Capture and fitting of satellite- and radio-telemetry equipment onto Cape Griffon Vulture *Gyps coprotheres*, African White-backed Vulture *Gyps africanus* vultures and Lappet-faced Vulture *Torgos tracheliotos* in the Waterberg area, Namibia in 2004

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Summary

The breeding population of Cape Griffon Vultures *Gyps coprotheres* (CGVs) on the cliffs of the Waterberg Plateau has declined from an estimated 500 in 1939 to only eleven birds in 2004, and the species is now considered critically endangered in Namibia. In 2002, the Rare and Endangered Species Trust (REST) initiated a supplementary feeding scheme on the farm Uitsig, as part of a project to obtain and fit satellite-telemetry equipment onto some of the remaining birds. Three capture operations were performed, in January, March and April 2004, using a capture and release aviary designed by REST, and captive CGVs as decoy birds to lure the wild birds. Each capture had 1-3 processing teams. REST is now the first organization in the world to fit satellite "collars" or PTT harnesses onto CGVs. Radio-telemetry devices have been fitted to a further five African White-backed Vultures *Gyps africanus* (AWBVs) in the area. REST is also the first in the world to develop a capture aviary and mechanism of this nature and the first in Africa to catch and process such a large number of free-flying old-world vultures in one operation for extensive sampling. During the three operations, a total of 291 birds were captured. These include two of the last remaining CGVs from the Waterberg colony (one of which was recaptured during the third operation). Altogether 259 of the captured birds were ringed. All vultures handled were documented photographically, while a full set of mensural and other data was taken for 36 birds, and sex estimations done for 164 birds. No losses were sustained, and marked birds returned to the restaurant and into the capture aviary almost immediately after the captures. The success of the operation is ascribed to painstaking organization and preparation, good team work, the gradual habituation of the wild birds to the capture aviary, the practical design of the capture mechanism and subsequent refinements, and the thorough testing of the harness devices on captive birds.

Introduction

In 1939 the breeding population of Cape Griffon Vultures *Gyps coprotheres* (CGVs) on the cliffs of the Waterberg Plateau Park in the Otjozondjupa Region, Namibia was estimated at 500 (S. Diekmann pers. comm. in Brown 1985), but by the late 1960s this number had declined to only about 300 birds and by 1985 to only 13 adults (Brown 1985). This decline was attributed to (i) the indiscriminate use of poisons on farmlands for the control of mammalian predators (leopard, jackal, caracal and hyaena occur in the area), and (ii) severe bush encroachment in the thornveld savanna as a result of over-stocking, which effectively reduced the amount of available foraging habitat for the birds (Brown 1985). As a result of the introduction of a conservation programme that included education and a supplementary feeding scheme in 1984 (Brown 1985), the decline was slowed down (Brown & Cooper 1987; Brown & Jones 1989) and by 1991, 25 CGVs were recorded at the feeding site (pers. comm. M. Berry). By 2001, however, only eight birds (seven adults plus one immature) were recorded on the Waterberg Plateau (pers. obs. MD). Although up to 11 birds have been recorded in 2004, the species is now considered critically endangered in Namibia.

In 2002 a supplementary feeding scheme was initiated by the Rare and Endangered Species Trust (REST) on the farm Uitsig (20°15'44"S 17°03'42"E), 25 km north of the Waterberg and 25 km northeast of Otjiwarongo. Food was initially supplied every 4-6 weeks, but has been every week since early 2003, and the numbers and the age structure of the CGVs are monitored on a regular basis.

The determination of foraging range, and of roosting and breeding sites are important in terms of providing a focus for conservation action (Boshoff, Robertson & Norton 1984). In 1983 a harness-mounted radio transmitter was fitted to an adult CGV at Potberg in the Western Cape, South Africa (Boshoff *et al*. 1984). Until the bird was recaptured 10 months later, it provided useful data for determining foraging range, distances and periods; flying speeds; and prey species. Together with other vulture species, CGVs have also been captured and marked and/or fitted with radio-telemetry equipment by two other researchers elsewhere in South Africa, although the results have not been published. In one operation, however, four CGVs were fitted with radio telemetry at the De Wildt Cheetah Research Centre by Dr Gerhard Verdoorn (GH Verdoorn pers. comm.). The related Rüppell's Griffon Vulture *Gyps rueppellii* has been radio-tracked with success in East Africa (Pennycuick 1983).

