

Protocols for mass capturing, handling, and fitting tracking devices and patagial (wing) tags on vultures

version 3.0

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Abstract

VulPro is a vulture conservation organization in South Africa which has contributed to vulture research and rehabilitation since 2007. The organization's efforts focus on captive breeding, rehabilitation, and research of the Cape vulture (*Gyps coprotheres*). The paper describes in detail VulPro's methods for mass capturing using a specially designed walk-in trap, handling, weighing, collecting blood samples, and fitting patagial tags and tracking devices on vulture species. These protocols were employed with four species of southern African vultures: Cape vulture (*Gyps coprotheres*), African White-backed vulture (*Gyps africanus*), Lappet-faced vulture (*Torgos tracheliotos*), and Hooded vulture (*Necrosyrtes monachus*), but may be applied with other similar species.

Keywords

vultures; handling; walk-in trap; patagial tags; backpack harness

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Note: This is a living document which will be altered and improved as we learn more about the preferences of the species and 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

VulPro is a non-profit vulture conservation organization, established in 2007, which maintains a 9.6 hectare rehabilitation and captive-breeding facility in the North West Province, South Africa. Their efforts focus on Cape vulture (*Gyps coprotheres*) captive-breeding for population supplementation and reintroduction, wild vulture population monitoring, research, rehabilitation, public education programs, and managing vulture feeding sites. The organization's directors and staff together bring over 35 years of experience handling vultures and other large raptors, mostly in southern Africa.

These protocols are intended to guide research endeavours, but they cannot substitute for training under qualified personnel. Each research effort should assess its specific needs and adjust protocols accordingly. These suggested protocols represent the experiences obtained through research and daily vulture work at and for VulPro. Always refer back to the source website, as this is a living document and is subject to change.

Walk-in trap design for mass captures

Over the past years there have been many approaches used to capture vultures. The most widely used historical method was the cannon-net technique. This often caused injuries and fatalities to the vultures and permits for the explosive devices necessary have become increasingly hard to obtain (Bamford et al. 2009). Since the walk-in trap has been developed and put into practice, it has been used successfully throughout South Africa and Namibia over the last decade (Diekmann et al. 2004, Elorriaga et al. 2004). It has proven to be superior to the cannon-net method as it can capture larger quantities of birds, requires less man hours (per captured bird), and generally *Gyps* vultures exhibit little stress during the capture process (Bamford et al. 2009).

The particular walk-in trap described here was designed to undertake mass vulture captures at a well-managed and frequently used vulture feeding site: one where vultures can consume safe, poison free carcasses in safety. It has proven successful with large numbers of vultures being captured at one time, with limited injuries, and no fatalities (unpublished data). With qualified staff, it is possible to process a large number of vultures, around 40 large *Gyps* Species in approximately three hours. From VulPro's experience, a capture should not continue longer than this to avoid stress for the captured vultures. If an isolated and injured vulture needs to be captured for whatever reason, alternative trapping methods should be considered to capture that single targeted bird as opposed to many birds at one time.

Building such a capture enclosure at a regular feeding site is recommended to be carried out over a period of one to three months. This is to acclimatize the vultures slowly to the new construction without scaring them away from the feeding site.

Once the enclosure is completed, the next objective is to acclimatize the vultures to feed near the enclosure and eventually to feed inside it. Once again, it is recommended that this process is not rushed and you should allow for anywhere up to 6 months. Once the birds are feeding inside the enclosure, allow the birds additional time to relax and feed inside the capture enclosure for another week at least before a capture is attempted. VulPro has found that the longer the birds feed inside the capture enclosure, the greater the chance of a successful capture and future successful captures.

No vulture capture operations should occur during the breeding season. In southern Africa captures should only take place from November until the middle of April each year. These dates can change as a result of temperature, seasonal variations, and climate change. The breeding behaviour of the vultures should be monitored one month before the capture is due to take place to ensure no breeding is occurring.

A comfortably sized capture enclosure to hold fifty *Gyps* vultures should measure 15m long x 5m wide x 3m high.



Figure 1: Walk-in trap during construction. The pedestrian gate has been installed.



Figure 2: Vultures are entering the walk-in trap. The curtain is pulled to the side while the diamond mesh door is raised. The pedestrian gate is closed.

The capture enclosure should be built with 40/50mm diamond mesh, also known as chain link. Do not use welded mesh, as this material is more rigid than diamond mesh and will cause trauma to the birds if they collide with it. The mesh must have a wire thickness of 2mm or more. Thinner wire will cut the birds' skin. A pedestrian gate (fig 1 and 2) needs to be installed and half of the roof should be covered with at least 70% shade netting to avoid excessive heat exposure. The sides of the enclosure should have shade netting rolled up on the outside. The shade netting should be rolled down once the vultures have been captured, providing more shade, creating a 'safer' and cooler environment for the birds, reducing their stress (fig 3). The use of large heavy poles around the inside perimeter of the floor of the enclosure to attach the mesh will reduce wire injuries to the vultures' heads and also prevent birds being exposed to the wire ends where the mesh reaches the ground (fig 4).

