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## COMMUNICATION

### ANALYSIS OF STEREOTYPIC BEHAVIOUR AND ENHANCED MANAGEMENT IN CAPTIVE NORTHERN GIRAFFE *GIRAFFA CAMELOPARDALIS* HOUSED AT ZOOLOGICAL GARDEN ALIPORE, KOLKATA

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## Analysis of stereotypic behaviour and enhanced management in captive Northern Giraffe *Giraffa camelopardalis* housed at Zoological Garden Alipore, Kolkata

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**Abstract:** In the wild, giraffes live complex social lives exhibiting fission-fusion social systems. They have sophisticated communication which likely forms a crucial component regulating subgroup dynamics. They spend a large part of their day browsing and traveling over large distances. In captivity, lack of continuous browsing opportunities and limited space can lead to various abnormal and stereotypic behaviours. These stereotypic behaviours can have cascading detrimental health consequences. A behavioural analysis of stereotypic behaviours in giraffes under human care was conducted to evaluate sources of variation within a population and provide management recommendations. The aim of this investigation was threefold: 1. to examine current behaviour of giraffes in Zoological Garden Alipore, Kolkata to advise on their enhanced management; 2. to highlight any behavioural abnormalities and recommend enrichment mechanisms; and 3. to compare the observed stereotypic behaviours with behaviour described in other zoological institutions and in the wild to provide a focal trajectory in the development of guidelines. Four individuals (two adult males, one adult female, and one male calf) were observed outdoors for seven days, three times a day for 30 minutes by instantaneous scan sampling method. During the observation period, the giraffe exhibited oral stereotypy more than any other behaviour recorded, though this was recorded disproportionately between individuals. The giraffe spent a larger amount of time exhibiting oral stereotypy compared to feeding/foraging activities. The study suggests incorporating diet and feeding strategies with provision of natural browse as well as offering enrichment methods to increase the foraging time using various time-engaged feeding devices to mitigate the observed abnormal stereotypic behaviour. Additionally, recommendations are made for expanding the size of the open enclosure to meet guidelines by the Central Zoo Authority, as a minimum.

**Keywords:** Animal welfare, behavioural abnormalities, enrichment, Giraffe, stereotypy.

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## INTRODUCTION

Giraffes *Giraffa* spp. are tallest of the land mammals, largest of the ruminants, and are mega herbivores. Over the past decade the first-ever comprehensive DNA sampling and analysis (genomic, nuclear, and mitochondrial) from all major natural populations of giraffe was undertaken throughout their range in Africa. As a result, an update to the traditional taxonomy now exists. This study revealed that there are four distinct species of giraffe and likely five subspecies (Fennessy et al. 2016; Winter et al. 2018). The four species are Masai Giraffe *G. tippelskirchi*, Northern Giraffe *G. camelopardalis*, Reticulated Giraffe *G. reticulata*, and Southern Giraffe *G. giraffa*. Nubian giraffe *G. c. camelopardalis*, Kordofan Giraffe *G. c. antiquorum* and West African Giraffe *G. c. peralta* are the three subspecies of the Northern Giraffe, while Angolan Giraffe *G. g. angolensis*, and South African Giraffe *G. g. giraffa* fall under the Southern Giraffe. Rothschild's Giraffe is genetically identical to the Nubian Giraffe, and thus subsumed into it (Winter et al. 2018). Based on this research, we refer to the updated giraffe taxonomy of four species.

The pursuit of forage constitutes a large portion of the daily activities of giraffe (Dagg & Foster 1976) with studies suggesting that wild giraffe spend approximately 51–59% of the day feeding/foraging (Fennessy 2004). Giraffes move constantly while feeding due to spatially heterogeneous distribution of forage and the protection mechanisms of browse plants (EAZA 2006). As such, daily foraging and rumination times make up a large proportion of their activities. Food and energy intake, therefore, remains distributed over the whole day for giraffe due to their specialized feeding ecology. Pellew (1984) observed wild Masai Giraffe in Serengeti National Park, Tanzania and 96% of feeding was on trees or shrubs, with *Acacia* species most frequently consumed during the wet season. Removal of *Acacia* leaves is difficult because most species have thorns (Dagg & Foster 1976; Pellew 1984) or stinging ants (Dagg & Foster 1976), and giraffes must use their tongues to remove the tree's leaves (Dagg & Foster 1976).

As giraffes have evolved to use their prehensile tongues to remove leaves from trees, oral stereotypies like non-food object licking behaviours likely result from a captive environment that does not provide ample opportunities to satiate this need (Sato & Takagaki 1991; Kolter 1995; Koene & Visser 1996; Baxter & Plowman 2001; Fernandez et al. 2008). Although giraffes rarely exhibit stereotypic behaviours in the wild (Veasey et al.

1996) other studies of giraffe under human care suggest that 79.1 % of captive giraffe in surveyed zoos (Bashaw et al. 2001) with reported prevalence of tongue playing stereotypic behaviours reached as high as 25% of total observed behaviours (Koene & Visser 1996).

Giraffe are foregut fermenters (Mertens 2007). Captive giraffe are often fed diets too high in starch and sugars (as are found in sugar-rich produce), and the reduced fiber could cause explosive fermentation in the foregut, increasing the risk of occurrence of rumen acidosis among giraffe (EAZA 2006). Rumen acidosis contributes to several physiological and behavioural problems in captive giraffes including oral stereotypy (EAZA 2006). A fully grown giraffe with maintenance requirements (including moderate locomotion levels) consumes about 8.5–12 kg of dry matter (DM) per day on a captive diet (1.2–1.3 % of body weight) (EAZA 2006). Lintzenich & Ward (1997) recommend 60–70 % of forage in diets for giraffes. Hofmann (1973) classifies the giraffe as browsers. Browse closely resembles their natural food and food acquisition patterns. Also, being ruminants, a considerable proportion of tongue movement occurs during rumination. In captive settings, lack of browse or opportunities to browse to induce rumination do not promote natural tongue manipulation and could lead to increase in oral stereotypies (Schaub et al. 2004; Hummel et al. 2006; Duggan et al. 2015). In zoological institutions, therefore, a major task for giraffe husbandry is to simulate the feeding and foraging behaviours, as lack of behavioural foundations representing natural behavioural ecology can lead to behavioural pathologies (e.g., oral stereotypies or pacing), and impaired health (e.g., rumen acidosis).