Since REST recently launched its project to fit satellite-telemetry equipment onto some of the remaining CGVs in the Waterberg population, it was also decided to include the large-scale capture of associated species such as African White-backed Vultures *Gyps africanus* (AWBV) and Lappet-faced Vultures *Torgos tracheliotus* (LFV). This unique opportunity allowed us to fit radio-tracking equipment to some of the AWBVs; to ring the majority of birds captured, for

research and monitoring purposes; and to obtain standard mensural data and biological samples, and to photograph of as many of the birds as possible.

Methods

Three capture operations were performed, namely on 18 January, 21 March and 29 April 2004. After the first capture an evaluation session, facilitated by Dr C.J. Brown of the Namibia Nature Foundation, resulted in several minor refinements in the method. The entire first capture operation was captured on film by Oracles Television Productions cc, which is producing a one-year documentary on the work of REST. A short training film is also being made on the capture and harness-fitting operation.

Capture operations

The capture operations took place at the Commercial Bank of Namibia Release and Capture Aviaries at the REST vulture restaurant at Uitsig (see above; Figure 1). An observation hide and two large aviaries were built 18 months before the first capture, with the help of volunteers from Raleigh International.

The capture aviary was 11 m x 5.5 m in size, 5.5 m high and built of telephone poles covered with 50 mm diamond mesh wire. A medium-sized tree just inside the entrance of the aviary gives a distinct reference point to the birds when the capture is initiated and provides a perching site during the operation and for overnight holding. Alongside, an aviary of the same size was used as a holding pen for ten captive CGVs for three weeks prior to the first capture. Apart from two hand-reared captive-bred individuals, all of these were birds that have been rehabilitated successfully; all will eventually be released. At this stage, however, they were used as decoy birds in order to lure the wild vultures to the site. These wild birds immediately showed a noticeable increase in confidence to feed after the introduction of the decoy birds to the site. On the day of the first capture, eight of these birds were removed, leaving only the two tamer, hand-reared captive-bred birds that were easier to move without too much stress after the capture device had been set off. During the second and third captures, however, all ten birds were left in the holding aviary in order to reduce the stress involved in their removal.

For the first capture a horse carcass and a large amount of entrails and other offal were placed within and immediately outside the aviary to attract the wild birds, who were not fed at the restaurant during the four days prior to capture. In January 2004 the restaurant typically attracted 2-5 CGVs, 200-450 AWBVs, 15-30 LFVs, one Hooded Vulture *Necrosyrtes monachus* and 3-7 Marabou Storks *Leptoptilos crumeniferus* (although subsequently up to 120 storks were recorded at the restaurant). During the second capture, the horse carcass was placed in a more central position at the back of the aviary, with the opened stomach facing the entrance, to discourage birds from going around the outside of the cage and trying to enter from the side. For the third capture only offal was put out and the WBVs had finished

feeding by the time the target CGV individual (see below) had arrived. The following day, more offal was put out and this bird arrived and began feeding immediately.

The capture device was designed, built and modified by REST. During the first and second capture the device consisted of a curtain of cream shade netting (92% opaque) folded up into a trench and disguised with a soil covering (see Figure 1). The curtain was raised by means of a rope running over pulleys in order to close the opening of the capture aviary without injury to any birds. A deficiency was found in this curtain system during the second capture when some of the vultures entering the aviary accidentally triggered the release, partially raising the curtain. The birds inside the aviary managed to fly out, but no new birds would enter. For the third capture the system was revised and the curtain was pulled across on steel wires secured to the top and bottom of the opening (similar to game capture techniques). Eyelets were put into the shade netting every 50 cm. Steel circular hooks were used to attach the netting to the wire. It is important that these hooks are strong enough so that they do not bend. In all captures a meshed steel gate was then slowly lowered on a hinge to close the opening more securely. This gate contained a smaller gate to provide access for the person catching and removing the birds. For the first capture only (see above), a small team entered the adjoining aviary once the trap was closed and took the two hand-reared captive birds out during the first capture (see above). The adjoining aviary was thus available to be opened for some of the wild birds to enter should numbers necessitate it. A shade net curtain was also dropped along the fence divide of the two aviaries in order to calm the birds. During the second and third capture, shade netting was fitted to the inside of all sides of the capture aviary and dropped and pegged after capture, to protect birds from flying into the wire mesh and to give the birds visual boundaries. Water was drained from the pond, to prevent the plumage of birds from getting wet and to facilitate the task of the person capturing individual birds.

