

African White-backed Vulture (Gyps africanus) - Captive-Breeding Protocols



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This document is designed to guide the development of conservation breeding protocols for White-backed vultures (Gyps africanus). While the headings provided may not apply to every species, using this template as a reference will help create protocols that enhance the reader's understanding of various documents. Please note that this is a living document that can be reviewed and updated as necessary.

1. Introduction

The African White-backed Vulture (*Gyps africanus*) was once the most common and widespread species of vulture in Africa. However, the population of this species has declined rapidly, by over 90% throughout its range, leading to its listing as critically endangered by the IUCN (The International Union for Conservation of Nature).

Vulture populations are continuing to decline due to a variety of threats. These include the loss of habitat due to expanding human development, collisions and electrocution caused by power lines, collisions with wind farms, direct and indirect poisoning, and a lack of safe and accessible food. Additional challenges include disturbances at roosting, breeding, and feeding sites, capture for belief-based practices, ignorance about the species, and drowning in concrete dams.

African White-backed Vultures are also more vulnerable to anthropogenic disturbance, nest harvesting and capture than other species as they are arboreal nesters and social roosters.

In response to the ongoing threat to vulture populations across much of southern Africa, Vulpro launched its captive breeding programme in 2011. The objectives of this programme are to provide healthy chicks for population supplementation and restocking, as well as to reintroduce certain species into areas and countries where they historically bred but no longer do, or where their populations have declined to unsustainable levels.

This document outlines Vulpro's captive-breeding protocols based on our experiences. It is a living document that will be continuously updated as we gain more knowledge. Please note that it does not represent a universal solution for all species, but is specifically based on our work with African White-backed Vultures.

2. Objectives of the Breeding programme

- Maintain or increase genetic diversity.
- Support reintroduction programmes.
- Establish captive assurance populations.
- Contribute research on species-specific reproductive biology.
- Contribute to the development of husbandry and veterinary protocols.

3. Institutional and Legal Framework – funding / institutional security and stability

- Legislation and Legal requirements (CITES regulations, national wildlife laws).
- Relevant Permits
- Institutions involved (e.g., zoological collections, trusts, conservation organizations).
- Agreements between institutions (e.g., MOUs, animal loan agreements, ownership terms). *Full versions can be attached in the appendices if necessary.*
- Threatened or Protected Species (TOPS)
- Studbooks
- Contingency planning, including succession planning, winding down at completion, and an exit strategy.
 - *When a breeding programme goes to plan it is important to plan ahead for how and when to draw the project to an end and how to pass the project on to new leaders/different institutions should things change.*
 - *Not all breeding programmes or releases proceed according to plan. There will be a point at which investing further resources is no longer justified, despite any prior management adjustments. The decision to discontinue is defensible if the breeding programme design includes indicators of lack of success and the tolerable limits of their duration, or if undesired and unacceptable consequences have occurred. An exit strategy should be an integral part of any plan. Having a strategy in place allows an orderly and justifiable exit.*

4. Species-Specific Information

The African White-backed vulture is a monogamous scavenger that breeds in clusters of trees in Southern Africa, foraging in open habitats such as grasslands. This social species relies on its keen eyesight to locate carcasses, which it consumes, playing a crucial role in disease prevention.



Figure 1: African White-backed Vulture

Biology & Behavior

- **Appearance:** Large, social vultures with distinctive white lower back and white neck ruff that contrasts with the rest of its dark brown plumage.
- **Diet:** Obligate scavengers primarily feed on the soft muscles and organ tissues of carcasses, using their keen eyesight to spot food from a distance.
- **Social Structure:** They are monogamous and mate for life. They are social roosters.
- **Breeding:** These vultures are arboreal roosters and females lay one egg each breeding season. Both parents participate in incubation and raising the chick, with the entire breeding cycle lasting up to a year before the chick fledges.

Ecology

- **Habitat:** Open lowland wooded savannah and grassland areas with tall trees for roosting and nesting in social groups.
- **Distribution:** They occur in Sub-Saharan Africa, breeding in Namibia, Botswana, Zimbabwe, Mozambique, and South Africa, though they may be found as vagrants in other southern African countries.
- **Ecological Role:** By consuming decaying meat, African White-backed Vultures act as crucial ecological engineers, preventing the spread of disease in the environment.
- **Foraging:** They travel long distances from their breeding colonies, with juveniles dispersing further than adults, to find food.

Captive Breeding History

- Previous successes and challenges.
- Known protocols and data from similar programmes.

5. Enclosure and Husbandry Requirements

The flightable breeding African White-backed Vulture enclosure:

- The enclosure measures 27 meters wide, 60 meters long, and 6 meters high.
- The breeding platforms and perches are scattered throughout the enclosure at varying heights to replicate natural behaviors of roosting in tree clusters. The highest roosting platform is approximately 4 metres high.
- The enclosure contains two separate lines of 9-metre-long framework poles placed from north to south. Each line is spaced 9 metres apart, and within each line, the poles are placed 10 metres apart. This setup reduces the number of poles in the center of the enclosure.
- At the bottom of the 60-meter enclosure, mesh markers indicate the end of the enclosure to prevent vultures from flying into the barrier and injuring themselves.
- There is a large gate wide enough for vehicles, but we prefer using wheelbarrows to transport food in and out.
- There is a large pond measuring 3 meters by 3 meters and is 20 centimeters deep at its deepest part, with gradual slopes made of river sand to prevent the cement from becoming slippery.
- One-fourth of this enclosure is covered for shade and protection from the weather elements. This covered area should not include any nest sight.
- The enclosure's floor is composed of natural materials, such as sand, grass, and bushes, to create an environment as natural as possible. But grass is kept short to reduce tick activity and to avoid tripping up the vultures.



Figure 2: VulPro's artificial breeding enclosure with numbered platforms for monitoring activities.