Enclosure space has a profound influence on the behavioural activity budget of the giraffes housed in it (Garry 2012). Giraffe naturally have a mean home range size of 282km<sup>2</sup> (du Toit 1990) and have been found to cope well in restricted captive conditions; however, enclosures too restrictive due to space constraints for group size and density of animals have also been correlated with increased stereotypic licking in giraffes, okapi, horses (Redbo et al. 1998; Bashaw et al. 2007). The Central Zoo Authority (CZA), Ministry of Environment and Forests, Government of India prescribes minimum size of outdoor enclosure of 1,500m<sup>2</sup> for housing two giraffes (Bonal et al. 2014).

This study was conducted with a threefold objective. Firstly, to examine current behaviour of Northern Giraffes in Zoological Garden Alipore, Kolkata to advise on their enhanced management. Secondly, to highlight any behavioural abnormalities and recommend enrichment

mechanisms. And lastly, to compare the observed stereotypic behaviours with behaviour described in other zoological institutions and in the wild to provide a focal trajectory in the development of guidelines.

## MATERIALS AND METHODS

To characterize stereotypical behaviour in captive giraffe, behavioural observations were conducted at the Zoological Garden Alipore, Kolkata, India. The giraffe enclosure housed seven individuals, consisting of three adult males, two adult females, and two calves (a male and a female). The outdoor enclosure was 20m x 20m in width (400m<sup>2</sup>) (Figure 1), with an indoor facility that contained the feeding and drinking area. The feeding and drinking area was not visible during the observation sessions, although the giraffes had open access day and night to both areas. Therefore, observations on feeding and drinking behaviour could not be included in the study.

The food offered to the giraffe at Zoological Garden Alipore included higher proportions of concentrates and

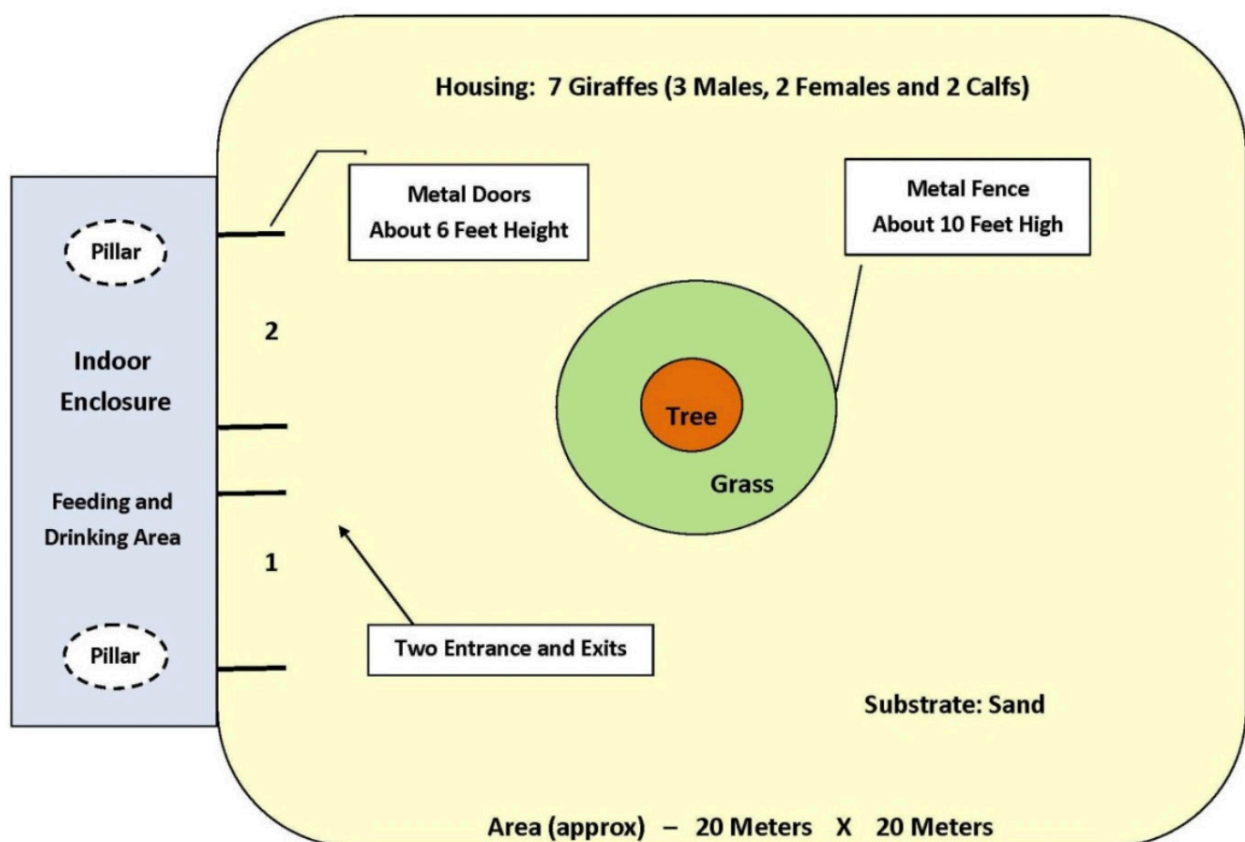
sugar-rich produce (in the form of fruits and vegetables). No browse was offered as a part of the diet. The feed was offered in open feeders and was accessible to all giraffes equally. The proportion of concentrates and produce a single giraffe would eat was not estimated. The giraffe were fed twice a day at 08.00 and 15.00 h, making them susceptible to large amounts of starch and sugar loads in the rumen at any one time.