Post-capture procedures

Three teams carried out post-capture procedures during the first capture. One team was responsible for boxing and removing the birds to be fitted with telemetric tracking equipment (see below) to a separate locality. The other teams processed the remainder of the birds on site. The more stressed birds were processed first, after a light-weight cotton bag had been placed over their heads in order to calm them, and released as soon as possible.

For each bird captured, the species and age were recorded and the bird was fitted with a metal ring and 1-5 plastic PVC rings, each in an individual colour combination. For a large sample of the birds captured, standard mensural data was taken and recorded on an observation form, together with wing and tail moult, mass and an estimate of general condition. Standard veterinary samples were taken including 3 ml blood samples, a blood smear, a fecal swab and the collection of observed external parasites. Photographs were

taken of the side view of the head, inside of outstretched wing, blushing patches and feather patterning on the exposed back. The sex of the bird was estimated according to the shape of the head where possible, to supplement determinations obtained from blood samples.

It was regarded as absolutely essential that a veterinary team was on hand throughout, and each bird received a final check before release along a predetermined "runway" path.

During the first capture, five AWBV (four adults and one juvenile) were removed at the beginning of the capture and boxed before being fitted with radio transmitters. The remaining birds were removed from aviaries one by one, but subsequently their removal in batches of three was found to reduce stress. Each bird was handled in exactly the same order of procedure to limit stress for the bird and to make it faster and easier for the processing teams. The order of processing birds was in relation to their value to the research and their behaviour. The first birds taken out were thus CGVs, then LFVs, then highly stressed AWBVs, then the others at random. The detailed order for the processing of captured birds is provided in Appendix 1.

The results of procedures other than the fitting of telemetric equipment, are described elsewhere (Diekmann *et al.* in prep.).

Telemetric equipment

Both satellite (PTT) and VHF radio telemetric devices were used, secured to the birds by means of harness mountings.

Satellite transmitter

The PTT-100 GPS/ARGOS transmitter by Microwave Telemetry (Figure 2a) features an internal twelve-channel GPS with GPS accuracy; altitude, heading and speed readings; solar power; and up to three years' operating lifetime. Physical specifications of the unit are length 98 mm x width 34 mm x height 21 mm, mass: 68-75 grams, antenna length 180 mm (hard nylon coated flexible stranded marine grade stainless steel, protruding at a 45° angle from the back edge of the transmitter). The design and position of the harness are not deemed to inhibit copulation in the case of a female. The housing construction is epoxy glass reinforced lightweight composite material, plated on the inside with a contiguous metal coating and a final seal of metal-to-metal solder. The unit is hermetically sealed against changes in temperature and humidity.

VHF radio transmitter

Tracking of five H-module SB2 VHF radio transmitters (Figure 2b) will be done using two AVM LA-12 receivers and two three-element yagi antennae (*vide* Boshoff *et al.* 1984). Each unit features a battery life span of three to five years and a signal distance of 50+ km. The

physical specifications of the unit are length 72 mm x width 28 mm x height 25mm, mass: 86 grams, antenna length 340 mm x diameter 0.5 mm (flexible stranded stainless steel protruding at a 45° angle from the back edge of the transmitter). The housing construction is a light weight composite material, epoxy coated by dipping the entire unit to the base of the antenna.

Harness mounting and materials

Each tracking unit was secured to the bird by means of a snugly fitting harness (Figure 3). Harness designers in both southern Africa and Israel were consulted on design used in similar telemetric projects. Several prototypes were made, tested and fine-tuned on two captive CGVs at REST. Two designs of harness were used, one for the larger CGV and a slightly modified version for the smaller AWBV.

