



Vulture Rehabilitation Manual

VulPro NPO

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This is a living document which will be altered and improved as we learn more about parameters for success. Always cite which version is used and be sure to check our website www.vulpro.com for the most updated copy.

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INTRODUCTION

Every single vulture species is under threat, not only in southern Africa, but across Africa and the globe. The dangers to the species vary by location, with most threats being anthropogenic.

The principle behind this manual is that every vulture's life counts. Each individual deserves the chance to fly free and reproduce.

This manual is based on 15 years of VulPro's experience in rehabilitating African vultures. VulPro's rehabilitation experience is mainly based on the *Gyps* species, namely the African White-backed and Cape Vulture; but also with Lappet-faced, White-headed, and Palm-nut Vultures. VulPro also rehabilitates large raptors such as owls, eagles, hawks and secretary birds. Vultures, however, are unique in several respects and therefore warrant their own attention with regards to husbandry and medical treatment. This document is designed to advise and aid the rehabilitation of large, Old World vulture species (namely the *Gyps*, *Torgos*, and *Trigonoceps* species) but should also be considered in the treatment of smaller vulture species.

Most medical treatment needs to be undertaken by a registered vet, vet nurse or para-veterinarian. Procedures such as prescribing medication, injections and some forms of fluid administration should only ever be done by one of the above mentioned, registered individuals.

VulPro is always available to assist and advise.

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In addition, we are extremely grateful to our project partners who offer sound veterinary advice and assistance with vulture treatments, namely; Broedestroom Veterinary Clinic, Dr. Neil Forbes and Dr. Sarah Woodhouse

REHABILITATION MANUAL DISCLAIMER & COPYRIGHT

DISCLAIMER

This manual is provided to improve the rehabilitation and emergency medical treatment of all African vultures. To the best of our knowledge, the information is correct at the time of going to print. The manual should be considered a living document, since practices continue to evolve through advances in scientific knowledge.

The application of information within this manual should be in accordance with all local, provincial, national and regional laws and regulations. The recommendations are not exclusive management approaches, medical treatments, or procedures, and may require adaptation to the specific needs of individual animals and particular circumstances. In all circumstances, the advice of a qualified veterinary practitioner should be enlisted, where possible.

The information contained in this manual has been obtained from years of experience and we deem it to be reliable and accurate. However, VulPro disclaims all liability for errors or omissions that may occur. VulPro and all contributing authors shall not be liable for any incidental, consequential, or any other damages whatsoever (whether resulting from negligence, application or otherwise) including, without limitation, exemplary damages or lost profits arising out of, or in connection with the use of this publication.

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Chapter 1: Handling and Housing

Introduction

Rehabilitation of any injured wild animal is an honourable and laudable activity. However, in taking any animal into care, the rescuer accepts the responsibilities of 'ownership' for the animal, ensuring that all necessary treatment and care is provided to optimise its potential release back into the wild. It is vitally important, wherever possible, that one works closely with a local veterinary surgeon, who is prepared to aid and support when necessary (seeking additional support and advice themselves if needed). You may need to have access to appropriate veterinary services at all hours, which could mean using the services of more than one practice. It is thus worth proactively building relationships with your local veterinary practices, encouraging them to accompany you on rehabilitation courses and ensuring that all necessary resources and equipment are at hand before an incident occurs.

Handling

For the average biologist or bird ringer, handling a vulture may be intimidating or even dangerous. Even ringers who are comfortable handling large eagles may find their hands full trying to process a vulture. There are several important differences in the best techniques used to process vultures versus other large raptors. The techniques detailed here have been refined over the past fifteen years of VulPro's experience working with vultures in southern Africa.

Vultures can be intimidating due to their size and their so-called 'aggressive nature'¹, so it is important to handle these birds with care and understanding. The primary concern when handling these threatened species is to avoid injury and stress to the bird, while also minimising risk of injury to the handler.

There is no need to ever use excessive force. Vultures are sensitive and respond well to calm and control, rather than forceful and aggressive handling methods. When cornered, any vulture will try to flee but may act aggressively if no avenue for escape is available. Following these protocols will minimize the risk of injury to both vultures and handlers.

Equipment

Suitable eye and face protection, gloves, a long-sleeved shirt, trousers and closed shoes are necessary when working with vultures. One of the best tables for processing vultures is a vulture crate covered with carpet for the bird's comfort (Fig. 1). Alternatively, a sturdy folding table measuring 1.5 x 0.7m will suffice. This allows easy access from all sides for the team to work on the bird. Catching and handling vultures may result in serious and sometimes permanent injuries. Pay particular care when holding the bird or replacing it on the ground to keep your face away from the beak.



Figure 1: A vulture crate used as a processing table. The work space has been covered in a soft carpet and displays the necessary tagging tools and personal protection gear.

¹ Vultures are timid and wary birds that do not have a killer instinct. Their talons are weak and their feet are flat and ill-adapted to killing, making them poor hunters. Crows and vultures are often the first animals to scavenge a carcass. This observation has led to the misconception that they are responsible for stock losses. In southern Africa, only the Cape Vulture (*Gyps coprotheres*) has been suspected of killing livestock, and then only small lambs, and on very rare occasions. There are rare reports documenting the larger Lappet-faced (*Torgos tracheliotos*) and White-headed vultures (*Trigonoceps occipitalis*) killing small, wild game (see Mundy et al. 1992, *The Vultures of Africa*).

Catching vultures

Vultures need to be approached quietly, confidently and sympathetically; there is no need to 'rugby-tackle' them at all. The rehabilitator should approach the bird in such a manner as to avoid scaring it away or causing unnecessary stress. It is recommended that no more than three persons should be involved in this capturing process. Any more create unnecessary stress for the birds and inhibit the capture process.

Once the selected vulture is within close reach, its neck should be grabbed from behind first, just below the jaw bone (Fig. 2). Do not grab the head from the front as you can crush the trachea, potentially causing permanent and irreversible harm. Do not grab lower than the jaw bone as the bird can turn its head around and bite you. Do not grab higher as you will lose your grip and may cause injury to the head, especially the ears or eyes of the bird. Use your thumb and forefinger around the back of the neck from behind the bird's head. Reach your fingers around to be against but below the jaw bone with the pressure on the sides of the neck to avoid suffocating the bird by constricting the trachea. You can be firm but not rough or too tight so as to avoid harming the bird. Great care should be taken with the hand holding the head. The head should always be held far enough away from your face and other body parts, as well as other people in your proximity. Vultures are extremely strong and can lunge and bite suddenly in defence, even when appearing calm. This can result in serious injury.



Figure 2: *The proper hand placement to stabilize a vulture head*

Once the head is secured, swiftly sweep your other arm around to hug the vulture just above the legs, enclosing the wings in the embrace. Hold the bird with the legs below your arm but with the bird's legs stretched out downwards towards the tail, with your arm covering the thighs (Fig. 3). Make sure that your arm is covering the bird's legs just above the tarsus and not below, or the bird will be able to lift its legs and feet high enough to grab your arm in order to try and free itself, often causing injury to you. The bird should be held upright, its back against your chest, in the front and centre of your body. Both of your elbows should 'hug' the bird's wings from the sides to keep the wings closed and under control. If the bird struggles, simply 'hug' the bird tighter and use your elbows to prevent the wings from escaping your grip. One person can do this alone, but it is advisable for a second person to back up the catcher should a wing escape, for example. The wings are powerful so if they do break free it is extremely difficult to keep holding the bird and this will require a second person to help get the wings back into position. It is important to bring escaped or open wings into the appropriate position quickly as extensive flapping may also lead to injuries to the bird or handler.

Once the bird is secure, move to stand in the shade to prevent the vulture from overheating.



Figure 3: The proper way to hold a large vulture. The head is secured in one hand while the body, wings, and feet are restrained by 'hugging' the vulture.

Processing vultures

The duration of vulture restraint should always be minimised. To facilitate this, it is vital that all necessary equipment and staff are prepared and readily available, prior to restraint of the first patient. 'Processing' includes any handling of a vulture: including placement of patagial tags and or rings or leg bands, fitting tracking devices, taking blood or other biological samples, or conducting medical treatments.

The environmental conditions in which you are working are critically important to consider **before** any work begins. Working surfaces should be placed in the shade to reduce the risk of the bird overheating. In southern Africa, it is most likely that any handling of vultures will be conducted in warm environments, yet sudden changes in temperature or precipitation must be planned for. If the bird begins to overheat (i.e. the handler feels the bird's body temperature increasing or the bird begins to pant), one must rapidly cool the bird down by spraying cool water on its neck, collar bone, and legs by means of a spray bottle and a light spray to the bird. **A bird which suffers from overheating (hyperthermia) will have a reduced chance of recovery. An increase in body temperature exceeding four degrees above the normal range will almost invariably be fatal.** Vulture processing should be completed within 20 minutes per bird. The absolute maximum processing time should not exceed 35 minutes. Handling of wild animals results in high levels of stress hormones to circulate in the bird's bloodstream. Although a protective function of sorts, prolonged increases in these hormones can be very dangerous due to physiological changes. It is not uncommon for wild birds to die from the stress of handling. This is compounded if the bird in question is already in a compromised physiological state. It is therefore crucial to keep handling to a minimum and consider postponing procedures (where possible) if the bird appears overwhelmingly stressed.

Organization, preparation, and communication are important within the team processing the vulture. Have all equipment out, ready, and in a shaded quiet location.

The amount of time a bird spends in a horizontal position, either on its back or sternum, must be minimized. A bird restrained on its back will suffer a 10-60% reduction in respiratory volume and so this should be avoided, unless there is no alternative. It is less stressful for the birds to be held upright. This is the position that should be used when conducting initial exams and when giving medication. If the handler becomes tired, the bird can be handed over to another handler. The handler is less likely to become tired if seated. This position should be adopted where possible. There are circumstances when one person will not be able to hold the bird throughout processing and treatment. In such circumstances, the patient may be restrained on a low table preferably lying on its sternum).

Processing vultures on a table

When working with a bird on a table, depending on what you are doing, start with the bird on its sternum. For this type of vulture processing, you need three to four people and **under no circumstances should the bird be tied, taped or bound in any way.** This is unnecessary and can cause injury to the bird.

One person holds the head (see above on how to hold the head), another person holds both legs and the third person secures and holds the wings against the bird's body (Fig. 4). In the case that you want to stretch out the bird's wing, the fourth person can do this while the third person keeps the bent wing secure. The person holding the legs should hold one leg in each hand or should at least always keep one finger between the legs. Vulture legs do not have much muscle tissue separating skin from bone. Significant injury to the legs can occur if they are rubbed together.



Figure 4: A vulture being processed on its sternum. Each team member secures a body part while a separate member processes the vulture. One team member holds the head, another secures the feet, while another secures the wings.

It is not advisable to cover the vultures' eyes as they prefer to observe what is happening and will on occasion panic if unable to see their surroundings. This reaction varies between species and individuals. In some cases, visual seclusion is preferred although care must be taken to avoid corneal injury. Vultures thermo-regulate through the bare skin on their head, neck and legs. If, for whatever reason, the head is covered, the body temperature must be monitored (normal temperature 40-41°C (104-105.8°F)). If the body temperature increases, the head and neck should be sprayed with water with a light spray from a spray bottle and the procedure completed as soon as possible). Heart rate should also be monitored. Normal resting heart rate is 80-100 beats per minute, and should never exceed 200 beats per minute while restrained.