The pedestrian gate is used to enter and leave the closed capture enclosure without interfering with the curtain. A colleague should always watch and help open and close the gate behind the researcher entering the enclosure, to avoid escape by any vultures (fig 3)



Figure 3: Handlers remove a vulture from the enclosure while team members help open/close the pedestrian gate. Curtain and shade netting are fully extended whenever vultures are in the enclosure.



Figure 4: The inside floor of the mass capture enclosure: Diamond mesh is attached to a pole on the ground using wires, eliminating stray sharp points.

There should be no sharp points on the inside, outside, or top of the enclosure, to avoid causing harm to the birds. A captured vulture may be harmed through panic and trying to escape by running and brushing the enclosure sides in the hope of finding a gap. Vultures will walk on the outside of the enclosure, sometimes brushing the sides. Free vultures may also alight on the top, using the capture enclosure as a perching and roosting spot (fig 5).



Figure 5: Vultures resting on top of capture enclosure, demonstrating the need to remove sharp mesh edges on all sides of the enclosure.



Figure 6: Ready for captures. Shade netting is rolled up in the closed position on the side of the enclosure. The curtain is pulled open and diamond mesh door is raised, allowing vultures to enter.

On the entrance of the enclosure, a curtain needs to be fitted which can be pulled from a viewing hide. The viewing hide can be 50m to 100m away from the capture enclosure and can take many forms. The construction should be inconspicuous – to avoid disturbance to the vultures – and the distance between the hide and capture enclosure should not hinder the pulley system's speed. The curtain needs to close (fig 3) within seconds to prevent any vultures from escaping, but needs to be soft enough to avoid injury to any bird trying to escape. The curtain can be made from canvas material and some shade netting. The material of the curtain must be able to close quickly and be soft to prevent injury to the birds, and able to provide shade and cushioning. The curtain must not close on a vulture which is crossing the threshold. Above the curtain, a metal door with diamond mesh should be constructed to close behind the curtain; i.e., the curtain will be on the *inside* of the enclosure, the diamond mesh door on the *outside* of the curtain (fig 6). This maintains a solid frame keeping the vultures securely inside the capture enclosure. The curtain is merely used to trap the birds inside initially and then, once the birds are inside, it takes the same function as shade netting. The stationary lower and upper guide cables for the curtain need to be installed in such a way as to avoid vultures from colliding with them or tripping over them. The bottom guide cable should be installed inside an open cemented groove, over which the vultures step (fig 7).

The cement groove needs to be kept clean at all times during the capture operation. The upper pull cable needs to be kept fairly taught, running parallel to the upper guide cable by using a number of split rings (key rings) spaced about 40cm apart. The curtain should be attached to both the upper and lower guide cables with split rings (fig 7). The split rings slide very easily allowing the curtain to close within seconds. The split rings are collected and bunched by the curtain as it passes along the guide cables. The split rings will need to be replaced in time depending on the force of the curtain and the amount of wear.



Figure 7: Cement groove with the lower guide cable running inside. The curtain is attached to the lower guide cable via split rings and is being pulled open.

Handling Protocols

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 were refined over the past eleven years of VulPro's experience working almost exclusively on vultures in southern Africa.

Although vultures appear to be intimidating because of their size and their 'so-called' aggressive nature¹, it is important to handle these birds with care and understanding. The primary concern when handling these threatened species should be to avoid injury and stress to the bird(s), with the secondary goal being to minimize risk of injury to the handler(s), thereafter collecting data etc. There is no need to use excessive force. Vultures are sensitive and respond well to sensitivity rather than forceful and aggressive handling methods. Any vulture when cornered will try to run, fly away or as a last resort even dominate the situation by advancing on a presumed threatening person. Following these protocols will minimize the risk of injury to both vultures and handlers.

These handling methods are accepted as the standard by the National Society for the Protection of Animals (NSPCA) in South Africa.

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 vultures' comfort (fig 8). Alternatively, a sturdy folding table

¹ Vultures are timid and wary birds that do not have a killer instinct. They do not have talons 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, only small lambs, and on very few occasions. There are rare reports documenting the larger Lappet-faced (*Torgos tracheliotos*) and White-headed vultures (*Trigonoceps occipitalis*) killing small, wild game (Mundy et al. 1992, Piper 2002).



Figure 8: 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.



Figure 9: Two handlers calmly approach a vulture.

measuring 1.5 x 0.7m will suffice. It 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 in the absence of proper equipment, care and training.

[Catching vultures in an enclosure](#)

Vultures need to be approached quietly, confidently and sympathetically; there is no need to 'rugby-tackle' them at all. The researcher must approach the bird chosen for catching so as to avoid scaring it away, causing the selected bird and others to fly or run away into the enclosure sides. It is recommended that no more than three persons should be included in this capturing process (fig 9). More human beings will cause commotion as the birds will try to run or fly away from the perceived threat and possibly cause injury to themselves.