Hang-gliding cord was selected for the harnesses on account of its strength, small diameter, lightweight and believed minimal stretch potential. The cord was threaded through transparent plastic tubing of a small inner diameter (3-mm) to prevent chafing to the bird's skin. This tubing was also used to make spacers for the transmitter connections. The transparency allowed the monitoring of progress during the threading of the cord and the fitting of the harness. Two lengths of 550 mm and one length of 120 mm of tubing were used for the CGV satellite-telemetry harness, with four additional lengths of 18 mm tubing as "spacers" (see also Figure 2a and 2b). Two lengths of 550 mm only were used for the smaller AWBV radio-telemetry harness, with ten lengths of 15 mm as spacers.

A length of 2.5 m of cord was used per harness, doubled over once. Although knots were avoided in the design where possible, particularly in the neck region, one knot was necessary to connect the transmitters to the harness. A flat "cat's paw" knot was selected in order to avoid chafing, to avoid slippage and because it would open up in time as no epoxy was used on it. A "weak link" was included in the connection between the transmitter and the harness (Boshoff *et al*. 1984; C.J. Brown pers. comm.), designed to deteriorate, disintegrate and slide off the bird after three to five years (the maximum estimated operation time of the batteries of the radio transmitters). It was made from a 16 cm length of 12 mm pure cotton hemming tape, doubled over and rolled to a thickness of 4 mm, then sewn together to form a ring with an outstretched length of 35 mm. Quick-setting epoxy glue was used carefully to seal and smooth all the knots except the cat's-paw link.

The positioning of the satellite transmitter on the bird's back is critical as the solar panel requires 3 to 5 hours of exposure to the sun per day to maintain sufficient energy and should therefore not be covered by feathers. The VHF transmitter should also be fitted no lower than mid-back. The harness comprised four fitting zones: transmitter to neck; neck to sternum; sternum to above tail; and above tail to transmitter (Figure 4). Each of these regions was

checked for tightness in three progressive fitting phases. Between the back of the neck and the back of the transmitter above the tail only two securing points were required, each consisting of a steel crimp (Figure 2c) made from 10 mm outer diameter steel tubing with a 1 mm wall thickness, smoothed with medium carborandum paper. The crimps enable a faster and less stressful fitting for individual birds. It was noted that the harness cannot be too tight in the sternum area as this could cause breathing difficulties. However, the harness must also not be too loose as the bird can easily become entrapped in the excess strings. It must also be remembered that the bird will preen the harness very close to the skin. Originally an excess slack of two fingers vertically between sternum and harness was used. After careful consideration this was modified in the last harness refitting to one finger between sternum and harness to allow for excesses when the harness is preened in.

As body size differs among birds, it is not possible to produce custom-fitted harnesses beforehand. Efficient fitting equipment is therefore necessary, including large bird-ringing pliers equivalent to the crimp lug size; “leatherman” type of pliers, used in conjunction with the ringing pliers to reopen crimps that might have been over-tightened during fitting; and sharp slim-line scissors (surgical type) to trim the plastic tubing to individual size on the bird.

By April 2004 the PTT fitted to the first CGV in January 2004 was not sending out a consistent signal, and a third capture was deemed necessary in order to check the harness and equipment. The harness was refitted and the bird re-released (see below).

Results

During the three capture operations a total of 291 vultures were captured and processed. Details of the data collected are summarized in Table 1.

On 18 January 2004 two CGVs, 240 AWBVs, 15 LFVs, several Marabou Storks and a sub-adult kite *Milvus* sp. were present at the restaurant. At 15h15 the capture mechanism was pulled. It operated smoothly and one adult male CGV and 91 AWBVs were captured successfully in the aviary. A satellite transmitter was fitted to the CGV. The bird was held for an hour for observation, then released and it flew off strongly. Radio transmitters were fitted to three adults, one immature (three-year old) and one juvenile (first-year) AWBV. All the birds were ringed and photographed. A full set of data was taken from the CGV and 32 AWBVs, and basic data for the other 59 AWBVs. The sex of 49 birds was estimated.

Due to the time of day only 20 of the captured birds were processed on the first day. No bird was lost or seriously hurt in the operation. One AWBV was found to be missing an eye from a previous injury; it appeared to be completely healed. Only one bird, an AWBV, needed to have overnight veterinary observation as it had become highly stressed, but was deemed ready for release the next day. A second bird was also boxed as its plumage had become wet

and soiled during the capture. The final bird was released by 14h00 on the second day of capture.