The Open-Top flightless breeding African White-backed Vulture enclosure:

- The enclosure measures 60 meters wide, 80 meters long, and 1.8 meters high.
- Adding roosting platforms is not feasible because the vultures cannot access them. Instead, wooden roosting platforms are provided on the ground, allowing the flightless vultures to build their nests off the ground. The standard size for these wooden roosting platforms is a minimum of 1 meter by 1 meter, with the platform positioned approximately 60 cm above the ground. Roosting platforms should be spaced out near each other but with a few meters between each nesting pair to avoid conflict.

- There is a large gate wide enough for vehicles, but we prefer using wheelbarrows to transport food in and out.
- There is a large pond measuring 3 meters by 3 meters and is 20 centimeters (8 inches) deep at its deepest part, with gradual slopes made of river sand to prevent the cement from becoming slippery.
- One-fourth of this enclosure is covered with a roof for shade and protection from the weather elements. The shade structure does not cover any nest sites.
- The enclosure's floor is composed of natural materials, such as sand, grass, and bushes, to create an environment as natural as possible. But grass is kept short to reduce tick activity and to avoid tripping up the vultures.

A natural soft substance should be present beneath the breeding platforms and raked after each breeding season. If there is no soft surface material naturally occurring then river sand can be used as it does not compact over time. If river sand is used, a yearly replacement of river sand on the ledge floor is recommended.

Enclosures must be carefully designed to maximise breeding success, comfort, and ease of management, while also offering protection from extreme weather conditions such as excessive heat, heavy rain, hail, and strong winds. Enclosures must be spacious enough to accommodate breeding pairs and equipped with ample breeding platforms, tailored to the natural requirements of each species.

African White-backed Vultures, being social arboreal nesting vultures, require large artificial breeding platforms in clusters at varying heights designed to replicate natural colonies. These must provide multiple individual breeding ledges in a safe, accessible, and social layout, ensuring that both disabled and flight-capable vultures can comfortably reach their chosen sites.



Figure 3: African White-backed vulture breeding platforms that are suitable for both disabled and abled birds at varying heights

In all enclosure designs, it is crucial to provide more platforms than breeding pairs, ensuring vultures have freedom of choice and reducing competition. Orientation must also be considered, it is crucial to allow chicks to gain vitamin D from direct sunlight and not to shade the breeding platforms.

Attention to prevailing wind and weather patterns is essential to prevent breeding failures caused by adverse conditions.



Figure 4: African White-backed vulture breeding enclosure with shaded structures that do not shade nest sites

We have intentionally avoided using downward-sloping platforms, as these can compromise nest stability and increase the risk of eggs rolling out of the nest. Each platform has a lipped edge to ensure eggs do not roll from the nest.



Figure 5: African White-backed vulture breeding platform with lipped edge



Figure 6: Ladder being used to access African White-backed vulture nest

It is essential to ensure that staff can **safely and easily access nests** for effective egg and chick management. In the flighted enclosure ladders are used to access nests.

In addition to the design and management of breeding platforms, attention must also be given to the **furnishings within the enclosures** to ensure a safe, healthy environment and reliable access to clean drinking and bathing water.

For perching, we provide **natural branches of varying dimensions, shapes, and sizes**, all with intact bark to help prevent bumblefoot, pressure sores and infections.

Perches must accommodate both semi-flighted and non-flighted vultures and be long enough for multiple vultures to perch together safely, as these are social species that naturally rest in groups. Placement of perches should avoid areas where vultures could injure themselves, get trapped, or get stuck. Perches must also be easy to replace regularly. When securing perches

together, care should be taken to eliminate risks such as loose wires or loops where talons could become caught.



Figure 7: Perching branches of various shapes, sizes and placed at varying heights



Figure 8: Pond for drinking and bathing

Water sources are equally important. **Ponds must be large enough** to allow multiple vultures to drink and bathe simultaneously, reflecting their social behaviour. The pond should be positioned in a safe location where vultures cannot fall in accidentally or defecate excessively in the water. It must also be easy to clean and designed to prevent flooding of the enclosure during maintenance. We also provide perching branches within the pools, especially for disabled vultures in the flightless enclosure.

Safe Food Provisioning

We provide safe, fresh whole carcasses (from livestock and game), rather than small meat pieces. We are fortunate to have support from companies, farmers, and individuals who donate safe carcasses. Vultures obtain all their nutritional needs from whole carcasses, and having these carcasses available allows them to exhibit their natural feeding behaviors.

During the non-breeding season, we feed the vultures every three to five days. However, when chicks are present—up to about 3.5 months old—we increase feeding to once every day or every other day.

It is an absolute MUST that the carcasses are free from veterinary drugs, including pain medications, antibiotics, anesthetics used in darting, and drugs used for euthanasia.

Additionally, lead bullets should not be used to kill the animals, as lead fragments in the meat can cause lead poisoning (Cade 2007; Grund 2010). Always know and trust the source of your carcasses, and be aware of any prior treatments they may have received.

Calcium Supplementation

Thin eggshells, bone deformities, and broken wings in chicks have been reported both in the wild (Mundy 1992), in other Gyps vulture captive-breeding programmes (van de Meer, online, accessed 14 May 2014), and within our own captive breeding efforts. To mitigate these problems, bone chips no larger than 10 cm (Fig.1) are provided in the breeding enclosure throughout the year. When small chicks are present, smaller bone fragments are supplied.

Observations confirm that the adult vultures readily consume these bone chips and feed them to their chicks.

A purpose-built bone-crushing machine is used to process the bones into small, manageable pieces, similar in appearance to sawmill wood shavings.

Only bones from adult carcasses are used as bones from subadult carcasses lack the calcium density required for healthy development in the crucial early stages of a chick's life. Bones are collected from remains within the enclosures or at vulture feeding sites.



Supplementation consists of vertebrae, ribs, crania, and scapulae, as these are more easily crushed than long bones.