Once the selected vulture is within close reach, its neck should be grabbed first, just below the jaw bone from behind (fig 10). Do not grab the head from the front as you can crush the trachea or oesophagus. 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, with fingers reaching 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 oesophagus. You can be firm but not rough or too tight as you do not want to hurt 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 10 (above): The proper hand placement to stabilize a vulture head.



Figure 11 (right): 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.

The head is the most important body part to secure first, but vulture feet and wings must be secured soon after to prevent injury to the handler and vulture. Once you have the head secured, quickly 'hug' the vulture with the upper part of your arms keeping the wings against the bird's body. At the same time, with the arm that is not holding the head, you can take hold of the feet or simply hold the bird with the feet / legs below your arm but with the bird's legs stretched out downwards towards the tail, with your arm covering the thighs (fig 11). 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 should be capable of doing this alone, but it is advisable for a second person to back up the catcher should a wing escape and to open / close enclosure gates etc. 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 to 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. Once the bird is secure, move to stand in the shade to prevent the vulture from overheating.

Processing vultures

'Processing' includes any handling of vulture: placement of patagial tags, fitting tracking devices, or taking blood or other biological samples. The fitting of tracking devices, in particular, must take into account the age of the bird. **It is unacceptable to place a tracking device (with harness) on a young bird which has not fully developed. Placing a harness and tracking device on a bird which has not stopped bone or feather growth can potentially alter the development of the bird and can cause death.** We recommend tracking device harnesses should not be fitted on a bird unless it can stand and is conducting 'flapping exercises' at the nest. Fitting patagial tags and taking blood samples may be conducted at earlier stages of development.

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 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, you must rapidly cool the bird down by spraying cool water on its neck, collar bone, and legs. **A bird which suffers from overheating or hypothermia will die!** The bird will be exposed to stress and often there is a risk of heat exhaustion. and will, if unchecked, eventually compromise the condition of the bird **and can lead to death.** The **absolute** maximum amount of time you can restrain a vulture is 45 minutes; but this time will reduce in high temperatures and high humidity and also depends on the individual bird. Stress usually increases with time; the longer the process takes, the greater the risk. Any type of processing should ideally be conducted in 20 minutes per bird, when staff are prepared and well trained.

Organization, preparation, and communication are important within the team processing the vulture. The amount of time a bird spends in a horizontal position, either on its back or sternum, must be minimized. Have all equipment out, ready, and in a shaded quiet location.

Mass capture operations are not the time/place for training staff members because processing vultures quickly and quietly is a priority. Trainings should take place in captive settings or when few vultures need to be processed in a set time frame.

Processing vultures on a table



Figure 12: A vulture being processed on its back. 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.

When working with a bird on a table, you can either place the bird on its sternum or back, depending on what you are doing, but usually the bird is placed on its back to start. For this type of vulture processing, you need three to four people to work on the bird 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 12). 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. If the legs rub together, the bone-on-bone friction can be painful to the bird. It is not advisable to cover the vultures' eyes as they prefer to observe what is happening and they sometimes panic if their eyesight is taken away from them. But this reaction varies from species to species and even some individuals may prefer their head covered. Vultures thermo-regulate through the bare skin on their head and neck. Therefore, if you do decide to cover their head, it is important to monitor the bird's temperature and heart rate as it may over-heat, especially if stressed or on hot days.



Figure 13: 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.

Never tape or tie the beak closed under any circumstances. Vultures often regurgitate in defence or through stress and they need to be able to rid themselves of 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 the side and allow the bird to regurgitate freely. Never close the beak when a bird tries to regurgitate as this will lead to choking which can be fatal. Placement of the bird on the table / 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 to remove any regurgitated material before another vulture is processed.

If you need to turn the bird around onto its sternum (fig 13), 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 birds' 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 make sure not to cross the legs around each other and keep the bird comfortable at all times. 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 holding the head must make sure at all times to keep the head away from the person processing the bird to avoid any bites, 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 in processing depends on preparation and co-ordination of the team.

Releasing



Figure 14: Preparing to release the vulture. The handler is going onto her haunches to bring the vulture to ground level.



Figure 15: Releasing a vulture. Release the head and body simultaneously and step back slowly, allowing the vulture to decide where to move next.

When releasing a vulture go down on your haunches (fig 14), slowly allow 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 15). Be careful not to drop or throw the bird down, nor allow the bird to fall before placing it down gently to the ground. When releasing the bird or placing it back inside the enclosure, remain still and allow the bird to walk or fly away from you. 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 on 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.

Processing nestlings on a cliff

Working on cliffs should only be carried out by suitably trained and qualified persons, with proper equipment to ensure their safety. This will also ensure minimum disturbance as a good team will work fast. The team should comprise only two people for handling and processing the bird(s). Once again, no binding of the bird in any form is needed as nestlings are fairly easy to handle and process fairly quickly. Make sure the bird is restrained by holding his neck and keeping the bird between your legs using your legs to keep the wings together. Chicks are usually submissive and allow you to process them easily (fig 16). The second person will help with the tagging, ringing, etc, of the bird.



Figure 16 (above): Processing a nestling on a cliff.



Figure 17 (right): Chicks are being hoisted up in secure bags to the handler at the nest.

