted the manuscript. IC reviewed the initial draft and contributed on information and behavioural interpretation. All authors contributed to, read, and approved the final manuscript.

Acknowledgements

The project was financially supported by the University of Pretoria, the Giraffe Conservation Foundation, the SAVF, and by the CNRS HERD project, directed by H. Fritz. We thank the Zimbabwe Parks and Wildlife Management Authority for permission to conduct research work in Hwange National Park. For observation permission and collaboration we also thank the ecologists team from Entabeni Game Reserve, and the National Zoological Gardens, Pretoria.

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Received: 26 April 2012 Accepted: 15 November 2012

Published: 22 November 2012

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doi:10.1186/1756-0500-5-650

Cite this article as: Seeber et al.: Behavioural inventory of the giraffe (*Giraffa camelopardalis*). *BMC Research Notes* 2012 **5**:650.

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