For the study, four giraffe were selected as a sample of the herd (Table 1).

The four giraffe representing different ages and sexes; the dominant male, the subordinate male, a female and

**Table 1. Details of subjects involved in the observational study at Zoological Garden Alipore, India.**

Giraffe	Identity code	Age	Description
Dominant male	B1	14 years	Dominant bull and sire of calf (C)
Subordinate male	B2	13 years	Second largest bull
Female	F	4 years	Dam of calf (C)
Calf	C	1.5 months	Male calf



**Figure 1. Layout of the Giraffe Enclosure at Zoological Garden Alipore, India.**



**Table 2. Giraffe behaviour categories and descriptions recorded.**

	Behaviour	Description of behaviours collected
1	Resting	Subject is standing motionless, eyelids go down or remain half closed, or is laying on the ground, either neck held up right or low to the ground
2	Ruminating	Subject regurgitates food to the mouth and chews it again while standing motionless, sitting on the ground or moving from one place to another
3	Self grooming	Subject is nibbling, licking itself, appearing to clean itself while in standing position or sitting on the ground
4	Walking	Subject is moving from one place to another at a normal walking pace
5	Galloping	Subject is moving from one place to another in a three beat gait e.g. canter, faster than a walk
6	Reaching out for food	Subject in standing or in splaying position is trying to reach the leaves of trees outside the enclosure by sticking out the tongue through the gaps of the metal netted fence
7	Sniffing / Tasting soil or grass	Subject is splaying and sniffing or tasting the soil, or nibbling grass at the edges inside the enclosure
8	Vigilant	Subject is observing the visitors or focusing on visitor activity
9	Interaction with others	Subject is interacting with another individual e.g. touching nose, mouth, back, tail, licking / biting mane, bumping rump
10	Licking stereotypy	Subject is indulging in invariant and repetitive licking of walls, metal doors, metal fence, etc., along with tongue playing
11	Suckling	Subject (calf) suckling or trying to suckle the mother
12	Out of sight	Subject is inside the indoor facility and not visible
13	Others	Any other behaviours that are not listed above

the youngest calf (male), were observed for seven days from 24–31 October 2015, using instantaneous scan sampling method. Observations could not be done on Thursday, 29 October 2015 as the zoo remains closed on Thursdays. Behaviours were recorded every two minutes during each 30-minute session, three-times a day at 09.00, 13.00 and 17.00 h. A total of 84 observations were recorded, resulting in 1,260 data points.

The behaviours were categorized into an ethogram of 13 headings based on overall observed behaviour patterns (Table 2).

The average counts into an ethogram across the group were computed and aggregated into half-hourly blocks of time. To test if the observed levels of oral stereotypy at Zoological Garden Alipore were different than previously reported values in the wild and in other zoos, a series of one-sample t-tests were conducted. To assess if observed prevalence of stereotypic behaviour was greater than the null model of 0 in the wild, a series of one-sample t-tests were used comparing the observed prevalence of stereotypy for each individual's behavioural observations to 0 to account for the assumption that giraffe do not exhibit stereotypic behaviour in the wild (Bashaw et al. 2001). To assess if observed prevalence of stereotypic behaviour was different than previously reported studies, a series of one-sample t-test was conducted, comparing the observed prevalence of stereotypy for each individual's behavioural observations to 0.25 to account for the reported prevalence of stereotypic tongue playing

reported by Koene & Vissner (1996). To evaluate differences in stereotypic behaviours across age and sex classes over time, a linear mixed effects model was developed using proportion of time exhibiting stereotypic behaviour as the response variable. Age/sex class and time of day were used as the fixed effects and individual identity as a random effect. To account for proportional data, arcsine was used to transform the response variable.

## RESULTS

### Examination of behaviour

Figure 2 represents the behaviours recorded among all four giraffes during the total observation period at Zoological Garden Alipore (see Table 1 for identification of individuals).

During the week-long period, the giraffe primarily exhibited four behaviours: licking stereotypy, ruminating, walking, and resting more than any other behaviour recorded. The remainder of the recorded behaviours were observed less than 5% each of the total time observed.

### Behavioural abnormalities (Licking stereotypy)

Licking stereotypy (LS) was observed among the giraffe accounting for 25% of the total observations, peaking in the evenings (39%). LS was observed in all four giraffe, but disproportionately among the individuals.