Processing nestlings from a tree

Tree work should only be carried out by suitably trained and experienced arborists/climbers with correct bird handling training and experience acquired prior to handling nestlings in trees. The use of a cherry-picker or extension ladder can be considered should the situation of the nest allow. When using a cherry-picker, due consideration should be given to minimizing damage to vegetation when approaching and working at the nest tree.

When using a cherry-picker, it is important to approach the nest with due care and to agree on appropriate hand-signals with the crane-operator before you ascend to a nest. The bucket should be manoeuvred close enough to the nest to enable the handler to reach the chick and safely place it in a bag. Be careful not to push too hard against the nest as this may damage it.

First, collect the nestling from the nest and place it inside a specifically designed bag. This should be of strong hessian, burlap, durable thick cotton, and be built for the purpose. The bag needs to be large enough to fit an 11 kg vulture inside and strong enough to prevent tearing of the material. There should be two durable cords, running through the top of the bag, to draw the bag closed and act as handles for carrying or weighing the bag with its contents.

The bucket of the cherry-picker can then be lowered to the ground while the bird is being held in the bag by the person that placed it in the bag. Once the bucket reaches the ground, another person should be on hand to take the bird from the handler in the bucket. The person in the bucket must never attempt to climb out of it with the bird still in his or her hands. The chick can then be processed on a table or crate on the ground before it is returned to the bag and hoisted back to the nest where it needs to be carefully taken out of the bag and returned to the nest by the handler (fig 17).

Do not pull the nestling backwards out of the bag as this will damage the blood feathers, which may result in a bird that cannot fly properly. Rather, place the bag in the nest, open the bag to the point where the chick is completely exposed, and then slowly manoeuvre the bag out from under the chick. Give it space

as soon as possible. This will reduce the risk of panic which could cause the nestling to try to get far away, perhaps even jumping from the nest which could result in injury or death. The handler should already be ready to descend below nest level *before releasing* the chick from the bag, to reduce to post-release disturbance to a minimum. This applies for both climbers and individuals making use of a cherry-picker.

Taking blood samples

Drawing blood from vultures should only be done after proper training, and practice in a controlled environment under veterinary supervision, and always with the proper ethics clearance and required permits.



Figure 19: One person secures the bird's body and head while another person holds one leg and takes the blood sample



Figure 18: Drawing blood samples from the tarsus vein. The procedure requires only two people.

Vultures should always be held vertically, as this is more comfortable for the bird. The tarsus vein in the leg is the easiest location for drawing blood; the procedure requires just two people (fig 18). The tarsus vein is also preferred as it is less likely to blow or collapse as wing veins often do. Make sure your needle is the correct diameter for the species. A 23-gauge 1 inch needle works well for most species. VulPro has processed large *Gyps* species with this size as well as the smaller Hooded and Egyptian vultures. Shorter needles are easier than long ones. Slightly bend the needle before drawing blood to avoid going directly through the vein as the veins are right against the surface of the skin. One person should hold the bird according to the methods described above, while the other person should hold one leg and draw from the vein (fig 19).

Weighing vultures

Vultures of any age may be weighed in three ways: stand-on scales, weighing the vulture alone, and hanging scales.

The easiest weighing method is to use a stand-on scale (fig 20). The handler will weigh him/herself with the bird in hand and subtract his/her weight from the total. This is not 100% accurate but is the easiest method, especially when handling adults.



Figure 20: Weighing a vulture on a stand-on scale while on a secure, level surface.



Figure 21: Weighing a vulture on a hanging scale. The bird is secure in a durable cotton bag. Loops on the top of the bag are inserted into the scale hook.

Weighing the vulture on its own is more accurate than the stand-on method. It is necessary to use a scale large enough so that the majority of the body, i.e., the heaviest parts such as the chest and head, make contact with the centre of the scale. The bird must remain still long enough for the scale to settle on a single value.

Hanging scales produce the most accurate weight measurements. For this task, firstly place the vulture into a sack. We recommend using a specially designed 'sack' which has large pointed corners that can be folded around the bird which secure the wings but allow the vulture to leave its head exposed. They remain much calmer when they retain their eyesight. The sack must be large enough and strong enough to handle a vulture with its powerful feet and beak. When placing the vulture inside the sack, place its feet and tail first so that the head almost sticks out. This way you are placing the bird and still holding the neck/head, the most dangerous body part. Once the bird is secure inside the bag, let go of the head and completely close the bag, then place the loops of the sack into the hook of the hanging scale (fig 21). A well designed bag, used correctly, should reduce injuries and minimize stress to the bird and handlers. When it is time to remove the bird from the bag, the experienced handler will take the bag and find the head of the vulture. He/she will then grasp the head/neck through the fabric of the sack, then open the bag and take the head inside the sack with the free hand. The experienced handler will now ask somebody else to pull the sack down. While this is being done, the handler's body and arms start covering and hugging the vulture to restrain it, making sure the feet are secure and are against its body, preventing them from grabbing his/her arms or anything else.