Never tape or tie the beak closed under any circumstances. Vultures often regurgitate in defence or through stress and they need to be free to do this. If their beak is taped closed they can choke on their own regurgitation. During regurgitation, the person holding the head should simply tilt the head to one side and allow the bird to regurgitate freely. Never close the beak when a bird tries to regurgitate as this will lead to choking. Placement of the bird on the table or crate should ideally be with the head over one side of the table so that the head can be tilted to one side and slightly below the level of the table, allowing regurgitation to land on the floor rather than on the workspace. It is a good idea to place a plastic sheet or tarpaulin on the ground below the area where the head extends over the crate or table so that regurgitated material can be removed before another vulture is processed.

If you need to turn the bird around onto either its back or sternum, communicate this to the team members so that all turn the same way. Often the person holding the head will have a preference. You cannot keep turning the bird's head around 360°, but 180° is tolerable. Allow the person who is holding the head to dictate the direction of the turn. The person holding the legs must be careful not to cross the legs over each other. The person securing the wings will assist with the actual turning and lifting process but keep the wings together on either side of the bird. Always make sure the bird is comfortable. A bird that struggles is likely to be uncomfortable in some way and a change in position should be considered. The person restraining the head must keep the beak clear from other personnel, to avoid bite injuries, especially during the tagging process. He/she should also retain control of the head throughout the entire task until the bird is released or somebody else takes over.

Now with the bird on the table, secured by three to four people by holding the bird as already mentioned above, you can begin processing. **No binding should be used under any circumstances, i.e. taping the bill closed, taping the wings, or taping or tying the bird to the table.** The faster you work and process the bird, the better, but take care to avoid fast movements especially near the bird's head (unless eyes are covered). Speed and efficiency in processing depends on preparation and co-ordination of the team.

Releasing

When releasing a vulture, lower your body (Fig. 5), bringing the bird's feet to ground level, slowly allowing the bird to stand. Then release your grip on his entire body and neck at the same time, stepping away to give the bird some space (Fig. 6). Be careful never to drop or throw the bird down, nor allow the bird to fall prior to lowering it gently to ground level. When releasing the bird or placing it back inside the enclosure, remain still and allow the bird to walk or fly away from you, rather than panicking it, in which case it may take off, flying into stationary objects / fences. Do not force the bird to move. Allow the bird time to recover but monitor it for any unusual behaviour that could be a sign of heat exhaustion or injury from handling. The bird will decide for itself what to do next; it might fly off, run or drink water. Never force the bird to move or fly after the handling. Simply monitor and interfere only as a last resort if the bird appears not to be fit for release.



Figure 5: Preparing to release the vulture. The handler is going onto her haunches to bring the vulture to ground level.



Figure 6: Releasing a vulture. Release the head and body simultaneously and step back slowly, allowing the vulture to decide where to move next.

Vultures, when given the opportunity will time their take-off to coincide with a thermal or an increase in wind strength, making the take-off easier. Birds in general prefer to take-off against the wind, and this should be considered when choosing the release site and direction. Releasing a bird from a crate should be done at ground level, and not from an elevated site such as the back of a vehicle. Pulling a bird out by a wing or the tail is unacceptable, as is tilting a crate to encourage a bird to exit. Give the bird time to leave the crate of its own accord.

Transportation

Transportation is potentially stressful for every bird and all care should be taken to keep the bird as calm as possible. **The binding of a vulture's feet, beaks, or wings is totally contraindicated and should never be done.** If the transportation of vultures will be a common procedure, purpose-built crates are recommended. VulPro uses wooden boxes large enough for the bird to stand but not large enough for it to open its wings. VulPro crates measure 800mm long x 750mm high x 460mm wide and are sufficient to transport all larger

vulture species. VulPro crates have doors at one end which slide up so that there are no obstructions like door frames or hinges. The door can easily be slid up a small amount, whereupon the bird is observed before being carefully grasped by the neck. Once the bird is restrained, the door is removed to facilitate removal. Each side has several large ventilation holes which are then covered with shade netting to reduce light and keep curious fingers out of the vulture's reach. Each crate should be lined with a pre-cut swath of carpet. These carpets prevent the bird from sliding, are easier to clean than the crate itself, and are more shred-resistant than blankets. Carpets are preferred to blankets as they do not slide in comparison to blankets that can slide and bunch up resulting in the bird standing directly on the bottom and not on the blanket covering the inside bottom of the crate.

The inside surface of the crate should be sealed (e.g. varnished or painted), such that it can be effectively washed and then disinfected after each use. The cage should always be stored with the door removed, to ensure good ventilation so that fungal growth is avoided. Crates should also be stored indoors and not outside to protect the crates from the elements.

It is understood that it is not possible to always have a vulture-specific crate available. Make-shift crates or boxes can certainly be used. However, the most critical aspects of any transportation method are that the box reduces the risk of further injury to the bird and to handlers, minimizes stress, has ample ventilation and a stable temperature. Never transport birds in wire basket cages. Birds are at high risk of severe feather damage if they try to flap inside this style of container or rub their bodies against the sides. Once the bird is in the crate, it should always be kept in a shaded location, or at least in a place where a constant comfortable temperature can be maintained. Whilst in transit airflow will typically prevent overheating. Care must be taken once stationary as birds may rapidly overheat.

Housing

Temporary housing

These methods of temporary housing should only be considered if the bird is to be housed for a few hours, up to 3 days, until the bird can be transported to a licensed vulture rehabilitation facility or more suitable housing. If the bird is to be housed longer than a few days, other arrangements must be considered. See the long-term housing section below.

Stress management is a critical aspect to consider when housing compromised or injured birds. The bird should be kept in a quiet place, free from noise, onlookers, dogs or any other form of danger. Dim lighting is often beneficial. Patients must be provided with shade and water. A large, low bowl (10 litres or more) is sufficient. If the bird is not mobile, temperature control is far more critical, as it will not have the ability to move in and out of the shade as needed.

The size of the enclosure, garage, shed, etc, is also very important. At a bare minimum, the bird should be able to spread its wings fully, but it should not be longer than 10 metres so that if the bird flaps and tries to fly, it will not be possible to gain speed and/or height. All sharp points, sharp objects, and other dangerous items should be removed. The material in which the enclosure is made is also important, as brick, chicken mesh, and welded mesh have the potential to injure their feathers and extremities. If there is no place with suitable material, it is acceptable to cover the internal surface with towel or shade netting.

Long term housing

Long-term housing considerations should be made if the bird is to be housed for more than a few days. One of the most important considerations is socialization. Vultures are social creatures and they need to see, hear, and interact with other vultures of their same species. VulPro has shown that social interaction greatly increases their wellbeing and improves the chances of a positive outcome. For this reason, it is very important to transfer any patient to a vulture rehabilitation facility if the duration of care is likely to exceed 3-4 days.

Enclosures

Enclosures should be constructed with strong but flexible materials to prevent the birds from injuring themselves when flying around the enclosures and impacting with the sides. Suitable material includes; diamond mesh with a grid size of 60 mm X 60 mm (or 40 mm x 40 mm) and lined internally with shade netting material, (which reduces the impact of the birds colliding with the perimeter fencing). A solid retaining wall should also be constructed around the perimeter of the enclosures, to a height of approximately 80 cm.

A suitable amount of shade has to be provided for the birds and this can be in the form of 90% shade netting or a solid roof, such as fiberglass (corrugated iron becomes very hot but if used, needs to be a suitable height above the birds). A portion of solid roof is recommended (typically 30-50%) for shelter from rain and other weather elements. Course sand or natural grass should be used as substrate, which ensures patient comfort

and facilitates cleaning and maintenance. Smooth sand (e.g. building sand) is contraindicated, as it can result in pressure sores and bumble-foot.

Shade netting in strips on each long side of the enclosure should be used with 5m gaps between each long strip, from the top to mid height. The latter enables the birds to see the ends of the enclosure, this is particularly important inside a large (e.g. 40m long) enclosure. This helps prevent the birds from colliding into the ends of the enclosure, which would likely result in trauma, injury and potential death.

Enclosure furniture

Adequate perches and stumps need to be provided within the enclosures with at least one perch per bird plus a couple to spare. Vultures do not have feet that grip particularly well, so they require large, non-slip perches with plenty of space for landing. There should also be a wide range of perches and stumps of various diameters. This provides valuable gripping exercises for the birds. Irregular shapes and contoured surfaces reduce the risk of pressure sores or bumble-foot. Perches should be changed regularly before becoming smooth, which also predisposes the birds to bumble-foot. Perches should be erected at different heights with enough space around them to allow the birds to perch comfortably without their wings encountering adjacent structures. Avoid placing perches in the corners of enclosures as birds tend to touch the sides of the enclosure when landing close to the mesh, damaging their flight feathers.

Vultures love to bath and drink regularly, therefore fresh water is essential to their well-being. The water ponds / baths should be large enough to give the birds enough room to bath in, but shallow with a non-slip surface approximately 20 cm (8 inches) deep. Ponds should be placed at the lowest part of the enclosure (ensures water run-off) and be equipped with a suitable drainage pipe for easy cleaning and maintenance.

For colonial vultures (e.g. Cape Vultures), nesting cliffs should be constructed with 1 metre x 1 metre ledges for each breeding pair in an asymmetric style. The constructed cliff should be able to accommodate a group of perching vultures (>10) as Cape Vultures breed in groups rather than in isolation.

Enclosure hygiene and maintenance

Left-over food should be removed twice weekly, preferably two days after feeding as vultures tend to regurgitate if disturbed soon after feeding. Feathers, fur and castings should be removed regularly to prevent the potential build-up of pathogens or parasites, or of unsightly detritus. Perches or stumps that have decayed should be removed, burnt and replaced with new ones.

Water ponds and baths must be refilled every day and cleaned every second day. These ponds can simply be brushed and scrubbed out with a broom or scrubbing brush and clean water. Disinfectants should not be used for cleaning with the exceptions of Hibitane (Chlorhexidine) or F10. Use a hard broom, scrubbing brush or metal brush to clean, ensuring that any brush bristles which break off, are removed.

Feeding / Food preparation

Vultures should be fed twice a week on whole carcasses and bone fragments. Whole carcass feeding is ideal for vultures as this provides the birds with the natural nutritional requirements as gained if living in the wild. Bone chips no bigger than 10 cm must be provided to ensure adequate calcium intake, especially during the breeding season. These are best prepared manually, by smashing the ribcage, jaw bone, and spinal column from carcass remains with a mallet. Smaller vultures such as Palm-nut and Egyptian Vultures can be fed with day-old chicks if housed in separate enclosures but they do scavenge and will feed on whole carcasses if sharing enclosures with larger vultures. Some individuals dominate and will bully others, driving the subservient birds from food. Sufficient food should be provided to allow all birds to feed as their turn comes.

Toxins and drugs

All carcasses MUST be free from veterinary drugs, such as pain medication, antibiotics, anaesthetics used in darting and drugs used for euthanasia. Lead bullets should not be used to kill the animals as lead poisoning from fragments in meat is a common source of poisoning. You must know and trust the source of your carcasses and be aware of any prior drug treatments provided.

Below is a list of toxic drugs and toxins which might be encountered when choosing a carcass to feed to vultures. **The drugs and toxins below are deadly and must not be fed to vultures.** This is not a comprehensive list. Contact VulPro with any questions regarding the safety of any veterinary drugs.

1. Barbiturates (used for euthanising animals e.g. Phenobarbitone (also known as Pentobarbital))
2. Potassium Monofluoroacetate – a natural toxin contained in some plants, e.g. *Gifblaar Dichapetalum cymosum* that may be ingested by livestock or game, causing death.