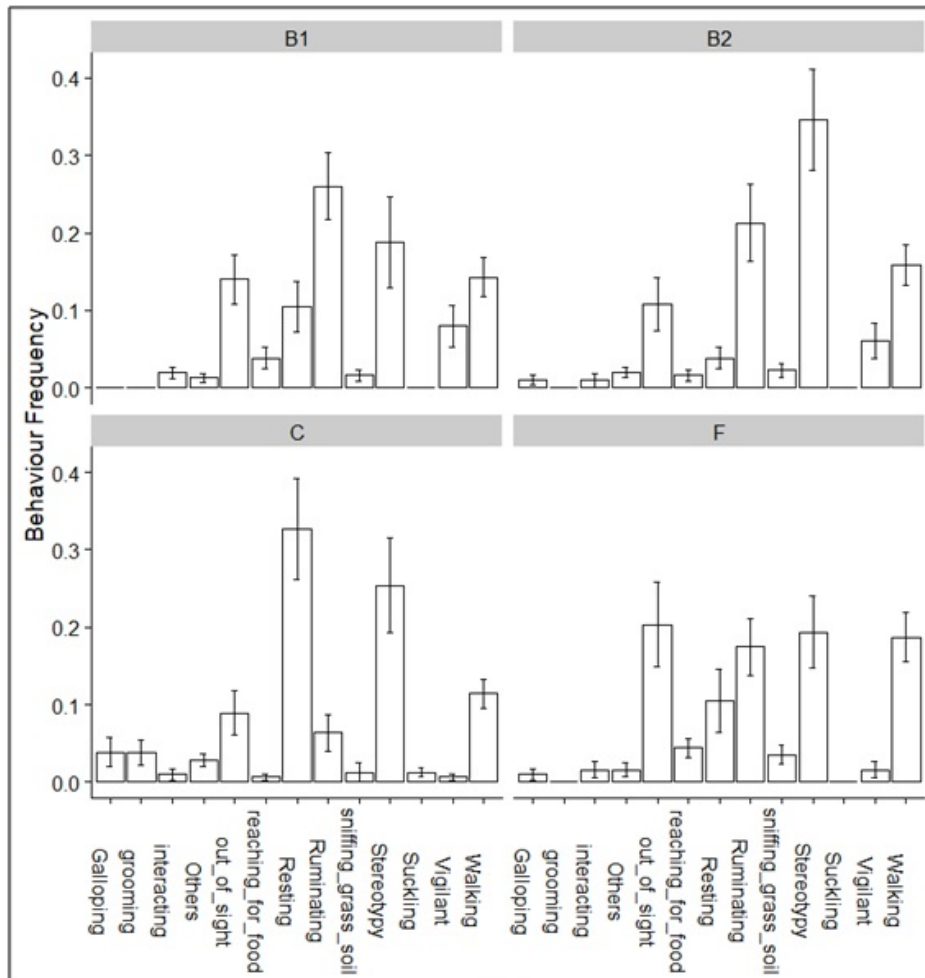


Figure 2. Behaviour among all four giraffe during total observation period at Zoological Garden Alipore.

The subordinate male (B2) was recorded 35% of time engaged in LS, compared to 26% for the calf (C), 20% for female (F) and 19% for the dominant male (B1). All captive giraffes consistently exhibited significantly higher proportion of stereotypic behaviour than giraffe in the wild (Veasey et al. 1996). These findings were consistent across all individuals of different age and sex classes, including: B1 ( $t=3.10$ ,  $df=20$ ,  $p<0.01$ ), B2 ( $t=5.13$ ,  $df=20$ ,  $p<0.01$ ), C ( $t=4.052$ ,  $df=20$ ,  $p<0.01$ ), and F ( $t=4.07$ ,  $df=20$ ,  $p<0.01$ ) (Figure 3). No significant difference was found in the proportion of observed stereotypic behaviour and reported values of 0.25 from other zoological collection. This finding was true for all observed giraffe: B1 ( $t=-1.04$ ,  $df=20$ ,  $p=0.31$ ), B2 ( $t=1.42$ ,  $df=20$ ,  $p=0.17$ ), C ( $t=0.06$ ,  $df=20$ ,  $p=0.95$ ), and F ( $t=-1.18$ ,  $df=20$ ,  $p=0.25$ ).

In evaluating the mixed effects model to test for the effect of time of day on the proportion of stereotypic behaviour, a significant effect of time of day on proportion of stereotypic behaviour was found with the highest proportions observed during evening observation

periods. Although the observed calf displayed an inverse temporal relationship with the highest proportion of stereotypic behaviours observed during the morning periods, the temporal effect was strong enough such that this relationship did not significantly vary across giraffe identity.

## DISCUSSION

The daily behaviours of the group of giraffe studied in this investigation was markedly different than the daily behaviours of their wild conspecifics. In particular, the amount of time spent indulging in oral stereotypical behaviours. Oral stereotypy, which was observed highest among all the behaviours in this study, is predominantly a giraffe behaviour observed in captivity as a result of diet, feeding method (foraging), appetitive behaviour, enclosure space, complexity of the environment and enrichment (Veasey et al. 1996; Mason & Mendl 1997).