6. Pairing and Breeding Management

Adult Health Management

To maintain a mentally and physically healthy captive population of White-backed Vultures, several aspects of their behavior must be addressed. This document highlights a few key points, but it is not comprehensive.

Adults must be individually marked for monitoring purposes, as many management decisions rely on our understanding of individual and pair behaviors. We mark each vulture with a colored leg band and SAFRING metal rings.

Pair formation and enclosure density

African White-backed Vultures are selective when it comes to choosing a mate. In our experience, simply placing any male and female together does not guarantee that they will form a pair over time. Adult vultures require multiple potential partners to make a choice, and some may never decide to pair at all. It is essential to identify the sexes of the vultures in the enclosure, as having a heavily skewed sex ratio can result in same-sex pairings, which can be misleading and confusing.

Our adult captive populations are always changing. Each year, we introduce additional vultures to our breeding groups, providing unpaired individuals the chance to find a mate.

We have also observed that some existing pairs may separate over time and choose new partners if they continue to be unsuccessful in breeding. The process of forming pairs can take anywhere from a few days to several years. We closely monitor the behaviors of all individuals and record any potential pair formations.

When conducting translocations, we take into account the vultures' behaviors and the time of year. For example, we refrain from adding or removing any individuals from the breeding enclosure once nests begin to form, as aggression and nest site defense typically increase around early April in Southern Africa.

Disturbance

Vulpro's captive breeding programme aims to produce healthy individuals for release into the wild. During the breeding season, and especially when chicks are present, staff enter the breeding enclosure only to clean the water pool and provide food and nesting material at the entrance. All other interactions are kept to an absolute minimum and occur solely to safeguard the health and well-being of both chicks and adult vultures.

7. Nesting and Egg Management

Nesting Material

Vulpro supplies nesting materials by placing them at the entrance of the breeding enclosure, allowing vultures to collect and utilize these resources according to their nesting preferences. This method not only supports natural nest-building behaviors but also serves as a form of enrichment, promoting the vultures' instinctual activities such as gathering and constructing nests. By enabling vultures to choose, carry, and arrange materials themselves, the programme fosters both physical and mental stimulation, which is essential for their well-being and reproductive success in captivity.



Figure 10: Rhus lancea branches



Figure 11: Cape vulture gathering nesting material, Rhus lancea branches, from the entrance of the enclosure. White-backed vulture also exhibit this behaviour when offered nesting material

Nesting materials provided to White-backed Vultures must be free from harmful chemicals to ensure vulture safety. At Vulpro, we primarily use branches from the fast-growing tree *Rhus lancea*, which is verified as non-toxic. Thin branches with leaves are cut to offer both flexible stems and soft foliage, allowing vultures to construct sturdy and comfortable nests. The vultures also make use of available feathers and uprooted grass from the enclosure floor for additional nest lining.

Feather cleanup is minimized during the breeding season so vultures can access this natural material. While other organic materials such as cut grass are sometimes offered for variety, vultures consistently show a preference for *Rhus lancea* branches.

Each breeding pair displays unique preferences in nest construction. Some pairs build substantial nests reaching up to one meter high (see Fig.4), while others create simpler structures resembling those found in the wild. Vulpro staff meticulously record the details of each pair's nest, including its nature and location.

We offer at least a wheel barrow's worth (Or ideally as much as is available) of fresh nesting material daily starting in early March in southern Africa, or as soon as regular copulation activity is observed. This daily provisioning continues for the first two months of the breeding season, then decreases to every other day during egg incubation. Once all chicks have hatched, we reduce supply further to twice a week.

The success of a pair in incubating an egg and raising a chick depends on the quality and stability of their nest. Egg losses can occur if nests are poorly shaped, so it is important to monitor nest shape as the egg-laying date approaches. Each nest should have a cup that is sufficiently concave to keep the egg from rolling out. Inexperienced pairs may lay eggs without building nests due to neighboring vultures stealing materials or as a result of difficulty gathering supplies. Though rare, helping these pairs build nests can allow them to practice incubation and chick rearing.

To address these issues early, consider providing more nesting materials to each ledge to reduce competition over the resource and thus aiding struggling pairs to build their own nests on the ledges with lips and drainage holes built into the artificial cliff face.

Please note: When the chicks have fledged we remove all nests and clean the ledges and platforms in order to avoid a build up of bacteria.

Egg Management and Incubation

A few days before vultures lay their eggs, their behavior changes slightly. The female becomes more lethargic and spends more time resting on her nest. This egg lethargy can be concerning for managers, as the female may appear unwell before laying. It is crucial to monitor vulture behavior closely during this stage.

If a vulture seems unable to get up, intervention may be necessary to prevent potential issues like egg binding, which, although uncommon, can be triggered by very cold winds during the egg-laying period. Be mindful that both the male and female vultures tend to become more aggressive when they start building their nests

and especially when they have an egg or chick. They may begin hissing and biting if another vulture or a human comes too close to their nest.



Figure 12: False nest made for educational purposes, displaying a dummy egg (left), real egg shell (right), and hatched egg displaying blood vessels and inner membranes.

African White-backed Vultures, like many other vulture species, typically lay a single egg. Once the egg is laid, a decision must be made about whether to leave it with the parents or to remove it for artificial incubation. Generally, Vulpro prefers to leave the eggs with experienced breeders who have demonstrated their ability to successfully incubate either dummy or real eggs. If a pair of vultures is inattentive to their egg or allows it to roll off the nest, Vulpro will promptly replace it with a dummy egg.

In general, newly paired parents often lack attention to their eggs or chicks, may not incubate properly, and might allow eggs to roll out of poorly constructed nests. However, appropriate nesting and parental behaviors tend to improve with age and experience. We recommend closely monitoring these behaviors and reviewing management decisions annually based on the evolving dynamics of each pair. Only pairs that successfully incubate a dummy egg for the entire incubation period will be allowed to incubate a real egg in the following season.