3. Non-steroidal anti-inflammatory drugs [NSAIDs] are used to treat a variety of ailments in many animal species but are lethal to vultures. Sodium Diclofenac (active ingredient of Voltaren) caused a 99.5% crash in the vulture populations in Asia. **There is currently only one safe NSAID for vultures – meloxicam (trade name – Metacam).** This drug was previously unavailable for large animals but is now in production and available.
4. Antibiotics (especially Tetracyclines or Penicillins)
5. Lead (the main source of lead is from carcasses shot with lead-containing bullets which fragment on impact into many small, often microscopic, pieces. Many vulture fatalities have been linked to lead ingestion. Occasionally livestock die from ingesting lead, especially from car batteries, which may then lead to secondary lead poisoning of vultures.
6. Livestock insecticide / parasiticial dips. Any animal recently dipped in organophosphates should not be accessible to vultures.
7. Other agricultural products that are deadly to vultures and should not be used in known vulture territory include: Strychnine, Aldicarb, Monocrotophos, Methamidophos, Diazinon and Ethylfenthion.

Regardless of the use of any parasiticial dip treatment, it may sometimes be necessary to skin the animals to prevent the spread of ticks to the birds, particularly if the carcass is heavily infested.

If an animal has been shot through the head, it is critical to remove the head and burn it to avoid lead exposure. Other toxic metals are occasionally used in bullets, e.g. zinc or iron, so all head-shot carcasses should have the head removed or should be avoided entirely. Bullets which are genuinely non-toxic may be left in carcasses intended for vulture consumption.

Recommended food for vultures

- Rats and mice (for smaller vulture species and vulture chicks, i.e. less than 4 months old)
- Day-old chicks (for smaller vulture species *only*)
- Horse / donkey
- Cattle
- Pigs and piglets
- Goat
- Wild game
- Still-borne calves and foals
- Supplementary bone fragments should be provided in all the above diets

Do not feed adult chickens or any birds to vultures, due to the risk of spreading avian diseases.

Whole carcasses should always be the food of choice if the bird is healthy and able to feed itself. However, injured, malnourished and compromised birds may need assistance to get their full nutrient requirements. Weak and young birds (less than 6 months old) are given chunks of meat and bone from cow, pig, or wild game carcasses. Females during the breeding season, and growing birds especially, require a diet with an optimal Calcium to Phosphorus ratio (i.e. bone to muscle ratio, Ca:P ratio of 1.5:1).

It is advisable to prepare 2 litre Tupperware containers with meat when fresh carcasses are available. These tubs are then frozen until needed for feeding vulnerable birds. Pieces are cut only just before the meat is used (i.e. the night before or morning of feeding). Once the tub of meat is defrosted, it cannot be refrozen and should always be kept in the refrigerator until just before feeding. When previously frozen pieces of meat are offered, these are submerged in water, to ensure the patients remain well hydrated. Do not microwave frozen or cooled meat as this will result in the meat starting to cook, which is not suitable for the birds. Vultures only eat raw, preferably fresh meat.

Pieces are cut into thin slices which make assisted feeding, acceptance, and swallowing much easier. These pieces are offered to the birds with long tweezers. It is important to keep in mind that injured birds will be stressed by their surroundings as well as proximity to you. They should always be approached quietly and with a calm demeanour otherwise they are unlikely to feed from you. They may avoid the meat and tweezers at first or may attack the meat before they realize it is edible. Typically, once they appreciate it as food, they will readily eat from tweezers. Once a bird realizes that meat is inside the container, they are likely to self-feed from the container.

Record keeping

It is important to keep records of the history of each bird, the location it was found, injuries, and all treatment administered. This can aid and advise future medical efforts if the bird is taken to another facility. This information can also help build a case for anthropogenic injury; for example, prosecution of someone who laid poison or help make the case for the mitigation of power lines.

The most important data to record are:

- Date received
- Origin (GPS coordinates, if available)
- Reason for admittance
- Clinical presentations
- Enclosure where housed and with which other birds, if any
- Contact details of person who found the bird
- Any food offered and feeding frequency / schedule
- Drugs administered and schedule
- Behaviour changes and improvement in condition (or lack thereof)
- Physical condition (faeces, etc.) if relevant

✓Check list: basic required rehabilitation equipment

1. Transportation

- Vulture-specific crates
- Carpets
- Disinfectant

2. Medical Equipment

Checklist of basic inventory to have on site for rehabilitation efforts:

- silicone/plastic tubing around 30 cm long for oral tubing (IV fluid lines can be recycled for this purpose)
- electrolytes (Darrow's and Ringer's lactate solution)
- needles (23-21 gauge)
- Intra-venous cannulas (Jelco® 18-20 gauge)
- IV 'drip' sets
- syringes (60, 20, 10, 5, 2 and 1 mL, range for drugs and gavage)
- gauze
- VetWrap
- Elastoplast tape
- cotton wool
- scissors
- super glue
- F10® SC Veterinary Disinfectant spray, water-based
- F10® Germicidal Barrier ointment
- PluroGen PluroGel→
- Karbadust® or Frontline® powder
- Necrospray (or honey or other appropriate wound applications)

3. Drugs, listed by their active ingredient and, where relevant, trade names in brackets.

Also see CHAPTER 10.

- Atropine (Atropen®, others)
- Enrofloxacin (Baytril®)
- Amoxicillin-Clavulanate (Synulox®)
- Florfenicol (Nuflor®)
- Meloxicam (Metacam®, Mobic®)
- Corticosteroid
- Vitamin B
- Vitamin A
- Multivitamin (Catasol®)
- Probiotic Powder
- Dexamethasone Ointment
- Activated charcoal or carbon (CharcoAid®, others)
- Dexamethasone (Kortico® Injection)

Chapter 2: Stabilizing the bird, conducting an initial clinical exam

With experience, it is possible to begin to understand the injury and state of the bird by observing it at a distance. Pay attention to the bird's body posture and motion. How quickly do they react to you approaching? Is its head drooping (a symptom of non-specific weakness and depression, commonly observed with poisonings)? Are the wings symmetrical and held close to the body? Is it holding its head level? Is it placing its full weight on both legs or just one? Are there obvious distortions in the limbs? Can you see blood? Are flies present?

A bird which has just undergone a traumatic event (such as a vehicle collision) will be in shock and therefore in a critical condition. Initial efforts should be focused on stabilization, prior to addressing any specific injuries. A shocked bird should be moved to a warm, quiet and dark location; it will likely require intensive fluid therapy (preferably intravenously) and correction of hypo- or hyperthermia. Where relevant, pain relief and infection control should be addressed promptly.

Rehydrating a bird

Most medical treatment needs to be undertaken by a registered vet, vet nurse or para-veterinarian. Procedures such as prescribing medication, injections and some forms of fluid administration should only ever be done by one of the above mentioned, registered individuals.

Assessing dehydration

In the long-necked *Gyps* species, necks are useful in determining the state of dehydration as they have large patches of bare skin which can be used to determine the level of dehydration. Wrinkled skin indicates dehydration, while smooth, plumped skin indicates good hydration. One can assess dehydration by pinching this bare skin. Healthy, hydrated skin should spring back. If the skin remains 'tented', the bird is severely dehydrated.

Additional indicators of dehydration include tacky mucous membranes and thick strands of saliva at the back of the mouth, sunken eyes, and weak pulses.

Any rescued, traumatised or sick bird will typically require fluid therapy. We can safely assume that these birds have been sub-optimally hydrated for some time before admission. The method of rehydration employed will be determined by the experience of the rehabilitator, the facilities and equipment available, and the degree of dehydration and debilitation of the patient.

Vultures may be rehydrated as follows:

- **Per Os (PO) fluids:** Oral fluids (via tubing or gavage): Tubing is an invasive procedure. Knowledge, experience and great care should be taken to ensure that fluids are administered into the crop and not down the trachea, as the latter will certainly kill a bird.
- **Subcutaneous (SC) fluids:** a more immediate method of rehydration than tubing, but less immediate than IV. This can be difficult in a conscious patient.
- **Intravenous (IV) fluids:** should only be administered by experienced rehabilitators or vets, but this is the best method to quickly rehydrate a severely dehydrated bird, or one in shock.

Oral fluids (via tubing, or gavage)

Vultures are magnificent at digesting rotting meat together with pathogens (parasites, bacteria, and viruses) that come with it, thereby cleaning the environment. All vultures have a crop, an extendable pouch before the stomach, which holds up to 2 kg of meat (in larger species). The crop provides vultures with a very important physiological advantage in that they can store additional meat to take back to their chicks or for later digestion when food is scarce. The presence or absence of food in the crop and the odour of the breath yields vital information in relation to recent food ingestion. Bad breath is often an indication of a recent meal. In several species, crop filling can be monitored visually and therefore acts as a tool to ascertain how quickly fluid is emptying into the stomach (proventriculus).

Tubing is most easily done with two people. One person holds the bird upright while the other opens the beak (with care as the edges of vulture beaks are sharp), placing the tube into the crop and administering the fluids.

Even though one person holds the bird and does not let go of the head (from the back of the head), the person who will give the fluids should also hold the bird's head and beak with one hand (from the front of the head / beak). With the other hand, the mouth can be opened and inspected to visualise the glottis (the slit-like opening at the base of the tongue). The glottis marks the start of the trachea. A long tube (0.5-0.75m long) should be placed into the back of the mouth, **taking care to avoid the glottis**. This is best done by following the inner side of the mouth as the tube is passed down the throat. It should easily be pushed down the oesophagus. If

the tube feels obstructed, take great care to assess that the tube is being sent down the correct pathway. In *Gyps* vultures, you will be able to see the tube moving down the neck. In other bird species where the neck is feather-covered, the tube can easily be felt as it is passed down. If you cannot see the tube moving down the neck, remove the tube and try again. The tube should be inserted all the way down the neck into the crop. Again, **DO NOT** give fluids until you can visually or physically confirm that the tube is placed correctly and is all the way down into the crop. A large *Gyps* vulture or Lappet-faced vulture should receive up to 180ml of water, Ringer's lactate solution or other rehydrating solution at one time. You will see the crop expand with the fluids. If the bird is severely dehydrated, the crop will subside quickly and more fluids can be given. Do not give oral fluids to any bird who is not strong enough to hold their head up, otherwise they can regurgitate the fluid and inhale it, resulting in an aspiration, pneumonia, and almost certain death (Fig. 7).



Figure 7: Given fluids orally, securing the head and beak and safely inserting the tube down the bird's beak and into the crop

If the bird is severely dehydrated, tubing can be done several times a day, every few hours if necessary. However, oral fluid therapy is generally only used to rehydrate mildly dehydrated birds, or when veins cannot be cannulated for delivering intravenous fluids. Intravenous fluid therapy provides direct access to the bloodstream and so is the quickest and most effective route for fluid therapy. A severely dehydrated bird will have poor blood supply to many organs, including the digestive tract and the skin. In these instances, fluid delivered to these sites may not be 'collected' and enter the bloodstream. If the bird does not recover or rehydrate sufficiently from tubing, other more effective methods of rehydration should be considered (see below).

Sub-cutaneous fluids

Sub-cutaneous (SC) fluids are a more immediate way of delivering fluids than tubing, although it can be difficult and stressful to administer in a conscious patient. SC fluids can be given over several body locations. The most commonly used places are the inguinal folds (the connecting skin on the inside of the thigh, where the torso meets the legs) or on the mantle (between the shoulder blades/where the wings join the shoulder region). SC fluids, unlike tubing, MUST be sterile fluids such as saline or Ringer's lactate solution. For large Gyps vultures, up to 120ml can be given at one time, but over two or more locations: i.e. 60 mL in each inguinal fold.