Remember to subtract the weight of the bag from the total weight. **Do not tilt the bag upside down and allow the vulture to 'fall out', injuries will occur if the release is done this way. Do not place the bag on the ground and expect the vulture to escape on its own without panicking. Do not pull the bird out by its tail feathers as that is harmful and hurtful to the bird and unacceptable handling practice. The handler needs to assist the bird out of the bag gently to avoid further stress and unnecessary injuries.**

Only experienced handlers will be able to do this without getting bitten. Weighing the bird using the bag method should be the last step in the process before release. Poor bagging/handling may result in

serious flight feather damage, rendering the bird un-releasable. This method should only be used if absolutely necessary.

Patagial (wing) tag fitting techniques

Tagging the wing through piercing the patagium, if done correctly, should not cause pain or harm to the bird. However, there is great potential for causing serious damage, rendering it flightless or disabling it severely enough to affect its survival. **We have rehabilitated numerous vultures that could not fly or survive simply due to improper tagging!** If you are new to tagging, the following protocols should only be implemented in the presence of a trained professional who has previously tagged hundreds of birds.

It is important to note that there are currently several tagging schemes in southern Africa. Please do not order or fit patagial tags without first consulting VulPro to avoid duplicating tag numbers.

Cattle ear tags have been used for years in southern Africa. However, they are small, the numbers fade, and birds routinely remove them. VulPro recently started implementing larger tags made specifically for birds. These PVC-based tags are visible from both the dorsal and ventral surface of the wing, are durable, soft, larger and more visible than older styles, and numbers are cut into the material so they do not fade. As these tags are larger, you must consider which species you are tagging and fit the appropriate size tag and attachment.²

Most tags use a male and female ALLFLEX attachment (similar to the cattle ear tags) which are easy to implement with a hand-held applicator (fig 22).



Figure 22: GYPAETUS model tag with male and female attachments, ALLFLEX applicator

Tag placement

The piercing will be made about 2 cm away from the leading edge and about 3 cm distal from the bend in the leading edge of the vulture's elbow. The site should be thoroughly investigated. The piercing should be at least one cm away from the pro-patagial tendon. Avoid all feather follicles and minute blood vessels. The patagium should be thin in this region and piercing should not cause any bleeding. When the wing is folded, the edge of the tag should not touch or interfere with the crease in the bend by the elbow in the leading edge (fig 23).

² We source our tags from Maquia Ambientales Serveis, Spain (<http://www.maquiaambiental.com/>). The following models have proven to be good sizes for these species: GYPAETUS model for Cape Vulture, CHRYSATEOS model for African White-backed Vulture, and MILVUS model for Hooded Vultures.

Below is a series of photographs of a vulture's internal wing anatomy (fig 23 and 24). These highlight several vital ligaments and tendons within the patagium in red. The 'safe zone' for the placement of tags is highlighted in black (fig 24). The distances mentioned above and figures below guide the placement of patagial tags, and are critical to allow space for the tags to avoid contact with all ligaments, tendons and bones.



Figure 23: Sternal view of the Internal anatomy of a Cape Vulture's right wing with several tendons, ligaments, bone, and the patagium clearly visible. The elbow joint is in the bottom right corner and leading edge of the wing is at the top of the frame.

