**Supplementary Material**

Review of trial reintroductions of the long-lived, cooperative breeding Southern Ground-hornbill

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Appendix S1. Southern Ground-hornbill release stock quality, ranked on a scale of 1 (worst) to 3 (best), using the rearing method as a proxy.

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| --- | --- | --- |
| Rearing method | Behavioural classification | Release-quality classification |
| Captive-reared | Socialised only to humans or partially socialised to ground-hornbills | 1 |
| Captive-reared or captive-bred but parent-reared | Well socialised to ground-hornbills in a rural environment with minimal human contact | 2 |
| Wild-caught or rehabilitated | Wild | 3 |

Appendix S2.Predictor variables used for the analysis of factors relating to Southern Ground-hornbill reintroduction success. Bird ID (as individual-bird identification) was included as random effect control for bias and pseudo-replication associated with multiple releases of the same bird ǂ Correlated variables.

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| --- | --- | --- | --- |
|  | Variable acronym | Variable description (levels) | *A priori* hypothesis |
| Environ. variables | HabQual | 1 = most arid thus least productive,  2 = intermediate rainfall sites, or  3 = highest rainfall sites. | More productive (higher rainfall) habitat quality will lead to higher success rates. |
| SeasonRelǂ | In what season the bird released?  (Hot dry, rainy, or cool dry season). | The rainy season, being so important for the successful fledging of wild chicks is likely to be equally important for the survival of released chicks, especially in their first year as they learn to forage. |
| Individual biological variables | WildExp | Did the birds have any prior wild experience? (Yes or no). | Birds with wild experience will have a higher chance of survival than those without, as they will already have accumulated skills in foraging, territory defence and predator aversion. Wild-harvested or rehabilitated wild birds have the highest chance. |
| AgeRelǂ | At what age was the individual released? (Days or six-month categories). | Hand-reared birds released closer to fledging age have a higher chance of survival as they are accepted into the group as a natural fledgeling and during the same season as in the wild. |
| SexBias | Gender of individual released? (Male, female, or indeterminate). | Males are easier to incorporate into a group successfully than females, due to alpha male acceptance of male helpers. |
| Group social variables | WildLead | Was an experienced mentor present?  (Yes or no). | Having a wild or experienced mentor bird present in the group or ‘gang’ increases the survival of an individual as it will learn from a wild mentor and have the support and protection of this mentor. |
| SecFem | Was a female already present in the group? (Yes or no). | Given the natural group structure to only hold one mature female, the group will not easily accept a second female into the group, thus reducing the chances of success for secondary females due to the alpha male acceptance of male helpers. |
| SocialQual | 1 = hand-reared poorly socialised,  2 = hand-reared improved socialising, 3 = captive-bred, parent-reared, or 4 = wild origin (See Appendix 2.2) | Better quality socialising during hand-rearing leads to better quality release candidates with increased success as they are wilder, less likely to habituate to humans and are able to integrate socially into a group. |
| GrpAug | Was the individual part of a new group formation or being augmented into an already established group? (New or established). | Augmentation is expected to produce higher success rates than the formation of entirely new groups where individuals must learn their new territory. |
| Management variables | PreAcclim | Time birds were acclimated at release site prior to release (< 3 weeks or > 3 weeks). | Birds that are well-acclimated to the site prior to the release have a better chance of survival than those given less change to overcome any residual stress effect from transport, combined with the stress of learning a new environment under the new social regime. |
| SupFeed | Supplementary feed post-release? (yes or no) | Supplementary feed enhances success by keeping groups within a safe site, and ensuring survival if winter is extremely dry and unproductive and/or naive birds need time to develop wild hunting skills. |
| Phase | During what phase of management did this release occur? (I, II or III; see Appendix 2.3). | Adaptive management improves release success in Phase III, where several lessons have been implemented that were not available to the managers of Phase I and II. |

Appendix S3. Southern Ground-hornbill group size and demographics of releases.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Group size | Male | Female | Unknown  sex | Experienced male mentor | Group success |
| Group 1 | 3 |  |  | 3 | No | Failed |
| Group 2 | 2 |  |  | 2 | No | Failed |
| Group 3 | 3 | 3 | 0 |  | No | Failed |
| Ad. wild male to group 3 | 4 | 3 | 1 |  | Yes | Yes |
| Group 4 | 3 | 2 | 1 |  | Yes | Failed\* |
| Group 5 | 2 | 1 | 1 |  | No | Failed |
| Group 6 | 2 | 1 | 1 |  | No | Failed |
| Group 7 | 2 | 1 | 1 |  | No | Failed |
| Group 8 | 5 | 4 | 1 |  | Yes | Yes |
| Group 9 | 4 | 3 | 1 |  | Yes | Yes |

\* Failed because the alpha pair returned to their original territory >40 km away

Appendix S4. Eight causes of mortality for 28 released Southern Ground-hornbills.

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| --- | --- | --- | --- | --- |
| Cause of mortality | No. | Determination by observation (n) | Determination by post-mortem (n) | Adaptive management implemented |
| 1. Predation | 6 | Mammal: serval or caracal (4)  Bird: Martial Eagle (1)  Unknown: (1) | None | Release naive birds into a group with an experienced mentor. |
| 2. Starvation | 2 | Naive and imprinted | None | Release naive birds into a group with an experienced mentor. |
| 3. Persecution | 2 | Transmitter found buried next to a rural home (1); stoned to death for stealing domestic chicks (1) | None | Increased education and awareness at release sites prior to release. Enhanced monitoring. |
| 4. Poisoning | 5 | Farmers admitted using of aldicarb and other poisoned baits (4) | Beetles in gut tested positive for carbofuran (1) | Increased education and awareness at release sites prior to release. Enhanced monitoring. Testing methods to keep groups on chosen habitat. |
| 5. Electrocution | 4 | All electrocutions were on step-down transformer boxes and all had an insect nest/hive underneath them | Confirmed by post-mortem (3) | Insulation of transformer boxes (1). |
| 6. Accident | 5 | Back broken falling off a vehicle (1), leg broken after squeezing behind climbing wall (1), killed by falling branch in severe storm (1), killed by vehicle collision (1) | Heart pierced by ingested wire (1) | Only release hand-reared birds that are not imprinted. |
| 7. Disease | 3 | Succumb after eating dead doves at a waterhole following a Newcastle’s Disease outbreak (2); aberrant behaviour post-release (as if still in captivity) and died of dehydration despite supplementary feeding (1) | Newcastle Disease (2), compromised during hand-rearing (1) | Development of Newcastle Disease vaccine. Enhanced physical and behavioural screening prior to release. |
| 8. Unknown | 1 | - | - | Bird never had monitoring device (1). |