To administer SC fluids, place the needle (with preloaded syringe) just under, and parallel to the skin. The needle should be inserted very shallowly. Gently draw back the syringe. No blood should be seen either in the syringe or coming from the injection site. Slowly inject the fluids so that a bubble starts to form under the skin. If you do not see a bubble forming, you have placed the needle too deep into the tissue and should start again. Depending on the elasticity of the skin at the injection site, 40-70ml may be given at each site. The bubble will be large and taut. When the needle is removed, some fluids will escape, but if you gently place pressure on the injection site, this should stop quickly.

Intravenous fluids

Whilst requiring more equipment, experience and expertise, intravenous fluid rehydration (IV) is certainly the most effective and efficient method of fluid replacement and rehydration.

Fluid requirements:

One should assume that any sick or injured vulture is 10% dehydrated, i.e. there is a 100ml fluid deficit per kg of body weight.

This fluid deficit should be replaced 50% in day one, 25% in day two and 25% in day three. In addition, any bird will require 50ml/kg maintenance fluid each day.

<u>A typical 10kg Cape Vulture trauma case will require:</u>		
10kg bird, 10% deficit		1000ml
Given as		500ml day one 250ml day two 250ml day three
<i>Plus 10kg maintenance at 50ml/kg/day + 500ml/day</i>		

		Day one
	=1000ml	
IN TOTAL	Day two	=750ml
		Day three

Fluids may be given as boluses, using a syringe at a rate of 10ml/kg (standard large Gyps is taken as 10 kg so 100ml gradually over 5 minutes) at admission, repeated after 2 hours, then repeated every 3 hours over the first 24 hours after admission.

Alternatively (and ideally) fluids are administered intravenously, via a 'giving set'. For a 10kg bird, using a standard (20ml) giving set, the drip rate should be one every 3.5 seconds for the first four hours, reducing to one drip every 5 seconds thereafter, until the end of day three after admission.

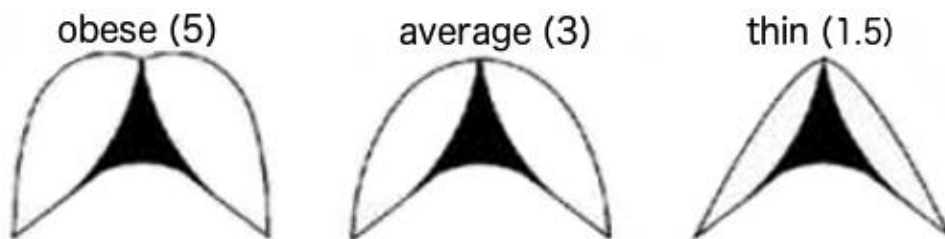
Some may criticise catheter placement in the inner lower leg (medial tarsal vein), as this site tends to be soiled. However, after appropriate cleaning and disinfection, it remains the ideal site from which to administer IV fluid as it can be easily placed in a conscious bird and accessing this site is far less stressful to the bird than alternative sites. Once the catheter is placed, it may be secured with adhesive tape. In contrast, the superficial ulnar vein (on the underneath of the elbow) is a challenging and stressful site in a conscious bird and catheters typically require suturing to remain in place. This is not advised in a conscious bird.

Very sick vultures tolerate catheters well. This is often assisted by restraining them to a limited enclosure. Once they are attempting to remove the catheter, fluid may instead be provided by the oral route.

Full Clinical Examination (once the shock has been addressed)

An in-depth clinical examination is only to be done once the bird is stable and is no longer in shock. Handling of a bird whilst in shock can result in heart complications and fatalities, therefore handling **MUST** be kept to a minimum until the bird is more stable. In conducting a head to toe exam, typically one or two major issues will be identified.

- Is the beak chipped? Are eyes open, alert? Does the nictitating membrane (third eyelid) react to stimulus?
- Dehydration: conduct a pinch test and look for 'tented' skin on neck
 - If tented skin stays up for 5 seconds or less, assume 10% dehydrated
 - If tented skin stays up for >5 seconds, assume 15% dehydrated, increase fluids for a 10kg bird to
 - 1250ml day one
 - 875ml day two
 - 875ml day three, then reassess
- Crop – has the bird eaten within the last 12-24 hours? How much food is in the crop?
- Assess the bird's condition and weight based on the species' averages. Relying only on weight is inaccurate, for example a bird may be very thin but full of fluid (ascites). Body Condition Scoring (BCS) is essential. Palpate the pectoral muscles, which flank the keel bone (breastbone). Record the body condition score (BCS) on a scale of 1 to 5 based on the amount of muscle tissue present. The keel bone is represented by the black area and the pectoral muscles are white. The images represent a cross section (as though you are looking down on the bird). Healthy birds range from BCS 2.5 to 4. You will struggle to feel the keel bone in an obese bird (BCS 5). Any bird below a BCS 2 is considered thin, very thin or emaciated. A palpably sharp keel bone indicates the bird is emaciated.



- Are the wings symmetrical? If you suspect a broken bone, use both wings to understand what a normal wing should feel like compared to the injured wing. Search for the break or any spots where the bird reacts, indicating that the area is tender. Be gentle! Assess the normal range of motion, moving each joint of each wing (starting at the shoulder and moving downwards) and see if there is any indication of a joint dislocation or a broken bone.
- Does the bird put full weight on both legs? Is it limping? Assess the normal range of motion for each joint of each leg in turn, moving the legs to see if there is any indication of a dislocation in a joint or broken bone.

In general, you must also assess the following:

- Are there any **open wounds**? Are **maggots** present? If so, they should be removed immediately (see CHAPTER 3).
- **Are bones or tendons exposed**? The answers will advise how quickly you must address the wounds. If there is tendon or bone exposed and the break is relatively new, keeping the area (especially the tendons) moist and disinfected is critical and may mean the difference between saving the wing and amputation. The tendons and bones must not be allowed to dry out as they lose blood supply and become non-viable.
- If there is a compound fracture (i.e. the skin is broken and surrounding tissues will inevitably be infected) or closed fracture (i.e. the skin hasn't been breached), and the wing is dangling, you may need to strap the wing before transport. This will provide comfort and reduce the likelihood that the bird will stand on the wing and cause more damage (see CHAPTER 4).

- Does the bird have external **parasites**: ticks, lice, mites? If excessive, this will give you an idea of how long the bird has been grounded. More parasites = longer time on the ground. If Karbadust→ or similar ectoparasite dust is available, it is always a good idea to dust the bird upon arrival. This will help you to handle the bird, as well as for the bird's comfort.

Chapter 3: Wound care

Most medical treatment needs to be undertaken by a registered vet, vet nurse or para-veterinarian. Procedures such as prescribing medication, injections and some forms of fluid administration should only ever be done by one of the above mentioned, registered individuals

✓ Check List: Important items to have when treating wounds

- F10→ SC Veterinary Disinfectant spray (water based)
- Hibitane or similar (alcohol based)
- F10→ Germicidal Wound Spray
- F10→ Germicidal Barrier Ointment
- Necrospray (Oxytetracycline Hydrochloride)
- PluroGen PluroGel→
- Honey (preferably Manuka honey)
- VetWrap
- Granuflex→ dressing or any moisture-retentive dressing
- gauze
- cotton wool
- Elastoplast tape or other strong fabric/athletic tape
- super glue
- masking tape
- tweezers
- sharp scissors

Maggots

All wounds should be observed for maggots and these should be removed by physically picking them out. If not all maggots can be removed by hand, it is recommended to liberally apply honey to the wound which will smother the maggots and draw them upward and out of the wound. Ectoparasitic wound preparations, such as 'F10 Germicidal and Insecticidal Spray' **should not be used on vultures** as the permethrin ingredient can be toxic to the patient. You do not want to simply kill the maggots and leave them within the wound site. Necrospray and F10 Germicidal Barrier Ointment, as well as F10 Germicidal Wound Spray will kill the maggots which will then need to be picked out of the wound.

Closed vs Open Wounds

It is important to first make the distinction between wounds that will require surgical closure (intervention) and those that will heal by second intention (the body's natural healing process). Will the wound need to be stitched or otherwise sealed closed? Deep, fresh wounds with edges that can be easily apposed will typically fair better, and heal faster, with surgical intervention. Shallow wounds with unapposable edges, e.g. burns, will need to close over naturally. This is a much slower process and the wound must be kept moist and clean throughout. The wound itself should not be the only consideration when opting for a surgical or non-surgical approach. Healing by second intention inevitably involves regular handling to dress wounds, change bandages etc., and is always an important factor to consider when treating wild animals. Surgical closure will require a general anaesthetic which is not always ideal in a weak/unstable bird. It is advised to consult your veterinarian to discuss the options.

If the wound needs to be surgically closed, it is critical not to put anything inside the wound which may impede the healing process. It is vital that contaminated/infected wounds are not stitched closed immediately. In addition to contaminants, a proportion of tissue within the wound will degrade and encourage infection. Typically, placing the patient on a course of antibiotics for 48 to 72 hours, while cleaning and flushing the wound, reduces the likelihood of post-surgery 'wound breakdown'. Honey has antiseptic properties and is a suitable substance to pack into a contaminated wound. F10 Germicidal Barrier Ointment will also improve the wound environment.

The area should be debrided, meaning all the dead (necrotic) tissue should be removed. This can be done by hand or with a clean scrubbing brush, toothbrush or scalpel blade. When deciding what tissue should be removed, assess the colour and ease with which it can be removed. Light pink tissue is viable and should not be picked. No dead or rotting tissue should require excessive effort nor cause excessive pain in its removal. Debriding will cause some light bleeding. If the bleeding becomes excessive, stop. You are probably removing healthy tissue; necrotic tissue has a poor blood supply.

Next, the area must be disinfected with a water-based disinfectant spray such as F10 SC Veterinary Disinfectant. The wound should be kept moist as it requires a moist environment to form a 'granulation bed', a vital stage in the healing process. A dry wound will heal slowly and may cease healing altogether. Wound gels, such as PluroGel work very well in keeping wounds moist. Hydrocolloidal dressings, such as Granuflex

encourage a moist environment to optimise healing. Granuflex and similar dressings (e.g. Allevyn Thin) will not adequately stick to the wound if creams or ointments are applied. This moisture-retaining dressing can be secured in place by covering with a VetWrap bandage and/or Elastoplast tape. It is easy to apply VetWrap too tightly and thus it is helpful to unroll and then re-roll the VetWrap and Elastoplast tape prior to applying it on the bird to avoid the bandage being too tight. A bandage that is too tight can restrict circulation, overflex joints, or cause discomfort and therefore interference.

It is important to keep in mind that a constantly moist wound brings a real risk of attracting flies. It can become a breeding ground for flies, midges, and bacterial infection. If the wound is left open, it must be kept clean and moist and should not be allowed to dry out. The best product for fly-infestation is F10 Germicidal Barrier Ointment and it should be applied very thickly and as often as needed until the wound heals.

Wounds should be re-assessed and re-banded every 2-3 days. However, maggots, if present, must be removed and the wound assessed daily. Changing the bandage more frequently is stressful, but the treatment of every case should be considered individually, as more attention may be required.

Infection

If the wound is infected, you will see signs of inflammation. This includes reddening and/or swelling of surrounding tissue, heat and discharge (typically pus). If a wound shows signs of infection, place the bird on a course of Amoxicillin-Clavulanate (Synulox) antibiotics.

Bee stings/snake and other animal bites

Typically, with these injuries, the wound is not as problematic as the venom itself. The bird must first be stabilized which means it will likely need to be put on an IV drip and given antivenom. In these cases, you must consult with your local veterinarian and seek immediate action. *Gyps* vultures have been successfully saved through antivenom treatment.

With puff adder bites and multiple bee stings, the skin will become necrotic and cannot be stitched. If this is the case, the entire area must be kept very moist. To counterbalance the risk of infection and fly eggs, the bird must be kept in a relatively sterile environment until the exposed wounds heal.