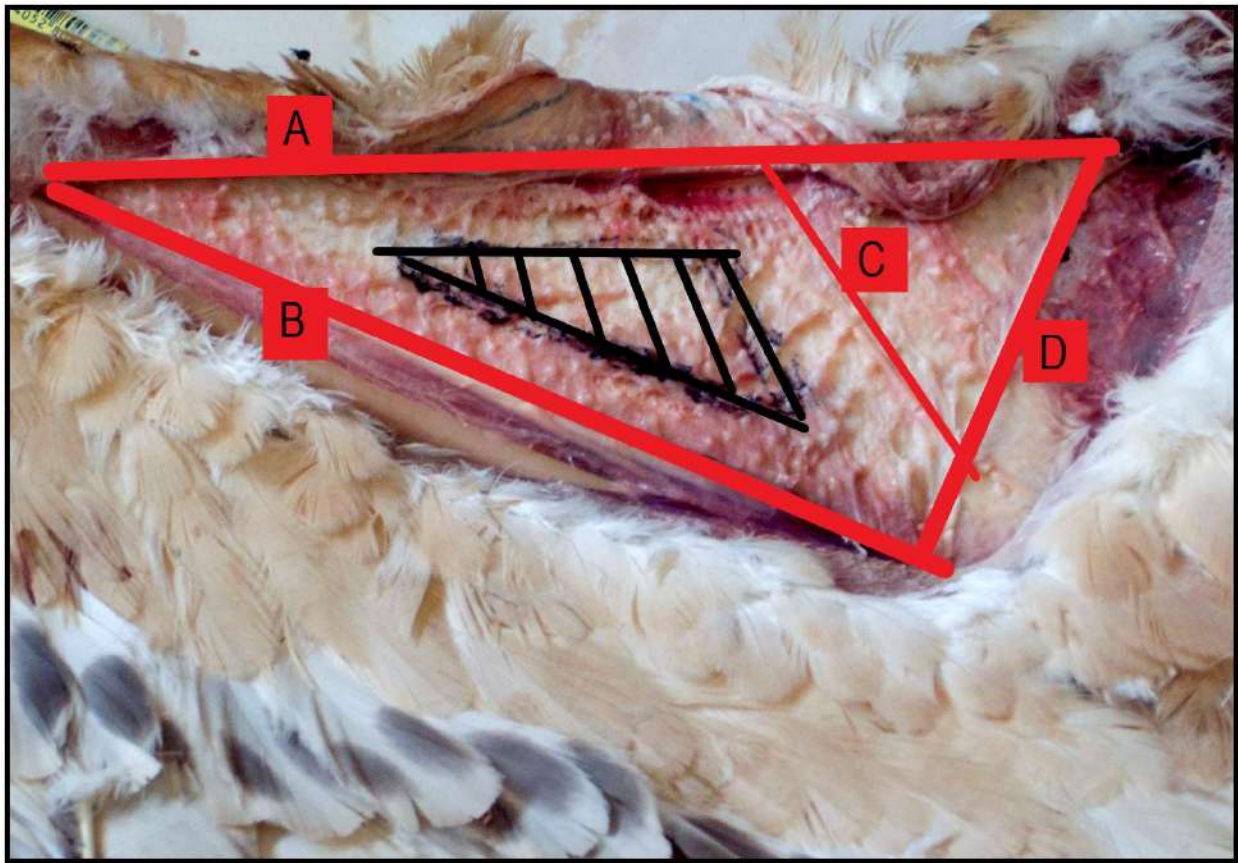


Figure 24: Vital ligaments and tendons (highlighted in red) must be considered when placing a patagial tag: A - ligamentum propatagialis, B - Musc extensor carpus radialis, C - unknown tendon, D - ligamentum propatagialis pars brevi. The only acceptable 'safe zone' for placing a patagial tag is highlighted in black. This safe space is 2 cm from the leading edge of the wing and 3 cm from the flex in the elbow joint, allowing safe distance from the tag pin to all vital tendons, ligaments, and bone.

If these guidelines are not followed the tag will not sit properly on the bird. It may stand upright, may fold in when the bird is standing or may become invisible altogether. Improper placement can cause serious discomfort and harm to the bird, and may render the bird flightless, resulting in permanent disfigurement and/or death.

In no circumstance should a bird be tagged before primary feathers are fully developed and the bird is stretching its wings in preparations for its first flight. This is around 4 months old in the case of *Gyps* species and large vultures. Smaller vultures need to be assessed from 3 months onwards. A developing bird's skin will stretch and the piercing created by a patagial tag, if placed when the bird is too young, will expand leaving a gaping hole (fig 25).

Figure 25: The resulting hole in a young bird's patagium, resulting from the bird being tagged when it was too young.





Figure 26 (left): patagial tag appropriately placed distal to the elbow so it does not interfere with the bend in the patagium.

Figure 27 (above): Inspecting the patagium for feather follicles or veins before piercing.

Methods

Work with the bird on its sternum. Have one person hold the wing out slightly so that you have room to work but can clearly see the bend in the leading edge of the patagium by the elbow. Using the placement guidelines, find a spot in the patagium without feathers or veins. Thoroughly sanitize the area and piercing equipment with F10 or similar. Place the 'male' piercing on the underside of the wing and push it onto the skin so you can verify there are not follicles or veins (fig 27). The dorsal surface of the tag must then be folded over the wing above the piercing site, without moving the male attachment. Once you have confirmed your placement has not moved, you can pierce the wing and release the applicator.

Tracking device fitting techniques: the backpack harness

GPS tracking devices have revolutionized the study of avian migration, ranging, juvenile dispersion, survival, mortality, and conservation threats (Bird et al. 2007). These devices can be lightweight, accurate, reliable, and allow for the collection of longitudinal data at frequent intervals. Many conservation research projects include mass captures and use tracking devices to gain behavioural and ecological knowledge of declining populations. As the popularity of these devices in ornithological studies grows, especially with endangered or declining populations, safe implementation of the technology will be critical to the project's success.

Various harness designs are used to fit tracking devices on a wide range of vulture species. Two methods have been successfully used on vulture species in southern Africa: backpack harnesses and pelvic harnesses. The type of harness chosen depends largely on the species to which the tracking device is being fitted. VulPro has used the backpack method to fit over 102 tracking devices onto four different vulture species, as well as other large birds of prey, including Cape vultures (*Gyps coprotheres*), African White-backed vultures (*Gyps africanus*), Lappet-faced vultures (*Torgos tracheliotos*), and Hooded vultures (*Necrosyrtes monachus*). VulPro believes the backpack method is suitable for all *Gyps* and large vulture species. The Bearded vulture (*Gypaetus barbatus*), which has a bony back, is more suited to the pelvic harness.