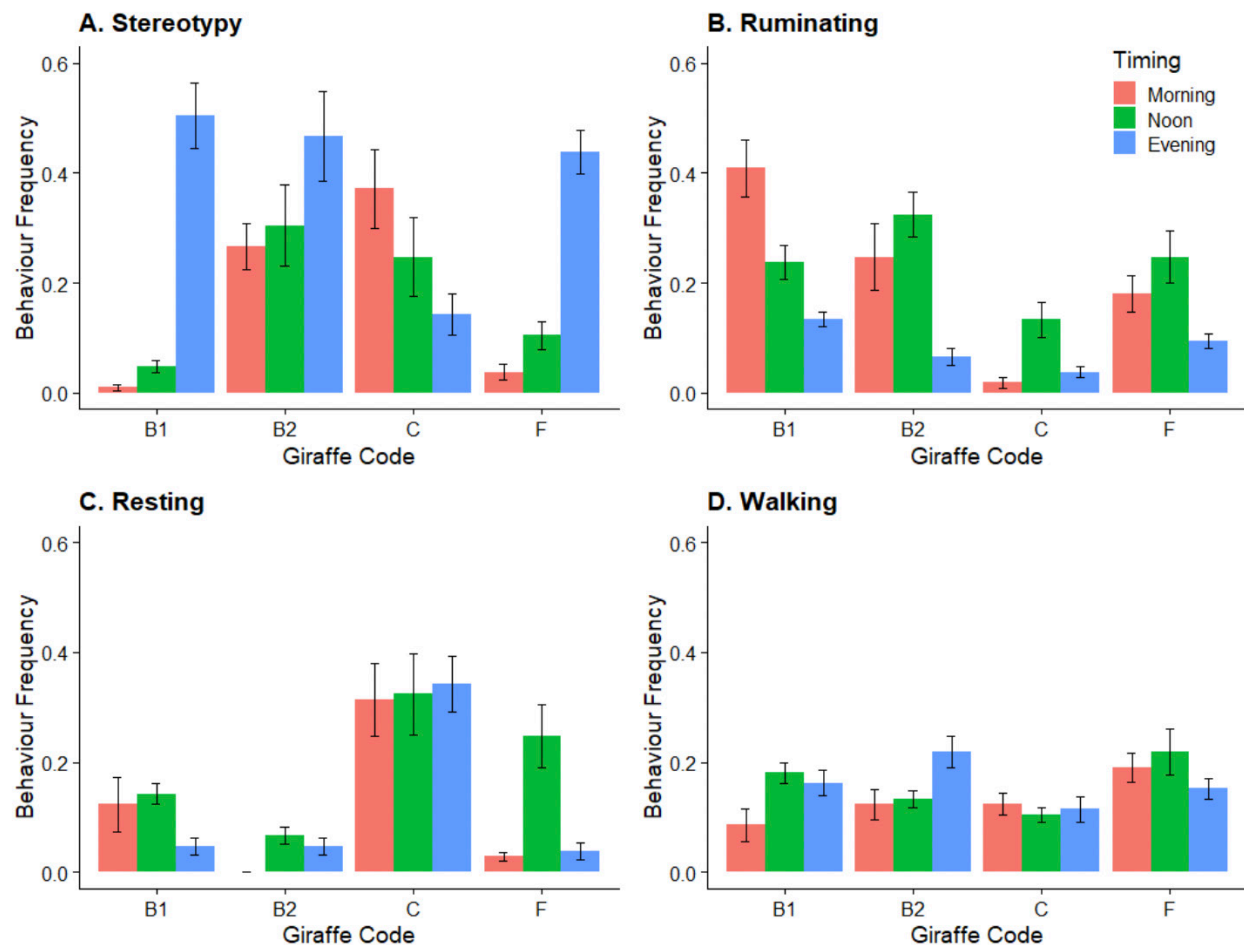


Figure 3. Behaviour across half-hourly blocks among all four giraffe during total observation at Zoological Garden Alipore.

The giraffes at the zoo were observed to perform stereotypical non-food object licking behaviours such as licking the enclosure doors, walls, and fence, which has been associated as a coping technique for captive animals in suboptimal environments (Mason 1991). Stereotypic behaviours are reported to have diminishing effects on the welfare of animals which perform them (Mason & Latham 2004; Mason et al. 2007).

#### Diet and feeding

Stereotypies in captive herbivores who are fed on diets largely consisting of concentrated feeds, presented in limited time and space, are often a result from a lack of opportunity to fulfill their innate motivation to perform foraging, consumption and digestive behaviour patterns (Appleby & Lawrence 1987; Terlouw et al. 1991). This in turn is detrimental to their welfare. The giraffe at Zoological Garden Alipore were fed higher proportions of sugar-rich produce (commercial fruits and vegetables) and concentrates, and no browse. Sugar-

rich produce contain nutritionally very fast fermenting sugars and starch and are low in plant fiber. Bergeron et al. (2006) suggests the hypothesis of occurrence of oral-stereotypic behaviours in captive ungulates having diets deficient in fiber, stating that the animals don't fill their gut and thus are not satisfied. Additionally, these feeds induce little chewing and hence little saliva production. In such cases oral stereotypy is suggested to benefit gut health by generating saliva which helps to rectify gastrointestinal pH (Bergeron et al. 2006). Intake of high proportion of concentrates can induce a rapid or even 'explosive' fermentation in the rumen, increasing the risk of occurrence rumen acidosis. Rumen acidosis could contribute to several problems in captive giraffes including oral stereotypy (EAZA 2006). By lowering the concentrations of sugar-rich produce and increasing the concentration of fiber in giraffe diet, Zoological Garden Alipore should be able to minimize the observed oral disturbances, and also a number of health problems associated with unhealthy rumens. It is recommended

that the zoo should restrict sugar-rich produce to very small quantities and special purposes like training or medication (EAZA 2006). Concentrates should be fed restrictively to minimize the fermentation effects for overcoming the observed oral stereotypy.

Feeding duration and schedule have been linked to the performance of stereotypic behaviour (Bashaw et al. 2001). In the wild, higher frequency of feeding behaviour occurs in the early morning and late afternoon but occurs throughout the day (Fennessy 2004). The observed giraffe exhibited oral stereotypy throughout the day but increased in oral stereotypy behaviour in the evening, post feeding times. The giraffe were offered meals only twice in a day resulting in peaks of energy intake during feeding hours. In the wild, however, energy intake remains distributed over the whole day because of their specialized feeding ecology. By increasing the number of meals offered, the energy intake can be prorated throughout the day. This will, in turn, lower the incidence of rapid microbial fermentation in the rumen and reduce the acidosis-induced tongue play, which the giraffe demonstrated through the oral stereotype behaviour. It is, therefore, recommended that the giraffe are fed at least three separate meals daily (EAZA 2006), with fresh browse or lucerne available at all times to guarantee additional fiber and reduced oral stereotypic behaviour.

The disproportionately observed LS behaviour among the individuals can be correlated with the incongruous feeding pattern adopted by the zoo as they desegregate the amounts of food consumed by individual giraffe. The giraffe are fed in feeders equally accessible to the entire herd, and as such, the proportion of food intake by an individual giraffe could not be measured. Allowing equal access to feeders can also spur dominant individuals to monopolize the feed stations and consume more. It is, therefore, recommended that the zoo provide separate feeders for each individual giraffe. This will enable to monitor food and energy intake by each individual and also prohibit dominant individual(s) from monopolizing a feed station and consuming too much concentrates or sugar-rich feed.