Carnivore bite wounds are typically highly infected due to the pathogens found on the teeth of carnivores. The wounds should never be sutured or otherwise closed. They should be cleaned daily. A course of antibiotics is essential.

Bumble-foot

Bumble-foot (Fig. 8) is the colloquial term for inflammation and/or infection of the plantar aspect of the feet. In vultures, this can be seen as large swellings, typically on the underside of the foot, along with scaling/cracking.

Bumble-foot in vultures is almost always the result of a pressure sore initially affecting one foot. So, if one leg is damaged or painful, the bird takes excessive weight on the 'good foot'. This excessive weight results in a pressure sore. Bacteria living naturally on the skin pass through the compromised skin, giving rise to a cellulitis (infection of the tissues between the skin and the bones of the foot). The foot swells, with the bird still standing on it, squeezing the blood supply out and preventing normal circulation, so the infection cannot be naturally controlled. As the foot is painful, birds often place too much weight on the opposite foot, resulting in bumble-foot in that foot also.

The best way to treat bumble-foot is to prevent it altogether. Birds which have injured legs or hips and can only bear weight on one leg are at great risk of developing bumble-foot in the non-affected, weight-bearing leg. The risk of bumble-foot can be reduced by placing a corn plaster or doughnut shaped dressing on the (at risk) foot, relieving pressure on the ball. Vultures do not always tolerate dressings on their feet. In these cases, an alternative is to ensure the substrate of the enclosure is weight absorbing (e.g. coarse sand and rough bark on perches) to help reduce the risk.



Figure 8: Image showing typical bumble-foot in a bird of prey's feet

The bird should be placed on a course of appropriate antibiotics (e.g. Nuflor) and the foot needs to be bandaged as per the instructions below. Preferably, take a microbiology swab for culture prior to administering any antibiotic. This information allows for a more directed antibiotic therapy and reduces the risk of resistance or treatment failure.

Step-by-step guide to bumblefoot treatment

The treatment of bumblefoot is as follows:

- Clean the area and scrub vigorously with disinfectant spray and a toothbrush or nail brush.
- Cover the surface of the infection with DMSO (Dexamethasone) ointment.
- Prepare a doughnut-shaped cotton wool bandage (Fig. 9) to place around the bulge of the infection (granuloma) to reduce the weight which is placed on the bulge directly. Alternatively, one or two layers of a corn plaster shaped dressing may be cut from the thickest available yoga or camping foam matting. Soak the cotton wool or foam in Baytril antibiotic.
- Place the doughnut bandage around the swelling or infected tissue and then wrap the foot and bandage with VetWrap first, and then Elastoplast tape to prevent the bird from tearing it off. The bandage will be bulky and appear cumbersome, but this is necessary.
- As the treatment of Nuflor is repeated (every 3 days), the dressing is replaced on each occasion. The dressing should be continued until the swelling is reduced, it is not hot to the touch, and the pain in the opposite leg has resolved.



Figure 9: Doughnut-shaped bandage, note the hole in the middle of the bandage

A dry and cracked foot (but not swollen or apparently infected) such as that shown above is best treated with Preparation H (ointment rather than the gel version), by daily application for 2 weeks. Preparation H is a human treatment for haemorrhoids and is safe for use, whilst some **other haemorrhoid treatments containing local anaesthetic (any drug with an 'aine' in the name) are toxic to birds.**

✓ Check list: bumble-foot treatment

- Toothbrush or nail brush
- DMSO (Dexamethasone ointment)
- Baytril (soak cotton wool)
- A large amount of cotton wool, OR
- A spongy foam matting
- VetWrap
- Elastoplast tape
- Nuflor (inject via IM)

Chapter 4: Broken bones and dislocations

If the skin is broken over any wound, it is highly likely that the underlying tissues will be infected. If this is associated with a broken bone, it is referred to as a compound fracture. If bone and/or tendon is exposed, it is critical to keep the bone and tendon moist. If the bone and tendon dry out, the limb will not be able to be saved. If the compound fracture is fresh and the bone and tendon are still moist, there is a chance the wing can be pinned and saved. In this case, the bird needs to get to an avian veterinarian as soon as possible. If a delay in treatment is unavoidable, then keep the wound moist and commence fluid therapy, antibiotics and pain relief. Even if the bones and tendons are dry, urgent veterinary intervention will still be necessary, although it is unlikely the wing will be saved.

Published release rates from the Minnesota Raptor Research Institute state (1993) the following data:

- 35% chance of release if the skin is closed
- 15% chance of release if the skin is open

If the triage (initial assessment of any casualty case) clinician suspects any break or dislocation, then the bird must be presented to an experienced avian vet as a matter of urgency. The bird will need to be stabilised with fluid therapy, pain relief and antibiotics. A diagnosis will typically be made with an X-ray, usually carried out under anaesthetic, and the fracture will need to be initially stabilized (e.g. support bandage) prior to surgical treatment, which typically occurs the following day. However, each case should always be considered on its own merits.

If the bird is tripping on its own wing, then either the tips of the primary feathers on each wing need to be taped together to keep it up off the floor, or the wing needs to be strapped against the body. Stabilizing the wing against the body, using the body as a splint, helps to prevent movement and hence reduces pain, but must be done in a way to avoid excessive pressure around the body. The wing should be strapped in such a way that the bird's breathing is not compromised, nor that excessive pressure is applied on the propatagium (the tendinous leading edge of the wing) which can cause localised loss of blood supply, with resultant loss of wing function.

Key Points for treatment

All trauma cases receive fluid therapy.

All open fractures should be treated with antibiotics (Nuflor). If closed, assess before giving antibiotics.

Pain relief (e.g. meloxicam) is only given after the bird is rehydrated, as if given to a dehydrated patient the drug can cause kidney damage.

Wing wraps

When deciding which wrap to use, consider the location of the fracture. The function of wing wraps is to stabilize the joints on either side of the fracture. Therefore, if a fracture occurs in the upper part of the wing (humerus, shoulder, or pectoral girdle: scapula, clavicle and coracoid) the wing will need to be secured to the body to stabilize the shoulder joint. If the break is more distal, towards the tip of the wing, then a body wrap is not necessary.

Upper wing fractures: body wrap

The most common fracture in flighted birds, including vultures, is to the humerus (upper arm/wing).

Below is a step-by-step guide to applying a wing bandage for fractures in the upper wing and shoulder.

Step 1:

Unravel and re-roll your bandage (we recommend VetWrap) prior to starting so you don't have to place pressure on the wing when wrapping, making the wrap unnecessarily tight.

Start with the wing in an anatomically correct, folded position. Gently place the wrap under the wing, just below the bend in the wrist joint.



Step 2:

Fold the loose end over the wing just behind the carpus.



Step 3:

Pass over the loose end to secure it.



Step 4:

Pass the bandage over the vulture's back, heading caudally (towards the tail end).



Step 5:

Bring the bandage under the flight feathers of the opposite wing and in front of the opposite leg.



Step 6:

Bring the bandage between the legs and behind the other leg as you bring the bandage back toward the injured wing.

It is important at this point to check that the bandage does not cover the vent and check the tightness of bandage around the body. It should be tight enough to remain in place on the body, but not so tight that it could restrict breathing.



Step 7:

Bring the bandage over the distal section of the wing.



Step 8:

Direct the bandage cranially (towards the head) as you bring the bandage over the vulture's back.



Step 9:

Bring the bandage over the shoulder / clavicle but under the opposite wing.



Step 10:

Bring the bandage back to the front of the bird and over the sternum.

It is important here to try and not restrict the crop, or place the bandage too high on the neck as to rub on skin or restrict breathing and/or eating. Try to get the bandage to lay flat just under the crop.



Step 11:

Bring the bandage back over the injured wing, directed caudally (towards the tail end)



Step 12:

Secure and finish the bandage over the vulture's back.

Step 13:

Secure/knot the loose end as best as possible.

The injured wing should now be immobilized. Check that the wing can't be easily flapped up. Ensure the wing is in an anatomically natural position. If the wing is over-flexed the primary feathers will be pointing upwards. The bandage should not be too loose or too tight. The opposite wing should be free to flap and fully extend. Ensure the bandage is not lying over the crop or vent.



Dislocations

Dislocations are serious injuries with a poor chance of return to normal flight. The most common joint to be affected is the elbow and/or shoulder. On occasions, there may be a loss of circulation. It is important to check the temperature of the distal limb. You can suspect a loss of circulation when the tissue feels cold. Any such bird must be presented to a suitably experienced avian vet as soon as possible. The longer a joint remains dislocated, the less likely the bird is to fully recover. Immediate action is required. Dislocations often have a poorer prognosis than broken bones.

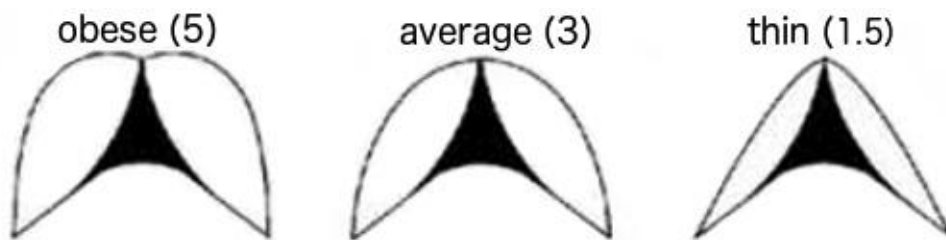
Chapter 5: Severe nutritional deficiencies, emaciation, head trauma

Vultures which have broken their wing can still walk and survive for several weeks after their injury. Many power line collision victims arrive at a rehabilitation facility emaciated and weak from spending extended periods on the ground after the collision. Emaciated, inexperienced juvenile vultures are common rehabilitation patients during the fledging season. When fledglings first leave the nest, many are not able to make it back to their colony or nest and are found grounded in areas where they are unable to fly. The risk of this occurring is greatly increased if the weather is inclement.

Body Condition Score

All vultures should have their body condition scored. This is done by feeling the amount of flesh around the keel (breastbone) and rating the bird using a basic scale from 1 to 5. Healthy birds range from 2.5 to 4. Any bird below 2 is considered thin. If a bird is severely emaciated, there may be little if any muscle felt around the keel, and neck vertebrae are usually prominent.

The images below depict a cross-sectional view of the bird's keel (as though you are looking down on the bird from above). The black area represents the keel bone and the white sections are the flanking pectoral muscles.



Feeding an emaciated bird, probiotics and supplements

Any bird presenting with a score of 2 or below should be fed daily. Emaciated birds should be fed frequently and kept hydrated at all times. Emaciated birds are fed with very small, thin pieces of muscle and fat from fresh carcasses. Soaking these in water or saline for 5 minutes prior to feeding may assist in digestion and rehydration.

The crop is not a stomach. Instead it is more akin to a shopping basket or personal pantry. There are no acids or enzymes inside the crop to stop food putrefying, so any food which does not pass on into the stomach rapidly begins to rot. If the crop does not reduce in size, do not continue to feed. You must be sure the meat is passing through the bird before you continue to feed. One should not feed any bird while there is still food in the crop. This may take up to 40 hours.

If food is slow in passing from the crop, it helps to moisten the meat in the crop and massage it to encourage it to move on into the stomach. You can achieve this by tubing 60-120ml of fluids after feeding.

One should also consider the administration of probiotics to any bird which is in bad condition, has had a gut infection, or been on a course of antibiotics. Powdered probiotics can be administered with food, or in fluid via crop tubing. A suitable dosage would be one heaped teaspoon on one or two consecutive feeds.