Double Clutching

Depending on the specific circumstances and history of each pair, Vulpro will decide whether to 'double clutch' or remove an egg from a nest without replacing it with a dummy egg. The removal of the egg is intended to encourage copulations and nesting behaviors, which may lead to the pair producing a second fertile egg. On average, our captive African White-backed Vulture populations lay approximately 37 days (with a range of 24 to 69 days) after the removal of the first egg.

Some pairs have shown that they will not successfully double-clutch. In these cases, the pairs either do not copulate and lay a replacement egg, or the second egg has never been fertile. For these pairs, Vulpro will not attempt double-clutching again and will only replace the egg with a dummy egg or fertile egg if the pair has shown success in incubating dummy or real eggs in past breeding seasons. In such cases, a pair can incubate a fertile egg from another pair and raise the resulting chick.

If any eggs are found to be infertile, we will remove the egg from the pair to initiate double clutching, allowing the possibility of producing a fertile egg on a second attempt.

It is essential to keep thorough records of each chick's parentage, particularly in programmes that aim to retain chicks within the breeding initiative. Our goal is to ensure that every pair capable of raising a chick incubates either a real or a dummy egg, as a pair will not accept a chick unless they have been incubating an egg.

Swapping the egg

During the egg-swapping process, vultures can be very aggressive, and some pairs exhibit more aggression than others. Typically, we only need two staff members to collect the eggs, although multiple staff members may be required to safely monitor the area and manage aggressive vultures.



Figure 13: Labelled egg with direction marker for determining degrees for manual rotation.

It's important to operate quickly to minimize disturbance, so aim to be in and out of the enclosure as swiftly as possible. A third person should remain outside the enclosure to watch for safety concerns and assist with opening and closing the gate.

Staff members must wear a full-face shield, especially in enclosures like the step-style cliff, where vultures are present at eye level. A soft-bristled broom can often be used to gently prod the incubating parent vulture off the nest. If necessary, you can remove and replace the egg while a tolerant parent vulture stays at the

nest.

Before entering the aviary, it is important to ensure your hands are clean. The egg should be placed carefully in a clean box of cotton wool, maintaining its original position. First, carefully take the real egg from the nest before placing the dummy egg in to avoid any damage to the real egg during the process.

Mark and number the egg with a pencil (see Fig. 8) and weigh it immediately upon arrival in the incubation room. To assist with turning the egg by hand, draw a single line on the pointed end to indicate the degrees of rotation.

Artificial Incubation

We use Grumbach and Brinsea incubators set to 37.0°C and 30% relative humidity (Fig. 9). During the White-backed vulture incubation season in southern Africa (April to August), the ambient humidity is extremely low, approximately 25%. Therefore, incubator settings may need to be adjusted based on regional ambient conditions. The ideal temperature and humidity settings will vary depending on the specific situation, the type of incubator used, and the species being incubated.



Figure 14: Incubator set to 50% RH and 37.4 C

At the beginning of the breeding season, when copulations become more frequent around mid to late April in southern Africa, the incubator is thoroughly disinfected, connected to an uninterrupted power supply, and turned on in preparation for egg arrival. The period between copulation and laying is different for every pair so it is important to be prepared.



Figure 15: Vulture eggs in the incubators where the door remains closed to better control ambient temperature



Figure 16: Vulture eggs should be labeled to differentiate them from each other for better management.

Vulture eggs are too large to be rotated fully with the automatic turning feature, so they need to be manually turned 180 degrees three times a day. Vulpro rotates the eggs alternately clockwise and anti-clockwise with each rotation, without lifting them from the incubator. It is crucial never to rotate the eggs in only one direction, as this can suffocate the chick by twisting the umbilical cord.

Manually turning the eggs three times a day allows for close monitoring, enabling us to detect any issues. Occasionally, an egg may show signs of infection, which may be indicated by a change in feel or smell. By turning the eggs frequently, we can regularly monitor for these signs and remove any suspect eggs promptly.

To minimize changes in the incubator's climate, we recommend keeping the door closed as much as possible. When turning and monitoring the eggs, it is important to record the current incubator settings (temperature and humidity), note the level of distilled water, refill if necessary, and document the time along with any observations about the eggs. It is important to wash your hands before handling the eggs.

We weigh all the eggs upon their arrival at the incubator and continue to monitor mass loss every three days. This ensures that the eggs maintain the appropriate constant rate of mass loss. In our calculations, the day an egg is laid is counted as development day zero (Mundy, pers. comm.).

We have used an egg mass loss equation adapted from *Gyps fulvus* captive breeding efforts (Hoyt 1979; van der Meer accessed online, 14 May 2014) and have found it to be a useful guideline, as *G. fulvus* eggs are indistinguishable from White-backed vulture eggs (Mundy 1992). However we are now able to use the RaptorMed software to calculate acceptable mass loss ranges which guide our work.

While some eggs may display mass variation above and below expected values, our egg mass loss generally aligns closely with expected values, resulting in healthy chicks.

Note: Eggs that are naturally incubated and reared by parents are not weighed.

The mean incubation period for African White-backed Vulture eggs, from laying to external pipping, ranges from 52 to 56 days, with the date of egg laying counted as day zero. Vulpro's naturally incubated eggs fall within this timeframe.

For eggs incubated artificially, the average time from internal pipping to hatching is 4 to 6 days. The duration from external pipping to full hatching can take anywhere from less than 48 hours to slightly more, as some chicks hatch more quickly than others; it is not an exact science.

Cracked eggs are susceptible to infections that can lead to chick septicaemia or bacterial infections in the blood. To reduce the risk of infection, it is advised to clean the crack with F10 disinfectant (diluted to a ratio of 1 ml to 250 ml) before sealing it. The crack can be sealed using a small piece of tissue paper and craft glue, applying the glue only to the smallest necessary surface area. Ideally, a separate incubator should be set aside for cracked and compromised eggs, as keeping these eggs separate can help reduce the transmission of bacterial infections between them.

