Measuring glucocorticoid metabolites in pachyderms in zoos and in the wild: opportunities and limitations

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Glucocorticoid metabolites are commonly measured in pachyderms, either in the wild or in captivity. A good example is the evaluation of stress following human interventions (e.g., capture, translocation and release to novel environments in the wild) or the monitoring of reproductive status, as well as responses to environmental changes (e.g., new enclosures, handling procedures, and social conflicts in captivity). Here, we present data from case studies (*in situ* and *ex situ*) using glucocorticoid measurements in elephants and African rhinoceroses under different research objectives. Studies were conducted between 1998 and 2011. *Ex situ* studies were carried out at Zoo Berlin (Asian elephants), Tierpark Berlin-Friedrichsfelde (Asian and African elephants), and Magdeburg Zoo (black rhinos). An *in situ* post-release study on African rhinos took place in a wildlife reserve in north-central Namibia.
Stress measurements related to reproduction has been proven useful to illustrate single events, e.g. mating, post-natal stress in conjunction with handling or separation or integration of mother-calf-dyad into the group (*post-hoc* info). However, measuring glucocorticoids to predict oestrus and parturition in zoo elephants has no sufficient prognostic values, because of the delayed response of glucorticoid metabolites to physiological changes.
The evaluation of post-release stress of African rhinos in the wild revealed limitations: the large study area and the small number of rhinos prevented collection of basic data on a daily level and allocation of samples to individuals. Additionally, a methodological artefact (clear relation between dry mass of samples and the level of glucocorticoid metabolite concentrations) was found *in situ* and *ex situ*. Two years of data collection of black rhino faecal samples showed lower metabolite concentrations of the pooled data during the second year post-release, which indicates a possible long-term acclimatisation process. A shorter study period (8 months) concerning a white rhino group (pooled data set) and a single white rhino male had shown no such trend.
Moving black rhinos into new housing facilities at a zoo provided the chance to verify the methodology and overcome some of these limitations. There was no difference in the average glucocorticoid concentrations between the wild and the zoo. The response of glucocorticoid metabolites of black rhinos after transfer into new housing facilities in the zoo is focus of another contribution.
Our results highlight the diversity of applications for measuring glucocorticoids but reveal also the importance of developing precise research objectives. Ideally, stress assessment should be combined with complementary methods (e.g. progesterone measurements, behavioural investigations).