The age of the bird must be taken into account before the decision is made to place the tracking device on the bird. **It is unacceptable to place a tracking device and harness on a young bird which has not fully developed. Placing a harness and tracking device on a bird which has not stopped bone**

or feather growth can potentially alter the development of the bird and can cause death. We assess the health condition and age of the bird before every fitting. Fat birds require tighter harnesses, while thinner birds' harnesses should be looser. The harness fit is not an exact science and there are no hard and fast rules for varying age classes and body conditions.

Materials and Equipment

Harness materials needed include:

- Teflon® tape, 4 to 6 mm wide
- Silicone tubing which will be threaded through the Teflon® tape should be 3.1 mm (for 4 mm Teflon®) or 4.7 mm (for 6 mm Teflon®).³
- Dental floss
- Super glue
- Epoxy glue
- Baby powder
- Metal rings for clamping (8 mm stainless steel SAFRING rings work best for thicker tubing, smaller SAFRINGS for smaller tubing)

The length of both the Teflon® material and the tubing will be dependent on which species you are working with:

- Cape vultures need 2m of Teflon® (in one piece) and 160cm of silicone tubing which will often (but not required) be cut into two pieces, each 80cm long.
- The White-backed and Lappet-faced vultures need a 1.5m length of Teflon® in one piece and 120cm length of silicone tubing cut into two pieces of 60cm each.
- Hooded vultures need 1.2m of Teflon® material in one piece and only 1m of silicone tubing cut in two separate pieces of 50cm each.

The cutting of the tubing into two separate pieces per bird depends on the type of tracking device used. With all the tracking devices used to date, VulPro has had to cut the tubing into two pieces in order to thread the Teflon® through the device's attachment loops. However, if using the thinner diameter tubing, this is not required.

Equipment needed includes:

- Sharp nosed thin scissors
- Needle for threading and sewing the dental tape
- Ringing pliers
- Scrap piece of cardboard
- Thin stick or something similar to mix up the epoxy

³ We source silicone tubing from VWR International, online catalog numbers 89068-474 (3.1 mm) and 89068-478 (4.7 mm)



Figure 28 (left): The solar-powered GPS unit is ready to be fitted to a vulture. Silicone tubing, sheathed in Teflon® tape, is threaded through the unit. Silicone tubing is exposed on either end, lengths are symmetrical.

Figure 29 (above): Close up image of Teflon® ribbon attachment to GPS unit. The Teflon® tape covers the silicone tubing. Left unit: silicone tubing is in one piece and threaded through the unit. Right unit: silicone tubing was cut into two pieces and threaded up into Teflon® tape from either end.

There has been some debate over the importance of using tubing either over or inside the Teflon® ribbon. In VulPro's experience, the tubing is an essential part of the harness' design. It helps reduce any chafing Teflon® may cause in tight spots i.e., inside of the collar bones and inside the 'leg pits', prevents the vultures from tearing the Teflon® with their beaks, and assists in ensuring the perfect fit and comfort of the harness to the bird without digging into these tight spots. Harder, 'air hose' tubing used to be used on the outside of the Teflon tape. However, we no longer recommend this tubing or method of placing the tubing outside of the Teflon®, as we have recovered numerous birds with harnesses with broken tubing, exposing the Teflon®, causing chaffing, blisters, and in one case, a broken harness. We now recommend using the silicone tubing inside the Teflon® which is slightly elasticated giving the harness some degree of movement and the soft silicone does not break or crack causing hard edges resulting in broken Teflon®.

Preparation and connection of the harness to the tracking device must take place before having a bird in hand (fig 28). But no harness can be made up in advance, as each is custom fitted to the individual bird. To prepare the harness, thread the Teflon® through the rear attachment point of the tracking device (fig 28) and then thread each piece of silicone tubing inside either end of the Teflon® tape. Once the silicone has reached the base of the GPS unit and sides are symmetrical, tightly crimp the Teflon® and tubing directly below the rear attachment point to secure the harness in place. Make sure the crimp cannot move around the Teflon® and tubing at this point. It has to be crimped firmly in place before starting to fit the device onto a bird. It is important to bunch the Teflon® at the ends to expose and provide access to the silicone tubing (fig 28).

Use a team of four and work on a small table of suitable height, allowing everyone easy access to the bird from all sides. VulPro uses a wooden vulture crate topped with a carpet or towel for comfort. Place the vulture on its sternum allowing you to position the device correctly on the bird's back. The device should sit centrally between the shoulders on the bird's back, just below the ruff of the neck feathers (fig 30).



Figure 30: Tracking device placed centrally between the shoulders and just below the ruff feathers.

Holding the device in place, take the harness straps down the bird's back and then separate the two straps to between the insides of the bird's legs. You will need one person holding each leg in each hand in order to open the legs apart to be able to correctly place the harness between the legs. The bird's legs should be held backwards towards the person holding the legs. Take both the harness straps up the sternum and then around and inside each collar bone. If using the thin tubing, you can directly thread the Teflon® with tubing through the centre of the tracking device's attachment point, coming from the top sides of the device and tie a loose knot at this central point in order to allow adjustments to the harness. This entire initial process is done with the bird placed on its sternum.