The diet of the giraffe lacked provision of browse: nontoxic, palatable tree branches and trimmings, closely resembling the natural food of giraffe. In the wild, browsing requires extensive use of their long prehensile tongues which is difficult to replicate in captivity if giraffe are fed more food concentrates that are thornless and relatively easy to process. A resultant LS behaviour was observed as the giraffe had inadequate opportunity for use of their long prehensile tongues in their natural feeding repertoire (Sato & Takagaki 1991)

thus consuming food rapidly. The importance of browse for both the nutritional value and the behavioural well-being of animals cannot be overstated and natural browse should be provided to the greatest possible extent, i.e., 40–60 pounds of browse per individual each day (Burgess 2004; EAZA 2006; Miller & Fowler 2012). Giraffe are highly efficient in processing foliage, and as such, browse should not be considered enrichment, but a formal requirement of their diet. Only browse that has been approved for use with giraffe should be fed. A well-developed logistics, either by contacts with the local forestry department, i.e., Department of Forests, Govt. of West Bengal, or by a browse plantation (Höllerl et al. 2006) is recommended to ensure year-round supply of sufficient browse for giraffe at Zoological Garden Alipore.

### Enclosure Space

In the wild, large herbivorous species have to walk long distances between feeding patches (du Toit & Yetman 2005). For giraffe, energy consumptive activity like walking is strongly biphasic with increased movements occurring post-dawn/early morning and pre-dusk/early evening, as compared to hottest period of the day (midday) (Fennessy 2004). Additionally giraffe are the only species to ruminate whilst walking (du Toit & Yetman 2005). Spatial limitations due to smaller enclosure caused eradication of the need to walk, and the giraffe were not observed to: walk, ruminate whilst walking for any long time periods.

It has been proposed that enclosure size influences the proportion of abnormal behaviour exhibited by confined animals (Maple 1979; Macedonia 1987; Kirkwood 1998). This appears very likely given the nature of giraffe movements in the wild who often have large home ranges (Baxter & Plowman 2001). In captivity, smaller enclosures limit opportunity to move and exercise due to inadequate space. Reduced opportunity to exercise may lead to decreased periods of sleep and increased time available for undesirable behaviour (Bashaw et al. 2001). Also, enclosures that are restrictive due to too large group size and density can have a negative impact on the animal's well-being (Garry 2012). The giraffe in the Zoological Garden Alipore were housed in a small enclosure space (400m<sup>2</sup>), far too restrictive for the group of seven. CZA prescribes minimum size of outdoor enclosure of 1,500m<sup>2</sup> for housing two giraffe (Bonafant et al. 2014), extrapolated to a minimum size of 5,250m<sup>2</sup> which is recommended. This is a significant difference. CZA also states that the enclosure for all the species displayed or kept in a zoo shall be of such size that all animals get adequate space



for free movement and exercise and no animal is unduly dominated or harassed by any other animal (Bonafant et al. 2014). It is, therefore, recommended that Zoological Garden Alipore should expand the enclosure to meet the guidelines by CZA as a minimum. Allowing greater access to exhibit space may also reduce the observed oral stereotypic behaviour and allow a more natural activity cycle (Forthman 1998).

### Enrichment

Providing opportunities for an animal to engage in its environment is an integral part of the daily husbandry routine, and is as important to an animal's care as diet and clean living quarters (Macphee & Mellen 2000). The existing giraffe enclosure at Zoological Garden Alipore was deficient in environmental complexity, lacking natural

browse, and feeding and behavioural enrichments, leaving excess free time which giraffe appear to have filled by performing oral-stereotypic behaviours. In the wild giraffe prefer to rest in microhabitats, such as under trees within the riparian woodland, allowing shade and wind to optimise heat loss or gain (Fennessy 2004). In captive environments, it is presumed that rumination is suppressed when giraffes cannot rest or relax (EAZA 2006). It is recommended that Zoological Garden Alipore provides special resting places in the outdoor enclosure, not too close to visitors or other busy places, to encourage the giraffe to lay down, rest, and ruminate (EAZA 2006).

In the wild giraffe use their prehensile tongues to remove small leaves from thorny plants, pluck off pods and flowers. Giraffe at the Zoological Garden Alipore are



Image 1. Enrichment Devices. A—closed-topped feeder | B—hay rack | C—browse ball | D—puzzle feeder | E—puzzle feeder (treat jar) | F—puzzle feeder (tongue puzzle bucket). Photo credits: A,C,D,E,F—Allison Suda & Chelsea Mihalick, Roosevelt Park Zoo, ND, USA; B—Cory Fagg, Fort Wayne Children's Zoo, IN, USA.

only offered food in open feeders and take mouthfuls without much tongue effort. As a result, their need for a certain amount of tongue movement was not met and they used their tongues for movements other than feeding, e.g., non-food stereotype object licking behaviours (EAZA 2006). Hence food presentation for giraffe in captivity should offer challenges to display increased tongue movements, encouraging the individuals to elicit more natural feeding behaviours. As compared to their wild conspecifics in the wild, the goal for captive giraffe should be to spend up to 60% of their time engaged in feeding or foraging activities (Fennessy 2004). Therefore, providing enrichment methods to increase time-engaged feeding for giraffe is strongly recommended. Closed-topped feeders (Bashaw et al. 2001) (Image 1), are recommended instead of traditional rack or trough-style feeders. These feeders require the giraffe to employ their prehensile tongue in obtaining food and increase feeding bout duration. Browse devices like hay racks, browse balls and puzzle feeders (Image 1) are recommended as they encourage giraffe to use their tongues to pull out the food, increasing their feeding durations and foraging time (Burgess 2004; EAZA 2006).

These devices are preferably spaced throughout the enclosure and rotated either on a schedule or randomly to provide more stimulation for the giraffe. Placing them at different heights also allows for foraging opportunities for all giraffe and encourages them to utilise all areas of the enclosure. CZA state that the timing of distribution of food, placement of food and way of distribution of food to the animals should be regulated in such a manner that the animals get maximum opportunity to express natural instincts and skills and behaviour related to feeding (Bonai et al. 2014).