Candling

We candle the eggs to check for fertility and monitor their development. This process is done every three days. Typically, signs of fertility should be observed by day eight, but they may appear as early as day six.

A fertile egg yolk should remain stable, it may get darker and more pronounced but it should not grow or develop a red ring.

If an egg shows no signs of fertility, it should not be discarded right away. However, if it remains infertile by approximately day twenty-one, we recommend removing it from the incubator to prevent contamination of other eggs. Having a separate incubator for these suspect eggs is very useful.

Immediately remove any eggs from the incubator if they begin to smell, if the shell changes texture, or if there are any other noticeable changes. These eggs should be discarded as they may lead to the spread of infection to otherwise healthy eggs.

Regularly candling eggs is essential, as fertile ones can still die and contaminate others. Early detection allows you to address environmental issues and prevent future problems like bacterial infections. Candling can be done frequently if handled carefully, as rough handling can harm the developing embryo.

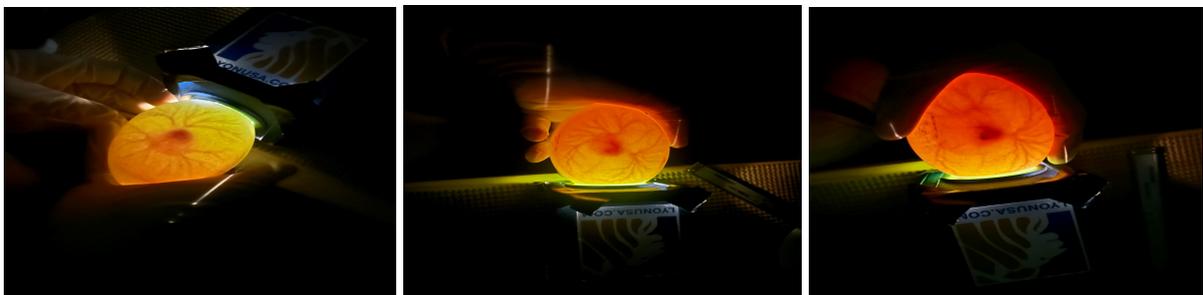


Figure 17: Candling eggs shows signs of fertility as early as day six

8. Chick Rearing

From 2011 to 2015, we returned the eggs to their parents as soon as the chick began to internally pip. However, during the 2015 breeding season, we experienced limited success, with several pairs killing the chick as it was hatching.

Now, we give the chicks back anywhere from three to five days.

Returning the chicks at an older age is crucial because they are stronger and more capable of handling potential harassment from the parents during the swap. Additionally, they will have spent the most critical time in development (hatching and newly hatched stages) under human care, which increases their overall survival rates. There are no concerns about imprinting with this species, provided the chick is returned to the parents within the specified timeframe of being younger than three weeks. However it is recommended that healthy chicks should be returned to parents as early as three to five days after hatching.

The swapping event is vital for the success of this protocol, and reactions can vary among individual vultures and pairs. Some adults may react violently within seconds of receiving the chick, leading to injury or death. For the safety of our staff, approaching the incubating pair should only be attempted with proper safety gear, such as a soft-bristled broom, face shield, and potentially multiple staff members, depending on the behavior of the pair (refer to the 'Swapping the egg' section above).

Each situation is assessed based on parental behaviors towards each other and the egg. In some cases, only the male might stay on the nest during a swap, while in others, both individuals may need to be flushed away before making the swap and allowing them to return. These decisions rely on understanding the vultures' behavior and trial and error. Monitoring the adults' reactions to the chick is crucial, as aggression can lead to harm with a single bite.

Vultures have unique characters and personalities, so not every pair will tolerate human interference. Because of this variability, hand-raising the chick to three weeks old may not be possible for every pair. In such cases, we revert to our original protocol: allowing the parents to naturally incubate, hatch, and raise their chicks, or swapping a dummy egg for the real egg just after the chick internally pips. The decision on which approach to take is based on our knowledge of the individual breeding pairs and their acceptance levels. Our goal in every instance is to provide the chick with the best possible chance of survival.

Typically, it is possible to quickly determine if the reintroduction was successful. The parents will exhibit excitement, confusion, and stress. If the swap is successful, they will acknowledge the chick's presence and should begin brooding within a few minutes. It is also essential to closely monitor the situation for the first 24 to 48 hours to ensure that both parents are feeding the chick.

Chick to Fledgling

Calcium is essential for the proper development of chick bones. It is important to provide either intact small adult carcasses from which the parents can extract small bones or ready-crushed bones, so the vultures have options. We supply crushed

adult ungulate bones at the entrance of the enclosure for the parents to collect and feed to the chicks. Bones from younger individuals should not be provided, as they have lower calcium content than adult bones. Bone chips are made available year-round for the adults, but when chicks are present in the enclosure, it is crucial to ensure the chips are small enough for them to consume.

From the moment of hatching until fledging, which takes approximately 4.5 months, we provide safe, fresh whole carcasses (from livestock and game), not small meat pieces, every other day for the breeding pairs to feed their chicks. Vultures obtain all their nutritional requirements from whole carcasses, and their presence helps to simulate natural feeding behaviors.

It is an absolute MUST that the carcasses are free from veterinary drugs, including pain medications, antibiotics, anesthetics used in darting, and drugs used for euthanasia. Additionally, lead bullets should not be used to kill the animals, as lead fragments in the meat can cause lead poisoning (Cade 2007; Grund 2010). Carcasses of animals that have died of a natural disease may be good, when available, as we suspect this helps in exposing the chicks to natural elements and diseases which they will encounter in the wild; however, you must know and trust the source of your carcasses and any prior drug treatments provided.

Fledglings

Once all the chicks have successfully fledged, we reduce our carcass feeding to every third day, as vultures do not require daily feedings. We place the carcass at the entrance of the enclosure, where all the vultures, including fledglings, can visit to feed. At this stage, the fledglings still depend on their parents for protection and sometimes for feeding.