However, if using the thicker Teflon®, you will not be able to thread the tubing into the attachment point, so must estimate the needed length of silicone tubing (inside the entire length of Teflon® in contact with the bird, up to the GPS unit attachment point) and cut/remove the rest. Each side of removed silicone tubing should be symmetrical. To do this, you will need to bunch the Teflon® to expose the appropriate amount of silicone tubing, cut the tubing, and then pull the Teflon® taught to thread it through the attachment point and create the first temporary knot.

The harness, which will need to be tightened, adjusted accordingly, and the metal crimps put in place. Make sure any surplus tubing and Teflon® is carefully cut to the desired length as you do not want long pieces of material hanging from the knot.

Check that the device is still correctly in place, i.e. in the collarbones. Lightly crimp one metal ring around the harness straps, joining the two together, leading from the device towards the tail, just above the base of the tail bone (fig 31). It is at this point where the tightness of the harness is measured. Make sure at all times that two fingers above one another can be placed, at an angle, between the bird and the harness at this exact point. Do not crimp the ring tight just yet as the harness still needs to be adjusted for a perfect fit. At this point, the metal crimp should be able to move up or down along the harness material for adjustment purposes. Tighten this crimp at the



Figure 31: Fixing the tail bone crimp in place. The crimp is not fully tightened at this stage. It should be able to move slightly for adjustment.

end *before completing* the final knot and releasing the vulture.

Once the tail bone crimp is in place, carefully turn the bird on its back. Take both harness straps and check that they are firmly in place between the inside of each leg. Run your hands upwards with the harness straps, preening the feathers under the two straps as you go along. Pull the straps together to meet on the lower end of the sternum, about an inch or so from the end and place the last crimp / ring here. Make sure the feathers are all running in a comfortable way so that the bird has no risk of irritation after release. Do not place the crimp higher on the sternum as this will interfere with the crop filling to its capacity during a feast. The placement of this particular crimp is extremely important so as to not interfere with breeding; i.e., incubation of an egg or the crop expansion. Again, do not crimp the metal ring too tight at this point as the ring might have to be adjusted once again. The ring must be firmly crimped in place once the harness is perfect fitted to the bird and before the final knot is glued together. Check the tightness of the harness at this point. If the bird is in good condition, the harness should fit fairly tightly against the bird's sternum. If the bird is slightly underweight, then the device should be a little looser to allow the bird to gain weight. This has to be evaluated *very carefully* as every bird is different; there is no hard and fast rule here.

Turn the bird again carefully over back onto its sternum. Now run both your hands on each strap and double-check that the harness is placed correctly inside each of the collar bones and that it has not popped out and is sitting on the bird's shoulders. Check this a few times to be on the safe side. Check symmetry and harness tension. It should now be tight, and you should be able to fit two fingers under the straps between the lower end of the device and the tail crimp. Any looser and there is a risk of the bird getting its head stuck under the straps. Once you are satisfied with the tension and symmetry, close the crimps on the rump and sternum. You will need to turn the bird over and back one last time to do this.



Figure 32: Completed two twist square knot.



Figure 33: Sewing through the two twist square knot with dental tape.

Once all the metal crimps are tightened so that the rings do not move along the harness, the final knot has to be secured perfectly to prevent the harness from failing. To complete the knot at the forward side of the device where you attached the straps together after the collar bones, re-tighten the knot making sure it cannot and will not come undone. The preferred method is a two twist square knot (fig 32). The knot must then be sewed through with dental tape (fig 33) to secure the knot and the ends of the Teflon® tape. Sew through the knot and ends a few times making sure to leave no weak points.

Place a piece of thick paper or cardboard under the device and super glue the ends and knots all together while pressing the knot into the desired position flat on the device. The paper/cardboard is used to prevent the glue and the device from sticking to the feathers. Finally, complete the process by covering the knot with epoxy. Baby powder can be used over the epoxy to speed up the drying process (fig 34). Glue needs to be tack dry before release, and the powder will dehydrate the surface of the glue while the inside is still setting. Remove the piece of paper/cardboard before releasing the bird, but avoid pulling it off with the glue as well. Pull it off gently or cut around the paper leaving a tiny piece stuck to the device which will, with time, disintegrate.



Figure 34: Cardboard is placed under the knot while glue and baby powder are applied.

It is important to take the bird's age and condition into consideration in order to get the perfect fit for that particular bird (fig 35). The older and fatter the bird, the tighter the harness will need to be fitted. The younger and thinner the bird, the looser the device should be fitted in order to allow the bird to pick up weight and muscle. But, the device can only be loose enough to fit two fingers above one another between the tail bone crimp and the device, no looser as *Gyps* species can get their heads through that gap and get stuck.

The fitting of tracking devices should only be done by suitably qualified individuals and should take approximately twenty minutes per bird at the most. Training to do this under qualified persons, preferably at a captive facility, not at a wild capture, is necessary.



Figure 35: A juvenile Cape Vulture displaying a GPS-GSM tracking device attached via a Teflon® backpack harness.

[Training and research opportunities](#)

VulPro welcomes researchers for postgraduate degrees with proposals for research projects on site. Training sessions can also be arranged.

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