For thin birds, especially young ones, bone chips, powdered calcium carbonate, or calcium and vitamin D3 liquid or powder, should be provided daily for two weeks after admission. Thin individuals will also benefit from vitamin supplements for the first few days after admission. Intramuscular Catasol (multi-vitamin), Vitamin B1, and Calcium may be beneficial. It is important to use one preparation and limit it to the recommended dose rate, as over dosage can be dangerous.

Seizures

In vultures, seizures range from slight twitches of the head to full body convulsions. Severe, involuntary muscle contractions often result in characteristic twisting of the neck towards the back of the body. These convulsions can be related to severe hypoglycaemia (critically low blood glucose), toxicity (poisonings), head trauma, severe nutritional deficiencies, or general emaciation or debilitation.

Emaciated, seizing birds should be given fluids (containing 10% glucose) and should be force fed, preferably with a semi-elemental critical care diet (e.g. Emeraid® carnivore care), immediately. If a critical care diet is not

available, then a diet of minced whole carcass, with added glucose powder and vitamins is appropriate. Typically, as soon as some nutrients and fluids have processed through their system, the seizures stop. If seizures continue after giving some food and fluids, the seizures are less likely to be nutritional, and more likely caused by toxins, head trauma, etc.

Any bird having seizures should be kept in a dark, calm, quiet, stable environment. All such cases should receive intravenous fluid therapy via a drip (see CHAPTER 2). Unfortunately, seizures are self-perpetuating; in other words, the more seizures that occur, the higher the likelihood of another seizure occurring. If seizures are occurring frequently (every few minutes), it is important that these are controlled as quickly as possible.

Seizures can usually be brought under control with the administration of a Benzodiazepine sedative:

- Diazepam (commonly known as Valium) administered at a dose of 0.5-1mg/kg by intramuscular or intravenous injection every 8-12 hours, or 2.5-5mg by mouth every 12 hours, or
- Midazolam administered at a dose of 0.5-1mg/kg by intramuscular or intravenous injection every 8-12 hours.

If sedatives are not available (these drugs are controlled veterinary medications), then some cases will respond favourably to steroids (e.g. dexamethasone). Careful consideration must be taken when administering steroids to bird species. Birds are highly susceptible to the immunosuppressant properties of steroids; thus, they should only be administered when absolutely necessary. Birds will often develop resultant bacterial, viral and fungal infections after administration of steroids. Consider providing prophylactic (preventative) courses of antibiotics and antifungals to these patients. **If steroids are administered, you must NOT give in conjunction with ANY non-steroidal anti-inflammatory drug (NSAID) e.g. Meloxicam→; there must be a waiting period of at least 3 days between the use of these two drug classes.** The combination of steroids and NSAIDs are toxic to all species, including vultures. Administering the drugs together can result in acute kidney failure, acute liver failure and ulceration/perforation of the digestive tract; often resulting in death from these injuries.

Blindness

In view of their lifestyle (communal living, flying and eating and their quarry / food doesn't run away), vultures with compromised eyesight generally cope well, indeed damage to the first eye often goes unnoticed. However if eyesight is totally lost this is a different matter. Vulture wildlife admissions have often suffered trauma.

Some 30% of all raptor trauma cases, has suffered eye damage and in 70% of these cases the only damage is seen in the posterior segment, (i.e. behind the lens, where it cannot be seen without use of an ophthalmoscope), this will typically comprise haemorrhage or retinal detachment behind the lens and often goes unappreciated as looking at the birds eye with the naked eye, no abnormality is seen. A traumatised bird can suffer damage to both eyes although this is relatively rare, however a vulture initially suffering damage to one eye will typically manage well, until the second eye is also damaged.

If a vulture is presented with apparent blindness, it should be submitted for full ophthalmic examination by an experienced avian or ophthalmic vet. There are many potential diagnosis, such as cataract formation, neoplasia, dry eye, uveitis, parasitic infestation, bacterial infection in the globe, penetrating lesions, glaucoma, insect stings. In some such cases therapy can be effective.

In cases of blindness, not associated with trauma, then the main differential cause would be lead poisoning. Whilst generalised weakness of limbs and incoordination is typically associated with lead poisoning in birds, in some cases the only presenting sign is acute onset blindness.

Chapter 6: Paralysis

Paralysis is commonly associated with traumatic injuries and poisoning (carbamate, organophosphate and lead) cases.

In respect of trauma – these are typically birds which have collided with a power line cable, crash-landed, and impacted the ground with their chest. This tends to result in a compression fracture of the lumbar (back) vertebrae, often resulting in paralysis of the legs, whilst the wings remain functional.

Assessment of paralysis cases

The most important prognostic test is to check for a pain response. Using a pair of forceps, pinch a toe or skin on the leg. The bird may well pull its leg up in an involuntary (automatic) response; this is called a spinal reflex. Whilst worth noting, this response only tells us about the nerve supply from the leg to the corresponding spinal segment and back.

What we are interested in is the connection between the spinal cord and the brain. In order to assess this, we are looking for 'deep pain response', or conscious acknowledgement of the pinch. Watch the head for any response. The bird should move its head, usually turning towards the stimulus, perhaps appear alarmed or try to defend itself. These are positive indications that the bird can consciously feel; that nerve impulses have successfully travelled up the spine. A lack of 'deep pain response' suggests severe spinal damage and carries a grave prognosis. In these instances, if the bird is not in too much distress, one can try treating the bird with fluid therapy and NSAIDs, with or without additional analgesia for a maximum of 48 hours. If the deep pain response has not returned after this period, the bird should be euthanised.

If there is some indication of a deep pain response, then supportive care should be initiated:

- Physical – sling the bird (Fig. 10), providing a poop hole. Always keeping the vent clear to allow the bird to defecate clear of the sling to avoid soiling itself.
- Fluid therapy (see CHAPTER 2).
- Nutritional support (force or tube feed at a rate of 2-3% of bodyweight per day)
- Anti-inflammatory medication and pain relief (meloxicam, only given following rehydration)
- Vitamin B complex
- Physiotherapy to prevent cramping and muscle/tendon contracture, including use of a water bath if appropriate

If there is no response or improvement within 2 weeks, the case is hopeless and the bird should be euthanised.



Figure 10: Cape Vulture in a sling

Chapter 7: Poison treatment

If you attend the site of a likely poisoning incident, i.e. several birds dead or ill around a carcass, consider and respect the site as a 'crime scene'. It is imperative to avoid any damage to evidence as this is vital information in bringing any future legal action against a suspect.

In this situation contact the local law enforcement authorities in the area of the poisoning event.

If any vultures remain alive, these should be treated as a priority. The observed clinical signs will vary with respect to the type of poisoning. The three main categories of poisonings are: agrochemicals, non-steroidal anti-inflammatory drugs (NSAIDs) and lead.

Agrochemical poisoning

Possible drug culprits:

- DDT is not likely to be a culprit, as large quantities would have to be ingested to have a lethal or sub-lethal clinical effect

Organophosphates:

- Fenthion
- Methamidophos
- Diazinon
- Chlorfenvinphos
- Fenamiphos
- Cadusafos

Carbamates:

- Aldicarb
- Carbofuran (granular and liquid)
- Methomyl

Clinical signs:

In general, if a bird has survived a poisoning incident and is able to make it to a rehabilitator, these are the clinical signs most likely to be seen:

- Incoordination, stumbling, falling over and an inability to balance (ataxia)
- High- or goose-stepping (over-exaggerated lifting of legs when walking)
- Seizures (severe)

Organophosphate (OP) poisoning

More specific characteristics of each drug reaction include:

1. Fenthion – relatively slow onset of about a half hour, pupil constriction (miosis), vomiting, tremors, paralysis. Prognosis is very poor. Birds may fly for half an hour before toxic effects ground them. Recovery can take as long as 8 months.
2. Methamidophos – rapid onset of symptoms within 5 minutes, prognosis very poor. Birds are typically not found further than 50m from the source.
3. Diazinon – very rapid onset of symptoms within 3 to 5 minutes, prognosis fairly good with no long term effects. Birds will be found within 100m of the source.
4. Chlorfenvinphos – rapid onset of symptoms within 5 minutes, prognosis poor. No long term effects.
5. Fenamiphos – rapid onset of symptoms, prognosis very poor with virtually no survivors. Birds found within 100m of source.
6. Cadusafos – slow onset of symptoms, up to half an hour after exposure. Prognosis very poor and survival unlikely. Birds can move very far from the source.

It is important to note, recovered birds will occasionally re-present symptoms long after the initial treatment of the poisoning event. When the bird initially ingests the poison, the body distributes a proportion of the poison into fat reserves. Should the bird lose weight post-recovery, these fat stores are utilised and the poison is

released back into the bloodstream. Typically, the symptoms will be mild as the volume of poison is much smaller.

Treatment of OP poisoning:

Rapid availability and administration of the correct antidote is imperative. If not treated correctly within 24-48 hours, therapy is often ineffective.

Antidote: treat with 2 PAM (Pralidoxime Chloride), at 50 mg/kg once intravenously slowly over a 5-10 minute period, repeated after 6 hours if necessary, then every 24 hours as required

Supportive care: sling as necessary, control seizures, fluid and nutritional support.

If the poisoning is OP and treatment is not started within 24 hours, therapy may make clinical signs worse. In this event treatment should be stopped.

Carbamate poisoning

1. Aldicarb – immediate onset of symptoms with pupil constriction, paralysis, some vomiting, tremors and hypothermia. Prognosis extremely poor. Birds found within a few metres of source.
2. Carbofuran (granular) – onset of symptoms from 5 to 30 minutes after exposure. Usually sub-lethal concentrations are ingested so prognosis is less guarded. Symptoms are like those seen from exposure to Aldicarb. Birds may get back to their nests where they and their chicks die.
3. Carbofuran (liquid) – immediate onset of symptoms with very poor prognosis. Birds found at the source.
4. Methomyl – immediate onset of symptoms, prognosis extremely poor with no survival, birds found at source.

Treatment of Carbamate Poisoning:

Antidote: treat with Atropine 2 mg/kg by intramuscular, or better still, intravenous injection. If the bird responds and later deteriorates, treatments can be repeated as often as necessary. If there is no improvement after 5 minutes, but saliva is still present in the mouth, repeat the treatment at 4mg/kg. **For as long as there is no improvement and yet also no deterioration and still saliva in the mouth, keep repeating the dose, doubling each time, 5 minutes between each dose.**

Maintain treatment until post-treatment deteriorations cease.

Supportive care: sling as necessary, control seizures, fluid and nutritional support.

Unidentified OP/carbamate poisoning

Treatment of unidentified OP/carbamate poisoning

Antidote: Atropine at 2 mg/kg plus 2 PAM at 25 mg/kg, repeated as necessary (i.e. if clinical signs improve then deteriorate again). Typically treatment will be required every 2-4 hours.

If the poisoning is organophosphate and treatment has not started within 24 hours, therapy may make clinical signs worse. In this event PAM treatment should be stopped, but Atropine maintained. In such cases then dose atropine as above under 'Carbamate' heading.

NSAID poisoning

Possible drug culprits:

All NSAIDs except Meloxicam (Meloxicam→, Metacam→, Mobic→) are considered toxic to vultures. The degree of toxicity varies between different NSAIDs, but every individual vulture reacts differently. Some birds may react badly to one drug while others appear unharmed.