Around 6 to 7 months of age, we separate the fledglings from their parents and move them to a large communal flight enclosure. This allows them to develop independence from their parents as well as strengthen their skills and establish dominance, which are essential for survival in the wild. This enclosure is kept out of public view, and only wild vultures being temporarily housed for rehabilitation are kept here; tame vultures are not housed in this enclosure.

All releasable captive-bred vultures are fitted with colored leg bands, a metal SAFRING ring, and a GPS tracking device. Monitoring each chick's movements is crucial to improving our methods and gaining insight into their survival. Understanding their post-release behavior will help us identify any problems or fatalities and the reasons behind them.

Monitoring Captive Breeding

To enhance our understanding of captive breeding and inform updated management decisions, it is essential to record both habitual and noteworthy behavioral observations from the breeding enclosure. Each vulture within Vulpro's breeding enclosure is identified by individually numbered and colored leg bands, allowing for effective monitoring of individual vultures and breeding pairs.

Monitoring begins when pairs start to exhibit regular copulation behaviors, typically around mid-March in Southern Africa. We track the rate of copulations to determine the need for supplementary nesting materials. As copulations become more frequent, we increase the supply of nesting materials. In South Africa, monitoring should begin at least two weeks before the expected egg-laying period, which is typically late April, coinciding with the onset of winter as temperatures drop.

Observations are recorded using a standardized data collection sheet (refer to Table 1). We recommend that monitoring takes place from a well-concealed hide or from a distance of at least 30 meters away from the breeding cliff. This distance helps avoid disturbing or habituating the breeding vultures, as well as the wild vultures that visit the adjacent vulture restaurant.

****Table 1: Recommended Method for Recording Copulation Behaviors of Vultures****

date	time	top	bottom	location	fply (sec)	fply behaviors	mnt (sec)	mnt behavior	cop (sec)	voc?	voc ID	comments
4/11/2014	15:57	B589	B675	21	20	walk in circles	19	ruff grab	5	y	B589	B564 watches as if to harrass
4/18/2014	14:54	B589	B675	21	0		13	ruff grab	11	y	B589	
4/18/2014	15:50	Yellow Ring	B399	7	0		28	ruff grab	12	y	?	
4/18/2014	15:50	B566	B415	5	0		28	ruff grab	15	y	B566	

Non-paired individuals should also be observed along with paired ones. If a particular individual frequently causes aggression or disturbances near the roosting platforms, it may be necessary to remove that individual to prevent future conflicts when eggs and chicks are present.

Each platform of Vulpro’s breeding cluster is assigned a unique and permanent number (see Figure 14). The nest ledge of each breeding pair should be recorded, including any changes in nesting locations and the potential reasons for these changes. For instance, when the first egg is removed from a pair, they may move to a new site to lay a second egg, possibly attributing the initial ‘failure’ to the original nest. Additionally, if neighboring vultures steal their nesting materials, the pair may be compelled to find an alternative ledge. All this information should be recorded, along with the date and time of each occurrence.

The frequency of copulation appears to be dependent on the mating pair. By understanding the typical behaviors of each pair, you can more easily anticipate egg laying and promptly identify any health concerns or abnormal behaviors, **allowing** for swift intervention.

Since vultures tend to vocalize during copulation, we recommend that observers familiarize themselves with the sounds associated with this behavior, as these vocalizations can alert them to copulation activity. Furthermore, these sounds may encourage other couples and neighboring pairs to engage in copulation as well.

Please note:

1. **Date and time:** Are they copulating more often in the morning or in the afternoon, closer to dawn and dusk, or in the middle of the day?
2. **Breeding pairs and their leg band numbers:** Recording these details provides insight into the sex of each individual, as males typically (though not

always) assume the top position during mating. Occasionally, same-sex pairs may form if there is a sex imbalance in the enclosure. These same-sex pairs behave similarly to normal pairs but will not produce fertile eggs. It's important to note the number of different pairs copulating each day and how often a particular pair mates within that time.

3. **Place in enclosure:** The majority of paired copulations occur inside the nest or nearby. If a pair copulates elsewhere frequently, it may indicate that they have changed their nest site.
 - Duration of Foreplay and Copulation is a matter of seconds. Foreplay includes any behavior observed before mounting. These behaviors can be subtle, such as a change in body posture, and may or may not involve vocalizations. Mounting begins when one individual stands on the back of the other. Copulation starts with the initial contact between their cloacas. Successful copulation occurs when the cloacas of both vultures touch. It is important to note that a couple may mount without achieving successful copulation, as cloacal contact is never established.
4. **Comments:** Note everything before, during, or after the copulation that might be important (for example, if copulation was attempted but disturbed by a neighbouring vulture).

9. Genetic Management

- Maintaining a studbook or genetic database.
- Avoiding inbreeding and ensuring genetic diversity.
- Collaborate with geneticists or conservation biologists.

Do not allow related vultures to breed. For Vulpro this is made possible through meticulous record keeping and because we are constantly receiving new vultures from the wild, we do not keep captive bred vultures as part of our breeding stock.

10. Veterinary Care

- Pre-breeding health checks for potential pairs.
- Disease prevention and quarantine protocols.
- Emergency care for complications during breeding or chick rearing.

Health Monitoring:

- Veterinary checks and growth tracking.
- Vaccination and disease prevention protocols.

11. Record-Keeping

Detailed logs for:

- Pair introductions and behaviours.
- Egg data (fertility, incubation, hatching).

- Chick growth and health
- Template for management of chick growth
- Veterinary treatments and interventions.
- Use of software
- For studbooks or breeding data.

12. Release

- Criteria for selecting individuals for release.
- Conditioning for survival in the wild (e.g., predator awareness, foraging skills).
- Post-release monitoring and support.
 - Tracking released vultures.
 - Monitoring survival rates and reproductive success in the wild.
- Retaining some individuals as a genetic reserve.
- Captive stock Management related to offspring that are unable to be released

Release protocols are dependent on species and why you are captive breeding. Consideration for these factors should be undertaken, however it is vital that all offspring releases are tracked in some form.