The following day (20 January), four more adults and one juvenile CGV arrived and fed at the site together with some 350 AWBVs. Although no birds with telemetric equipment were observed, five of the AWBVs had rings from the previous day. Ringed birds were sighted at the restaurant on a regular basis after this, as well as the bird with the satellite-telemetry device.

During the second capture (21 March 2004) two adult CGVs (including the bird fitted with a PTT; see above), about 100 AWBVs, 10 LFVs and five Marabou Storks were present at the restaurant. Due to heavy rains during the first part of the day, the capture mechanism was pulled only at 18h00. It operated smoothly, once a few minor technical problems had been sorted out, and one adult CGV and 27 AWBVs were captured. One of the AWBVs was a recapture.

The CGV was fitted with a satellite telemetry device, and a full set of mensural and other data was taken. One of the other captured juvenile birds that had been under observation during the whole of the pre-capture period that day was considered to have characteristics of both the CGV and the AWBV, especially in terms of physical characteristics such as plumage and neck colour. A similar individual had also been noted on the day of the January 2004 capture. It was now carefully documented (including with mensural data and blood samples) and also fitted with a satellite telemetry device. Preliminary findings indicate that some of the mensural data were in accordance with those of a CGV, and others with AWBV. Due to the shortage of available daylight, only 20 of the remaining AWBVs were fitted with rings and photographed, while basic mensural data was taken of 11 birds. A further six birds had to be released without being ringed. Only one AWBV showed signs of capture stress during the operation but was eventually deemed fit for release.

At the third capture (29 April 2004) an adult and a juvenile CGV were present, together with approximately 400 AWBVs, 20 LFVs and 12 Marabou Storks. The adult CGV had been fitted with a PTT during the first capture in January 2004. Late in the day it was successfully recaptured, along with 169 AWBVs and one LFV. The CGV was found to be in good health, with no signs of stress or chafing where the harness was in contact with the skin. The harness cord was found to have stretched slightly causing the PTT to become twisted and covered by feathers at times, thereby preventing the solar panel from being recharged adequately. The slack in the harness was therefore taken up and the bird was re-released. Future harnesses will be made of other material. The LFV and 145 of the AWBVs were ringed and photographed. One CGV and 8 AWBVs were already ringed, all during the previous two operations. Due to the fact that no more rings remained, 17 AWBVs had to be released

without being ringed. Two birds were found to have slight and probably previous injuries. They were treated by the vet and released.

During the first capture, one AWBV was a recapture, having a metal ring only, and was fitted with colour rings. During the second capture there was only one recapture, but six AWBVs were released without being ringed due to the lateness of the day. During the third capture one CGV and eight AWBVs were recaptures. A total of 30 AWBVs were released with metal rings but no colour rings due to lack thereof only, and 17 AWBVs without any rings for the same reason.

Discussion

REST is the first organization in the world to fit a satellite collar or PTT harness onto a CGV. Three such devices have now been fitted, and radio-telemetry devices to a further five AWBVs in the area. REST is also the first in the world to develop a capture aviary and mechanism like the Commercial Bank of Namibia Release and Capture Aviary, and the first in Africa to catch and process such a large number of free-flying old-world vultures (almost 300) in just over three months, for extensive sampling. The fact that no losses were sustained, and that large numbers of marked birds returned to the restaurant almost immediately after the captures, is an indicator of the success of the operation.

These positive results are ascribed by the capture team to painstaking organization and preparation, good team work, the gradual habituation of the wild birds to the capture aviary, the practical design of the capture mechanism and subsequent refinements and the thorough testing of the harness devices on captive birds.