The following drugs are proven to be toxic to vultures, but all others (except Meloxicam) cannot be ruled out:

- Diclofenac Sodium (Diclofenac→, Voltaren→)
- Ketoprofen (Ketofen→)
- Phenylbutazone (Tomanol→, Phenylarthite→, Equipa-lazone→, and Fenylbutazone→)
- Flunixin (Finadyne→, Cronyxin→, Pyroflam→, Hexasol→)
- Vedaprofen (Qaudrisol→)
- Carprofen (Rimdayl Aquous→)

Clinical signs:

- Dehydration ranging from slight to severe
- Generalised signs of weakness
- Drooping head
- Periods of 'zoning out' but may regain normal stance and consciousness when interacting with people.
- Depressed appearance
- Wings held slightly out from the body.

Treatment:

There is no specific or reliably effective treatment.

- Give the bird IV fluid therapy via a drip at twice maintenance rates (i.e. give 100 ml/kg/day). This is critical to reduce the severe dehydration.
- Uric acid levels can be reduced by administering Allopurinol at 30 mg/kg by mouth twice daily until recovery

Nothing will reverse the kidney damage caused by the toxic effect.

If the bird is showing significant clinical signs, then death is typically inevitable and euthanasia is indicated.

Lead poisoning

Lead poisoning, subsequent to the ingestion of spent ammunition fragments by scavenging birds is a long recognised complication in wildlife free living populations and in admitted casualty birds. Incidence varies depending on global and local location, species of scavenger and time of year, varying from: 31% above normal levels in white backed vultures in Botswana, 35% in Griffon vultures in Spain and 12% in Cape vultures in South Africa.

Levels below 10µg/dl are considered normal, levels above 40µg/dl may lead to clinical signs associated with toxicity, but even levels above 10µg/dl have been postulated to cause some deleterious effects. Naidoo et al. (2012) investigated a captive Cape Vulture breeding colony, exposed to high lead concentrations within their enclosures at the South African National Zoological Gardens in Pretoria. In this case-study, they described signs of decreased egg hatchability, embryonic death and abnormal chick development concurrent with whole blood lead concentrations ranging between 50 and 100 µg/dl in the adult birds.

Research into swans showed that birds with lead levels of less than 25 µg/dl, birds did not suffer any greater incidence of power cable collisions, birds with lead levels ranging 25-41 µg/dl suffered a significantly higher collision incidence, whilst birds with levels over 41µg/dl, had a lower collision incidence. It was postulated that birds with the highest levels were too weak to fly, hence their lower collision incidence.

In view of this data, the authors encourage the routine collection and testing of blood lead levels from all admitted vultures, with chelation therapy being administered to all birds with levels in excess of 10µg/dl.

Possible Sources:

Vultures can ingest lead from several sources. The most common source is lead bullets used in hunting of game or euthanasia of farm stock. As bullets typically splinter on impact with any bones, even if the body part around the area of impact is removed, fragments of lead will be found a significant distance from the point of entry. Lead shotgun pellets will also scatter throughout a carcass.

Additional sources of lead include fishing tackle weights, refuse areas, old agricultural gates etc. In addition to direct ingestion of fragments, lead can leach into water sources.

Symptoms:

- Seizures and neurological issues
- Incoordination, in flight or when walking
- Paralysis (in severe cases), often sitting on the ground, with their inter-tarsal joints on the floor
- Vultures are often emaciated and malnourished, as they are unable to adequately forage and feed

- Sudden onset of acute blindness

Diagnosis:- this should be based on the presence of lead particles in the gastrointestinal tract on x-ray, or an elevated blood lead level on testing.

Blood lead levels in vulture blood is normal if:- <10ug/dl (= <0.48 umol/l)

Blood levels between 10-20 ug/dl (0.48 – 0.96umol/l) indicates exposure which is unlikely to be of clinical significance.

Any vulture with a lead level above 20 ug/dl (= 0.96umol/l), should receive chelation (EDTA) therapy.

Blood lead levels are often elevated in vultures in the absence of particulate lead in the gut, which is consequent to the consumption of ballistic fragments (i.e. fragments of hunters' bullets).

Even in the absence of any nervous signs consistent with lead poisoning, there is now very good evidence of elevated lead levels in many vultures presented with trauma, power line injuries and other illnesses, which are considered to be associated with long term low levels of lead toxicosis.

Treatment:

EDTA – 35 mg/kg twice daily by intramuscular or intravenous injection for 5 days, after any particulate lead has been removed from the gastro-intestinal tract. If lead is shown to be in the gut, then initial stabilisation for 24 hours with intensive fluid and chelation therapy, then a veterinary surgeon may remove the lead from the proventriculus, under anaesthetic, with an entubated patent, the bird is tied to a tilted table, with the body above the head at 45 degrees, the lead particles are removed by gastric lavage.

Chelation therapy is not continued beyond five days after the particles are removed, as it can cause renal damage. If nervous signs persist, then a repeat blood lead level can be tested 7 days after the cessation of EDTA therapy. If it remains elevated, then a repeat of 5 days of therapy is justified.

In all lead poisoning cases, fluid therapy (preferably via IV drip) is important to reduce the likelihood of kidney failure and to concurrently treat any seizure activity.

Chapter 8: Managing sick and injured vulture admissions

It is vital to bear in mind that more birds will be saved by appropriate fluid and nutritional support than any single medical or surgical therapy.

Patients should at least be maintaining weight, if not gaining weight. Feeding regimes must be adjusted to account for any shortfalls. This may warrant increasing the frequency or volume of supplementary feeding. Further weight loss, despite efforts, suggests compromised health.

Infection control and biosecurity

A sick vulture can be carrying and excreting a range of infectious pathogens. A sick bird can be a reservoir for a variety of infections and could be a risk to young, old and immune-compromised vultures. Contamination of rehabilitation facilities can result in infection of other patients and staff working in the facility. It is worth noting that if a bird is shedding very high levels of a pathogen, the risk of bacterial, viral, fungal and parasitic infections need to be considered.

Veterinary input will be required in order to consider if a bird is suffering from a systemic (i.e. blood born within the body systems) infection. Verification is generally achieved by testing a blood sample. Published normal ranges for white blood cell (WBC) counts for a variety of African vulture species are given in the table below. White cell counts below the lower limit of the normal range tend to indicate a viral infection, whilst WBC counts above the upper limit of the normal range tend to indicate a fungal or bacterial infection (although lead poisoning will also cause an elevated level). Gut infections that do not pass into the body tend not to cause elevations of white blood cell levels.

No vulture that is considered to be suffering from an infection at admission should be released until one can be reasonably certain that the infection is fully controlled.

Record keeping

All birds admitted must be identifiable and good records maintained. Records should detail:

- reason for admission/cause of injury
- origin of where the bird came from
- clinical presentation and demeanour
- weight and body condition on admission and at subsequent checks
- all medications administered, tests conducted, food and fluid administered
- response to therapy

Accommodation

The following pre-requisites are essential:

- Easy to clean and disinfect
- Quiet, dimly lit (when required), in a stress-free environment
- Easy access for observation, either direct or by CCTV
- Must be easy to restrain and remove the patient from the box and replace it, with minimal risk of injury and minimal stress to patient and staff
- Isolation facilities for accommodating potentially infectious patients is important
- Weighing scales are essential

If birds are in sternal recumbency, but still able to keep their head elevated, then pressure sores on legs and keel are prevented by creating a towel donut. In birds with paralysed legs, facilities to sling the bird is essential. If the bird is in sternal recumbency and is unable to hold its head up, then a cushion or foam block must be placed in front of the bird's neck, with the head maintained on this raised surface. In this way the head is always kept above the level of the crop, so there is no risk of crop fluid reflux to the mouth and entrance into the wind pipe, which would result in aspiration and fatal pneumonia.

Once no longer in a critical condition, it is beneficial to house birds where they have access to sunshine, grass and other vultures.

Species	White blood cell (WBC) count reference interval x10 ³ cells/uL	WBC count mean x10 ³ cells/uL	Sample size (n)	Hematocrit (HCT) reference interval %	HCT mean %	Sample size (n)
Cape vulture <i>Gyps coprotheres</i>	3.4 - 22.9 ²	11.3	96	37.1 - 56.9	45.2	81
African White-backed vulture <i>Gyps africanus</i>	13.45 - 19.97 ³ 5.5 - 36.9 ²	16.71 16.25	21 83	42 - 58 34.2 - 53.5	50 43.1	21 92
Ruppell's griffon vulture <i>Gyps rueppelli</i>	6.02 - 49.87 ²	21.54	388	31 - 53	43.8	304
Griffon vulture <i>Gyps fulvus</i>	8.0 - 29.9 ² 4.41 - 19.93 ⁴	16.26 12.17	41 51	32.5 - 50.8 36.7 - 50.3	42.0 43.5	47 51
Bearded vulture <i>Gypaetus barbatus</i>	7.06 - 15.42 ⁵	10.17	26	41 - 54.2	47.1	26
Cinereous vulture <i>Aegypius monachus</i>	5.05 - 37.1 ² 14.74 - 24.14 ⁶	16.92 19.26	329 31	32 - 49 37 - 46	41.2 43	215 31
Hooded vulture <i>Necrosyrtes monachus</i>	5.69 - 39.29 ²	18.46	142	27.6 - 52.5	40.6	105
Lappet-faced vulture <i>Torgos tracheliotos</i>	5.79 - 38.70 ²	19.01	211	34 - 50	43.2	161

² ZIMS Expected Test Results for Gyps genus, Aegypius monachus, Necrosyrtes monachus, and Torgos tracheliotos. (2018 December 01). Species360 Zoological Information Management System. Retrieved from <http://zims.Species360.org>

³ Naidoo V, Diekmann M, Wolter K, Swan GE. Establishment of selected baseline blood chemistry and hematologic parameters in captive and wild-caught African white-backed vultures (*Gyps africanus*). *Journal of Wildlife Diseases* 2008; 44(3): 649-654.

⁴ Giambelluca S, Cammarata M, Dara S, Orefice T, Camina-Cardenal A, Vazzana I. The impact of captivity on some haematological parameters of griffon vultures (*Gyps fulvus*). *Veterinaria Italiana* 2017; 53(3): 243-249.

⁵ Hernandez M, Margalida A. Hematology and blood chemistry reference values and age-related changes in wild Bearded vultures (*Gypaetus barbatus*). *Journal of Wildlife Diseases* 2010; 46(2): 390-400.

⁶ Seok S, Jeong D, Park S, Lee S, Lee H, Yeon S. Hematologic and plasma biochemical values of Cinereous vulture (*Aegypius monachus*). *Journal of Zoo and Wildlife Medicine* 2017; 48(2): 514-517.

Chapter 9 – Release

It is vitally important that individual birds undergo an assessment prior to release. Any bird being released should be as fit as possible. Releasing a bird with an infection is a serious failure, and allowing that released bird back into a colony situation carrying contagious pathogens or infections, to potentially infect other birds in the colony, would act against the original goal of rehabilitation: to boost the overall population health and foster healthy wild individuals.

When is the bird ready to be released?

Only birds meeting the following list of requirements will be fit for release:

- Symmetry of wings when standing (both at rest and when extended).
- Birds should show strong flight capabilities and be able to gain height in a suitably large flight enclosure.
- Normal body posture, co-ordination, reaction and body movements are all essential.
- The bird should be assessed in social situations, if possible. Normal feeding habits, including interaction with a group of other vultures at a carcass, is an important indicator of successful feeding within a colony. The age and species of vulture must be taken into account during this assessment.
- In the case of leg injuries, even a minor limp must be considered carefully. To be released and survive successfully, a vulture must be able to run, perch on a movable object such as the branch of a tree, and defend itself within a group situation.
- Fully functional binocular vision is essential to cope within a colony and interact with other vultures. Any individual with blindness in one eye, or impaired vision, should not be released.

Where should the bird be released?