Vulpro does not use wing tags, instead opting to use colored leg bands as a visual marker for researchers and citizen scientists to identify and report vultures.

13. Review and Adaptation

- Annual review of the breeding programme's success and challenges.
- Updates based on new research or observations.
- Feedback mechanisms for keepers, veterinarians, and researchers.
 - Long-term conservation impact assessment.
 - Consider registering research projects with the managing authority.

14. References and Resources

References

- Cade T.J. 2007. Exposure of California Condors to Lead From Spent Ammunition. *J Wildl Manage* 71(7): 2125–33.
- Grund M.D., Cornicelli L., Carlson L.T., Butler E.A. 2010. Bullet Fragmentation and Lead Deposition in White-Tailed Deer and Domestic Sheep. *Human-Wildlife Interact* 4: 257–65.
- Hoyt, D.F. 1979. Practical methods of estimating volume and fresh weight of vulture eggs. *The Auk*. 96:73-77.
- Kuehler, C.M. and Witman, P.N. 1988. Artificial Incubation of California Condor *Gymnogyps californicus* Eggs removed from the Wild. *Zoo Biology*. 132: 123-132.

BOJ 11552/4/2025 NW 60489/04/2025 Application ID 60489

APPENDUM

holder :- a) must keep a stud book / register and submit to the issuing authority on an annual basis as prescribed in the Regulations. 6) Any person who conceals or fails to comply with any of the conditions of the management plan, shall be guilty of an offence. 7) The Issuing Authority reserves the right to amend, withhold, withdraw or cancel any permit at any time, especially if the permit holder obviously neglects or fails to comply with any permit condition or requirement or is found guilty of any contravention of the applicable legislation or any other regulatory.

FACILITIES - STANDING PERMIT - FAUNA

1) The property mentioned on this "Standing Permit", is considered to be a "Registered Facility", as defined in Chapter 1 and in compliance with Chapter 3 of the National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004): Threatened or Protected Species Regulations. 2) If any of the following species appear on the "Standing Permit", then the listing of restricted activities is not applicable and such species is only listed for record purposes namely: Scimitar-horned Oryx, Arabian Oryx, Addax, Cape Mountain Zebra, Black and White Rhinoceros, and Oryx. 3) No exemption for any restricted activity is applicable for the species as mentioned in point 2 above 4) The permit holder may not allow any exotic animal to leave the property alive unless under the auspice of a transport permit to an approved registered breeding facility or the country of origin. 5) The permit holder must with sufficient notice to the Issuing Authority, before any activity commences, apply on the prescribed application form, for a formal "STANDING PERMIT" to use any prohibited instrument or method or conduct any restricted activity with the species as mentioned in paragraph (2). Such permit applications will be handled on ad hoc basis in compliance with new national legislation and policy guidelines. 6) Any restricted activity, instrument and methods as authorized by the "STANDING PERMIT" does not apply to any listed CITES 1 species and / or species listed as Endangered or Specially Protected according to the Schedules of the applicable Issuing Authority's Provincial legislation.

FACILITIES - BREEDING FACILITY

1) The permit holder must :- a) Ensure that all animals are individually marked by means of an identity microchip.

GENERAL CONDITIONS - ALL PERMITS

1) This permit, unless otherwise stated, is only valid within the boundaries of the North West Province (hereafter named "the Province") and then specifically as specified on the permit. 2) This permit is valid only :- a) for the specific species, sex and numbers as specified on this permit. 5) for the specific activity / activities authorized. 6) for the specific methods authorized. 6) for the specific property / locality as specified. 6) for the specific day, time or period stipulated. 3) This permit is only deemed valid :- a) in the original format and with the content as issued by the Issuing Authority. 10) once it has been printed and the signature of the permit holder has been obtained thereon in ink. 4) the Issuing Authority reserves the right to amend, withhold, withdraw or cancel any permit at any time. 5) This permit is not transferable to any individual, natural person, juristic person or any other legal entity. 6) Any alterations or attempt thereto, whether electronically or in any other way, shall immediately render it invalid. 7) This permit shall lapse and be deemed invalid when it is altered, but or destroyed and no copy thereof shall be issued. 8) This permit does not grant the permit holder automatic access to any Protected Area, National Park, Provincial Nature Reserve, tribal areas or privately owned land and :- a) the permit holder must beforehand obtain all other relevant written permissions, documents, rights and licences. b) the permit holder must comply with any other / further conditions or restrictions that the manager / landowner may stipulate at their discretion. 9) The permit holder must at all times while performing any restricted activity authorized by this permit, have the permit and all other relevant documentation in their possession and without delay make it available upon request by any authorized person. 10) An authorized person must also be allowed access onto the property at any reasonable time for any inspection needed and can remain on such property as long as it is needed to do the inspection. 11) The permit holder must immediately after completion of any activity authorized by this permit, record the relevant particulars in the space provided hereon or on the annexure or document attached hereto or in the prescribed register related to the permit. 12) The permit holder must, return the original signed permit to the Issuing Authority within (14) fourteen days :- a) after performing or completing the authorized restricted activity, or b) after the date of expiry thereof whichever happens first, and c) if applicable furnish the Issuing Authority with a prescribed written feedback report on the results of every activity conducted. 13) The permit holder must retain a copy of the permit together with all other relevant written permissions, documents, rights and licenses for a period of at least (2) two years from date of issue or for as long as the permit holder is in possession of the animal, plant or derivative, whichever period is the longer. 14) If applicable, the permit holder shall apply for the renewal of the permit to the Issuing Authority, on the appropriate application form, at least (3) three months prior to the expiry date thereof. 15) This permit, during the period of validity thereof, is also subject to :- a) all applicable norms and standards in existence at the time of issuance. b) the provisions of any law in force, in respect of the specific species, activity, method or instrument to which this permit applies. 16) It is the permit holder's responsibility to obtain the correct information on any other legislation, specification, requirement or charges thereto that may be applicable or are required by any other Issuing Authority / Organisation / Institution relating to this permit. 17) By signing this permit, the permit holder declares that they are aware of the fact that :- a) any transgression or failure to render the required reports can lead to criminal prosecution and also jeopardize any future applications by or in the name of the permit holder. b) if the permit holder conceals or fails to comply with any permit condition or requirement, they shall be guilty of an offence. 18) The prescribed fees paid to the Issuing Authority for the issue of this permit shall not be refunded.