## CONCLUSION

The giraffe in Zoological Garden Alipore, India lack continuous feeding stimulation and a balanced proportion of forage and concentrates. The facility lacked methods to monitor proportions of individual food intake and availability of browse. The outdoor enclosure did not meet the minimum size prescription advised by CZA and also lacked any feeding and behavioural enrichments. The combined effect of these limitations clearly causes the giraffe to exhibit predominant stereotypic licking behaviour. Other impacts on their welfare were not observed in the short study period but will likely result from the cumulative effects and limitations described above.

By increasing proportions of fiber in the diet and using a combination of different forages along with browse, the zoo will be able to reach the feeding goals for the giraffe. Expanding the outer enclosure to 5,250m<sup>2</sup> for the existing herd of seven giraffe can emphatically influence the need for free movement and exercise. Introducing enrichment methods to improve the feeding behaviours (longer and more feeding periods resulting in longer rumination) and positively changing the animal's environment would encourage eliciting the animal's natural behavioural repertoire to achieve improvements in the observed oral disturbance pattern.

## REFERENCES

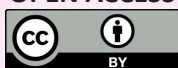
- Appleby, M.C. & A.B. Lawrence (1987). Food restriction as a cause of stereotypic behaviour in tethered gilts. *Animal Science* 45: 103–110. <https://doi.org/10.1017/S0003356100036680>
- Bashaw, M.J., L. Tarou, T. Maki & T. Maple (2001). A survey assessment of variables related to stereotypy in captive giraffe and okapi. *Journal of Applied Animal Science Behavior* 73: 235–247. [https://doi.org/10.1016/S0168-1591\(01\)00137-X](https://doi.org/10.1016/S0168-1591(01)00137-X)
- Bashaw, M.J., M.A. Bloomsmit, L.M. Terry & F.B. Bercovitch (2007). The structure of social relationships among captive female giraffe (*Giraffa camelopardalis*). *Journal of Comparative Psychology* 121: 46–53. <https://doi.org/10.1037/0735-7036.121.1.46>
- Baxter, E. & A.B. Plowman (2001). The effect of increasing dietary fibre on feeding rumination and oral stereotypies in captive giraffes (*Giraffa camelopardalis*). *Animal Welfare* 10: 281–290.
- Bergeron, R., A.J. Badnell-Waters, S. Lambton & G. Mason (2006). Stereotypic Oral Behaviour in Captive Ungulates: Foraging, Diet and Gastrointestinal Function, pp. 19–57. In: Mason G. & J. Rushen (eds.). *Stereotypic Animal Behaviour: Fundamentals and Applications to Welfare*, 2<sup>nd</sup> Edition. CABI, Wallingford, 384pp. <https://doi.org/10.1079/9780851990040.0019>
- Bonai, B.S., I. Dhamija, B.R. Sharma, S.C. Sharma & B.K. Gupta (eds.) (2014). *Zoos in India-legislation, policy, guidelines & strategy*, 5th revision. Central Zoo Authority (Statutory Body under the Ministry of Environment, Forests and Climate Change, Govt. of India), India, 271pp.
- Burgess, A. (eds.). (2004). *The Giraffe Husbandry Resource Manual*. AZA Antelope and Giraffe Taxon Advisory Group. Disney's Animal Kingdom, Orlando, FL, 184pp.
- Dagg, A.I. & J.B. Foster (1976). *The Giraffe: Its Biology, Behavior and Ecology*. Van Nostrand Reinhold Company, New York, 210pp.
- du Toit, J.T. (1990). Home range-body mass relations: a field study on African Browsing ruminants. *Oecologia* 85: 301–303. <https://doi.org/10.1007/BF00319416>
- du Toit, J.T. & C.A. Yetman (2005). Effects of body size on the diurnal activity budgets of African browsing ruminants. *Oecologia* 2: 317–325. <https://doi.org/10.1007/s00442-004-1789-7>
- Duggan, G., C.C. Burn & M. Clauss (2015). Nocturnal behavior in captive giraffe (*Giraffa camelopardalis*)—a pilot study. *Zoo Biology* 35: 14–18. <https://doi.org/10.1002/zoo.21248>
- EAZA Giraffe EEPs (2006). EAZA Husbandry and Management Guidelines for *Giraffa camelopardalis*. *Burgers' Zoo*, Arnhem, 132pp.
- Fennessy, J.T. (2004). Ecology of the desert-dwelling giraffe *Giraffa camelopardalis angolensis* in northwestern Namibia. PhD Thesis. University of Sydney, Sydney, NSW, Australia, xvi+265pp.
- Fennessy, J., T. Bidon, F. Reuss, V. Kumar, P. Elkan, M.A. Nilsson, M. Vamberger, U. Fritz & A. Janke (2016). Multi-locus analyses reveal four giraffe species instead of one. *Current Biology* 26: 2543–2549. <https://doi.org/10.1016/j.cub.2016.07.036>