Birds in your care have been compromised for a reason, and often this is the result of some conflict within their environment (power line collision, exposure to poison, etc.). While it may seem intuitive to release the bird at the same location it was found, this is not always in the best interests of the bird as there is a chance for re-injury. It is important to consider the release location carefully to balance finding an ecologically and socially appropriate location, while trying to avoid the initial cause of injury, all giving the individual the best possible chance of survival.

The following must be considered for every release, on a case-by-case basis.

- Weather – warm days with no or little cloud cover are ideal; the conditions when thermals will be available. Rain should not be forecast for the next 24 to 48 hours, in the case that the bird does not decide to immediately leave the release site.
- Time of day – release birds in the late to mid-morning, if possible. Vultures are heavy-bodied, with high wing loads (body mass to wing area ratio) and will generally struggle to fly high and find thermals in the late afternoon.
- Habitat – ideally the habitat should be suitable for the species and within the species' normal foraging range. For example, tree nesting-species should be released in an area with plenty of trees for perching opportunities. Colonial cliff nesting species would ideally be released near a cliff roosting or breeding location. The bird may fly away immediately, but if it does not, you need to feel comfortable with the release location if the bird decides to remain in the area for a while.
- Human disturbance – birds should not be released within the immediate vicinity of dense human habitation. No power lines (dangerous or safe structures) should be present for 1 km surrounding the release location. This allows the bird plenty of distance to take off and gain height without risk of collision. No dangerous power line or wind farm structures should be present in the greater (> 1 km) release area. If you have concerns over the safety of various power line structures, contact VulPro (see contact details in the Introduction).
- Social considerations – Vultures are very social creatures and choose to seek out the company of other birds. If several vultures have been rehabilitated together, it is best to release them together. It may be worth keeping a vulture which is ready for release until the other is ready, but only if the extra

time held in captivity is short (several days). If one vulture will be held more than several days, it should be released as soon as possible. If possible, release the bird where other vultures will be present (i.e. a vulture restaurant, colony). At the very least, the release location should be a place where vultures are known to fly overhead on a regular basis.

- Food availability – Do not release a bird in a region where you suspect poison to be used. Similarly, do not release a vulture in a location where you suspect lead ammunition is used and gut piles or meat is made available for foraging birds. Well-managed vulture restaurants provide ideal, safe locations for releases. This allows the released patient time to adjust to the surroundings and feed before leaving the site, if it so chooses.

When releasing a vulture, lower your body (see CHAPTER 1 for pictures), bringing the bird's feet to ground level, slowly allowing the bird to stand. Then release your grip on its entire body and neck at the same time, stepping away to give the bird some space. Be careful never to drop or throw the bird down, nor allow the bird to fall prior to lowering it gently to ground level. When releasing the bird or placing it back inside the enclosure, remain still and allow the bird to walk or fly away from you, rather than panicking it, in which case it may take off, flying into stationary objects / fences. Do not force the bird to move. Allow the bird time to recover but monitor it for any unusual behaviour that could be a sign of heat exhaustion or injury from handling. The bird will decide for itself what to do next; it might fly off, run or drink water. Never force the bird to move or fly after the handling. Simply monitor and interfere only as a last resort if the bird appears not to be fit for release.

Vultures, when given the opportunity, will time their take-off to coincide with a thermal or an increase in wind strength, making the take-off easier. Birds in general prefer to take-off against the wind, and this should be considered when choosing the release site and direction. Releasing a bird from a crate should be done at ground level, and not from an elevated site such as the back of a vehicle. Pulling a bird out by a wing or the tail is unacceptable, as is tilting a crate to encourage a bird to exit. Give the bird time to leave the crate of its own accord.

Chapter 10 – Medications

Below is a list of the drugs most frequently used by the authors for vulture rehabilitation. The dosages listed below are those used and recommended based on our experience. However, it is always important to consult with your veterinarian. In addition to this, always check the information insert in the drug's package to confirm the dosage recommended by the manufacturer (as on occasions the same drug may be available at different concentrations). Medications available in your region may not be the same as in South Africa and drug trade names and concentrations will vary. **Always consult your veterinarian!**

Some facilities deworm their vultures as a matter of routine. We recommend testing birds on admission and only deworming a vulture if it is suffering from an overwhelming burden of parasites. Wild animals typically carry a low level of parasites and build up 'resilience' towards them. They can cope with a low level. On occasion, if this burden is removed by deworming, animals can become immunologically 'naïve' and future parasite infections pose a problem.

Use of Antibiotics

The decision to treat with systemic antibiotics is not to be taken lightly. Development of antibiotic resistant bacteria is always a concern. For this reason, antibiotics should always be used judiciously. In ideal circumstances and with ideal resources, a wild vulture presenting for rehabilitation should have blood collected for a complete blood count (CBC) at minimum. See Chapter 8 for CBC reference ranges for various African vulture species. A white blood cell count greater than the upper limit of the reference range may warrant treatment with antibiotics. However, in many rehabilitation situations, performing a CBC may not be practical or possible. In these cases, consultation with a veterinarian is recommended.

Similarly, the use of antibiotics in wound treatment should ideally be informed by the collection of a swab from the wound which is submitted to a lab for bacterial culture and antibiotic sensitivity testing. When not practical or possible, the following should be considered in deciding whether or not systemic antibiotic treatment should be used in wound treatment: cause of the wound and age of the wound (if known), depth, surface area, and body part affected, gross contamination of the wound, and overt evidence of infection (increased warmth, redness, swelling, and/or discharge such as pus).

With the above-mentioned considerations in mind, there are certain conditions in which antibiotic treatment is always warranted:

- Compound (open) bone fractures
- Soft tissue wounds that expose bone, tendon, and/or ligament
- Wounds that are the result of an animal bite
- Severe bumble-foot (See Chapter 3)
- Severe electrical burns that require removal of necrotic tissue
- Osteomyelitis, as determined by radiography or appearance of exposed bone
- Upper respiratory infections
- Whenever more than one dose of dexamethasone is given [generally for treatment of seizures]

The only vulture safe NSAID is Meloxicam (trade names Mobic, Metacam or Petcam)! Do not use ANY other NSAID. Research has shown all other tested NSAIDs to be toxic to vultures.

How to calculate volume of the drug

Calculate the dose required by multiplying the required dose rate (mg/kg) by the bird's weight (kg). This gives you the dose required in mg.

To calculate the volume of drug required, you need to divide this value by the drug concentration (mg/ml).

For example:

Drug dosage 20 mg/kg Bird weight 10 kg Concentration 50 mg/mL

$20 \times 10 = 200$ mg. This is the dose of drug a 10k g bird must receive.

$200 / 50 = 4$ ml. This is the volume of drug to be administered.

ANTIMICROBIAL AGENTS				
AGENT (TRADENAME)	ROUTE	DOSAGE	INTERVAL	INDICATIONS
Amoxicilin/ Clavulanate (Synulox®)	IM	125 mg/kg	1 x / day. For at least 5 days.	A good, broad-spectrum, first-line choice. Used for a wide variety of infections including open wounds.
Enrofloxacin (Baytril®)	IM	15 mg/kg	1 x / day. For at least 5 days.	A second-generation fluoroquinolone – this drug should not be reached off the shelf readily. Broad-spectrum. Useful for septicaemia, respiratory infections. Do not use in chicks.
Florfenicol (Nuflor®)	IM	0,17 mg/kg	1 x / day. Every 3 days for at least 3 treatments	Broad-spectrum Chloramphenicol derivative. Effective against respiratory tract infections, osteomyelitis (bone infection), pododermatitis (bumblefoot) etc.
Ciprofloxacin (Cipro®)	PO (oral)	50 mg/kg	1 x / day. 5-14 days	In combination with Clindamycin for open bone fractures
Clindamycin	PO	150 mg/kg	1 x / day. 5-14 days	In combination with Ciprofloxacin for open bone fractures
Tobramycin (Tobrex collyrium)	Topical (eye drops)	2-3 drops per eye	1 x / day. 5-7 days	Eye ulcers and infections
Ofloxacin (Exocin®)	Topical (eye drops)	2-3 drops per eye	3-5 x / day. For at least 5 days.	Eye infections

NSAIDs: NON-STEROIDAL ANTI-INFLAMMATORY DRUGS				
AGENT (TRADENAME)	ROUTE	DOSAGE	INTERVAL	INDICATIONS
Meloxicam (Metacam®, Mobic®)	IM	1 mg/Kg	1 x / day. Up to 3 days.	For pain and inflammation

ANALGESIC AGENTS				
AGENT	ROUTE	DOSAGE	INTERVAL	INDICATIONS
Butorphanol	IM	1 mg/kg	1 dose per day. Can repeat daily as long as required.	For pain (fractures, large wounds, electrical burns)

STEROID AGENTS				
AGENT	ROUTE	DOSAGE AND INTERVAL	INDICATIONS	
Dexamethasone	IM	4mg/kg (day 1) 2mg/kg (day 2) 1mg/kg (day 3) 0.5mg/kg (day 4) 0.5mg/kg (day 5) 0.5mg/kg (day 6)	For shock/trauma and seizures. Always in combination with antimicrobial.	
Hydrocortisone (Cortisol®)	IV, IM	consult with your vet as this depends on the frequency and strength of seizures	Seizures only and ONLY if the seizures are severe and only on its own without any other medication	

ANTIPARASITIC AGENTS				
AGENT	ROUTE	DOSAGE	INTERVAL	INDICATIONS
Ivermectin	PO, SC, IM	0.2 mg/kg	Once. Can repeat in 10-15 days	De-wormer
Carbaryl (Karbadaust®)	Topical		As needed	Feather lice, mites, flat flies, and other ectoparasites

MISCELLANEOUS AGENTS				
AGENT	ROUTE	DOSAGE	INTERVAL	INDICATIONS
Ca-EDTA	IM	35 mg/kg	2 x / day (every 12 h) for 5 days – again – do you blood test to assess	Lead poisoning
Propentofylline	PO	5 mg/kg	1 x / day up to 10-20 days.	Wing-tip oedema after electrocutions

MINERAL SUPPORT AGENTS				
AGENT (TRADENAME)	ROUTE	DOSAGE	INTERVAL	INDICATIONS
Vitamin B12 (Catasol)	IM, SC, PO	0.5 mg/kg	Once, can repeat in 7 days.	To aid with poisoning and recovery. Also post-electrocution to protect the nerves
Calcium 10% solution	IM	1 ml/kg	Daily supplement	Hypocalcaemia, lead poisoning

EMERGENCIES				
AGENT	ROUTE	DOSAGE	INTERVAL	INDICATIONS
Atropine (Atropen®)	Half dose IV, half dose IM	2 mg/kg plus 2 PAM at 25 mg/kg	Repeated as necessary according to clinical response, typically every 2-4 hours.	Organophosphate poisoning. Bradycardia (slow heart rate) and cardiorespiratory arrest

Chapter 11 – Resources

Handling, housing, and management

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Mundy P, Butchart D, Ledger J, Piper S. 1992. *The vultures of Africa.* Acorn Books.

Global IUCN Red List: <http://www.iucnredlist.org/>

Toxicology and medication

Carpenter JW. 2012. *Exotic animal formulary, 4th Edition.* Elsevier Health Sciences.

Veterinary formulary website, an annual subscription is required: <http://www.vetformulary.com/>

Vulture conservation, southern Africa

VulPro: www.vulpro.com

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Vulture conservation, abroad

International Centre for Birds of Prey: <http://icbp.org/site/>

Avian Veterinary advice

Great Western Exotics, UK: <http://www.gwexotics.com/>

Bird and Exotic Animal Hospital, Pretoria, South Africa: <http://www.birdandexotic.co.za/>