SPECIAL CONDITIONS

Condition Name Unique Registration Number: W 28 / 770121 0049 082.
Special Conditions:
 1. The number of the animals on the permit may not be exceeded.
 2. This is only a captive breeding under TDPS legislation.
 3. The permit is valid as long as the applicant comply with the approved management plan.

Page 3 of 3

Signature of Issuing Authority (Constantine Willemse Hoogkamer)
 09 Apr 2025, 01:24 pm

Signature of Permit Holder (Kerri Wolter)
 09 Apr 2025, 01:24 pm

North West Department of Economic Development, Environment, Conservation and Tourism, Citr. Dr. James Moroka Drive & Stadium Road, /Mmabatho
 Contact Information: Tel: +27 (0)18 389 5130, Fax: +27 (0)18 289 5130, E-mail: idj@nw.gov.za
 Postal Address: Private Bag 8, 15, Mmabatho, 2735

Figure 16 & 17 - Permit - Biodiversity Eastern Cape Province Ordinary Breed pg.1-2

C/o Hargreaves Road
 Beacon Hill
 Hockley Close
 King Williams Town
 South Africa

Province of the EASTERN CAPE
 (THE PROVINCE OF THE EASTERN CAPE)
 ENVIRONMENTAL AFFAIRS AND TOURISM

Private Bag X0054
 Bisho
 South Africa
 5605

Permit No: TS-202403000005353 Issuing Office: Sarah Baartman Region (Port Elizabeth)
 Expiry Date: 2027-03-13 Amount Paid: ZAR 1000.00

STANDING PERMIT FOR A CAPTIVE BREEDING OPERATION

In terms of the National Environmental Management: Biodiversity Act 2004, Act 10 of 2004

NOT TRANSFERABLE

A permit is hereby issued to:

PERMIT HOLDER	FACILITY
Kerri Wolter	Agent Name Kerri Wolter
ID/Passport Number 7701210049082	Facility Name Shamswat Private Game
Email Address info@vulpro.com	Facility Number 2729/T75512
Cellphone Number 0828085113	Facility Size 20000.0 ha
Telephone Number 0828085113	Physical Address Shamswat Private Game Reserve
Physical Address Paterson 6130	Paterson 6130
Postal Address PO Box 91 Paterson 6130	Town Paterson
Lat/Lng /	Unique Registration No

SPECIES				
Common Name	Scientific Name	Qty	Restricted Activities	Particulars
Vulture, Cape	Gyps coprotheres	123.0	Breeding/Propagate	Non releasable
Vulture, white-backed	Gyps africanus	42.0	Breeding/Propagate	Non releasable

Signature of Approver
 Date Issued: 2024-03-13

Signature of Holder

I acknowledge, accept and fully understand the permit conditions as set out on this permit

Permit No: TS-202403000005353 Page 1 of 2

STANDARD CONDITIONS

- Please do not hesitate to contact this office should you not be in agreement with any aspect of your permit.
- PLEASE NOTE THAT THIS PERMIT DOES NOT NEGATE ANY RESTRICTIONS PLACED ON THE PERMIT HOLDER BY THE CURRENT COVID-19 NATIONAL LOCK-DOWN REGULATIONS ISSUED TO SECTION 27(2) OF THE DISASTER MANAGEMENT ACT, 2002.
- Please note too that if permits are not returned as per the conditions you are in contravention of Ordinance 19 of 1974. It may also result in the withholding of your permits and/or delay in the issuing of your permits in the future.
- The actual number of wild animals of every species which has been transported and the number of such wild animals of each species 5. The permit holder must adhere to the applicable National Norms and Standards and are bound by those Norms and Standards when carrying out a restricted activity.
- The permit holder must give regard to any other applicable legislations and/or protocols.
- The species listed on this permit are deemed as adequately enclosed; the ownership of the species is therefore maintained in terms of the Game Theft Act 19 of 1991.
- The use of the Game Farm Hunting Permit Book is subject to the validity of the registration certificate and standing permit and may only be used as per the Conditions specified in the Standing Permit.
- This permit is subject to a valid CAE in terms of the Nature and Environmental Conservation Ordinance 19 of 1947.
- This permit on a certified copy thereof must always be kept at the facility or in the vehicle used when the restricted activity is carried out.
- This permit or a certified copy thereof must be shown to any authorized official upon request.
- The permit holder must take reasonable measures in ensuring that the fence is in a good state of repair which includes but is not limited to: regular fence patrols, fence repairs and maintenance which must be according to the Departmental Fencing Specifications Policy Document at the time of such repairs.

SPECIAL CONDITIONS

Permit No: TS-202403000005353 Page 2 of 2

Version	Date	Comment
1.0	2014-09-14	Authors: Kerri Wolter, Walter Nesar, and Maggie Hirschauer Editors: Jemima Parry-Jones, Dr. Katja Koeppel
2.0	2015-12-05	Editors: Maggie Hirschauer and Kerri Wolter
3.0	2024-04-15	Editors: Kerri Wolter
4.0	2025-09-15	Editors: Nadia Opperman, Kerri Woter
5.0	2025-10-02	Editors: Jamie Venter, Kerri Wolter

For any further information or additional explanations, please contact: Kerri Wolter
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