- Fernandez, L.T., M.J. Bashaw, R.L. Sartor, N.R. Bouwens & T.S. Maki (2008). Tongue twisters: feeding enrichment to reduce oral stereotypy in giraffe (*Giraffa camelopardalis*). *Zoo Biology* 27: 200–212. <https://doi.org/10.1002/zoo.20180>
- Forthman, D.L. (1998). Toward optimal care for confined ungulates, pp. 236–261. In: Shepherdson, D.J., J. D. Mellen & M. Hutchins (eds.). *Second Nature: Environmental Enrichment for Captive Animals*. Smithsonian Institution Press, Washington, DC, 376pp.
- Garry, S. (2012). Analyses of captive behaviour and enclosure use in Rothschild's giraffes (*Giraffa camelopardalis rothschildi*) housed at Paignton Zoo Environmental Park. *The Plymouth Student Scientist* 5: 4–30.
- Hofmann, R.R. (1973). *The ruminant stomach. East African Monographs in Biology Vol. II*. East African Literature Bureau, Nairobi, 354pp.
- Höllerl, S., B. Stimm, J. Hummel & M. Clauss (2006). Browse provision for captive herbivores. Design and management of a browse plantation, pp. 211–212. In: Andrea, F., M. Clauss, K. Eulenberger, J.-M. Hatt, I. Hume, G. P. J. Janssens & J. Nijboer (eds.). *Zoo Animal Nutrition*, Vol. 3. Filander Verlag, Fürth.
- Hummel, J., M. Clauss, E. Baxter, E.J. Flach & K. Johansen (2006). The influence of roughage intake on the occurrence of oral disturbances in captive giraffids, pp. 235–252. In: Fidgett, A., M. Clauss, K. Eulenberger, J.-M. Hatt, I. Hume, G. Janssens & J. Nijboer (eds.). *Zoo Animal Nutrition* Vol. 3. Filander Verlag, Fürth.
- Kirkwood, J.K. (1998). Design for the accommodation for wild animals: How do we know when we have got it right? In: Plowman A.B. & P.M.C. Stevens (eds.). *Proceedings of the 5th International Zoo Design Conference*. Paignton, England.
- Koene, P. & E.K. Visser (1996). Tongue playing behavior in captive giraffes, pp. 106–111. In: *1st International Symposium on Physiology and Ethology of Wild and Zoo Animals*. Klima, Berlin.
- Kolter, L. (1995). Control of behavior and the development of disturbed behavior patterns, pp. 248–256. In: Ganslosser, U., J.K. Hodges & W. Kaumanns W (eds.). *Research and captive propagation*. Filander Verlag, Fürth, Germany, 338pp.
- Lintzenich, B.A. & A.M. Ward (1997). Hay and pellet ratios: considerations in feeding ungulates. In: *Nutrition Advisory Handbook, Fact Sheet* 006.
- Macedonia, J.M. (1987). Effects of housing differences upon activity budgets in captive sifakas (*Propithecus verreauxi*). *Zoo Biology* 6: 55–67. <https://doi.org/10.1002/zoo.1430060107>
- MacPhee, M. & J. Mellen (2000). Framework for planning, documenting, and evaluating enrichment programs (and the director's, curator's, and keeper's roles in the process), pp. 221–225. In: AAZPA Annual Conference Proceedings. American Association of Zoological Parks and Aquariums, Wheeling, WV.
- Maple, T.L. (1979). Great apes in captivity: The good, the bad and the ugly, pp. 239–273. In: Maple T.L., J. Erwin & G. Mitchell (eds.). *Captivity and behavior: Primates in breeding colonies, laboratories and zoos*. Van Nostrand Reinhold, New York, 286pp.
- Mason, G.J. (1991). Stereotypies: a critical review. *Animal Behaviour* 41: 1015–1037. [https://doi.org/10.1016/S0003-3472\(05\)80640-2](https://doi.org/10.1016/S0003-3472(05)80640-2)
- Mason, G.J. & M. Mendl (1997). Do the stereotypies of pigs, chickens and mink reflect adaptive species differences in the control of foraging? *Applied Animal Behaviour Science* 53: 45–58. [https://doi.org/10.1016/S0168-1591\(96\)01150-1](https://doi.org/10.1016/S0168-1591(96)01150-1)
- Mason, G.J. & N. Latham (2004). Can't stop, won't stop: is stereotypy a reliable animal welfare indicator. *Animal Welfare* 13: 57–69.
- Mason, G., R. Clubb, N. Latham & S. Vickery (2007). Why and how should we use environmental enrichment to tackle stereotypic behavior? *Applied Animal Behavior Science* 102: 163–188. <https://doi.org/10.1016/j.applanim.2006.05.041>
- Mertens, D.R. (2007). Digestibility and intake chapter: 32. In: Barnes, R.F., C.J. Nelson, K.J. Moore & M. Collins (eds.). *Forages, The Science of Grassland Agriculture, 6th edition*, Vol. 2. Blackwell Publishing, U.K., 808pp.
- Miller, R.E. & M.E. Fowler (eds.) (2012). *Fowler's Zoo and Wild Animal Medicine, Volumes 6, 7 & 8*. Saunders, USA, 688pp. <https://doi.org/10.1016/C2009-0-63976-3>
- Pellew, R.A. (1984). The feeding ecology of a selective browser, the giraffe (*Giraffa camelopardalis tippelskirchi*). *Journal of Zoology* 202: 57–81. <https://doi.org/10.1111/j.1469-7998.1984.tb04288.x>
- Redbo, I., P. Redbo-Torstensson, F.O. Odberg, A. Hedendahl & J. Holm (1998). Factors affecting behavioral disturbances in racehorses. *Animal Science* 66: 475–48. <https://doi.org/10.1017/S135772980009644>
- Sato, S. & I. Takagaki (1991). Tongue-playing in captive giraffe, pp. 22–29. In: *22nd International Ethological Conference*. Kyoto: Otani University.
- Schaub, D., M. Clauss, E.J. Flach, H.R. Wettstein, C. Tack & J.-M. Hatt (2004). Influence of physical and chemical composition of diet on oral stereotypies in captive giraffes (*Giraffa camelopardalis*). *Proceedings of the European Association of Zoo and Wildlife Veterinarians* 5: 27–28. <https://doi.org/10.5167/uzh-3550>
- Terlouw E.M.C., A.B. Lawrence & A.W. Illius (1991). Influences of feeding level and physical restriction on the development of stereotypies in sows. *Animal Behaviour* 42: 981–991. [https://doi.org/10.1016/S0003-3472\(05\)80151-4](https://doi.org/10.1016/S0003-3472(05)80151-4)
- Veasey, J.S., N.K. Waran & R.J. Young (1996). On comparing the behaviour of zoo housed animals with their wild conspecifics as a welfare indicator, using the Giraffe (*Giraffa camelopardalis*) as a model. *Animal Welfare* 5: 139–153.
- Winter, S., J. Fennessy & A. Janke (2018). Limited introgression supports division of giraffe into four species. *Ecology and Evolution* 8: 10156–10165. <https://doi.org/10.1002/ece3.4490>



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