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List of figures

Table 1. Summary of numbers of birds captured and data obtained during three vulture captures, January - April 2004 (* recaptured CGV , see January 2004; ** = possible CGV/AWBV hybrid)

	Capture (2004)			
	1: January	**2: March**	**3: April**	**TOTAL**
Birds captured:				
Cape Griffon Vulture	1	1	1*	2 + 1*
African White-backed Vulture	91	26 + 1**	169	286 + 1**
Lappet-faced Vulture	-	-	1	1
Total	**92**	**28**	**171**	**291**
Data collection:				
Ringed + photographed	92	22	145	259
Birds already ringed	1	1	8	10
Mensural data				
Full	32	2	0	34
Basic	60	11	145	216
Sex estimations	49	2	113	164

Appendix 1. Detailed order for the processing of captured birds

1. The person who is in the capture aviary with the birds, catches a bird.
2. This bird is handed over to the handler at the small gate of the capture aviary.
3. The handler brings the bird to the processing area (±50 meters away, to avoid frightening the birds in the capture aviary.
4. The handler sits in a chair until the processing team is ready for his bird
5. The handler lays the bird on its stomach with the feet outstretched behind and holds the head of the bird as it is processed. He/she also holds the further wing with one hand and the closer wing against his/her body.
6. One processor (the ringer) takes the feet and begins ringing.
7. The other processor begins taking further measurements.
8. Both processors complete measurements.
9. One processor prepares syringes and other equipment for sampling.
10. The other processor takes blood.
11. The samples are immediately handed over to the vet to begin final preparation.
12. PTTs or radio-tracking devices is fitted (if applicable).
13. The bird is photographed (right inside-wing with head shot and blushing spots, back); CGV and LFV were photographed extensively.
14. Bird is weighed.
15. Bird is released.
16. Next handler is immediately waiting with the next bird and when two handlers are free they return to capture aviary and begin process all over.

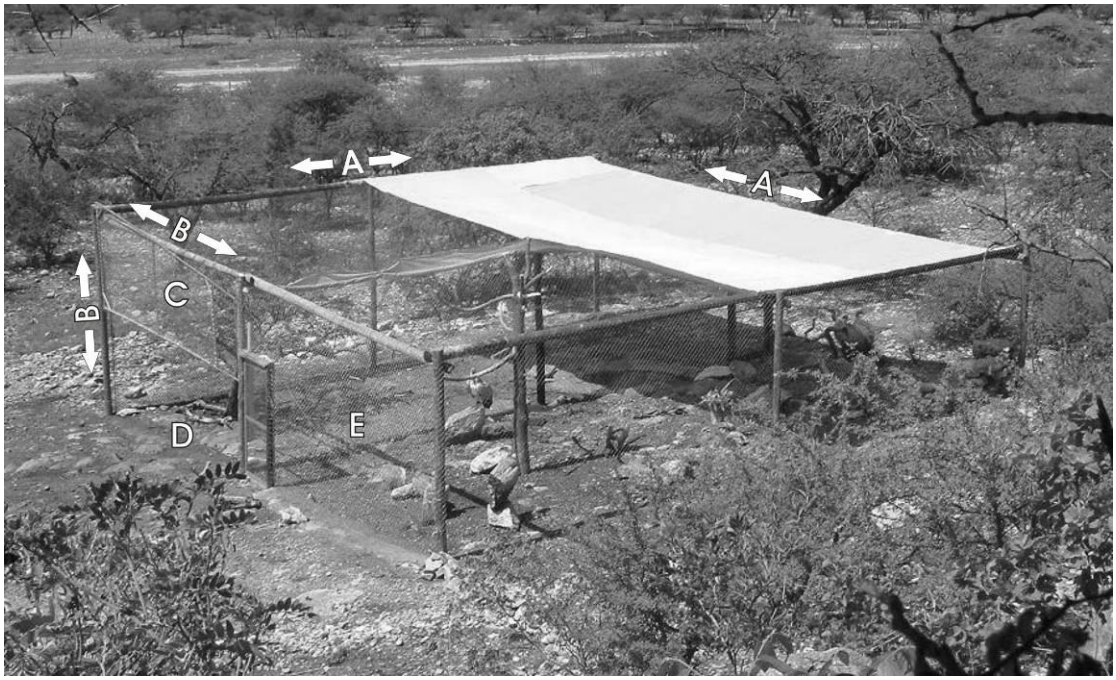

Fig. 1 The Commercial Bank of Namibia Capture and Release Aviary, built by REST

A = 11 m
B = 5.5 m
C = swing-down steel gate
D = hidden pull-up shadecloth curtain
E = holding pen for “Judas” or overflow birds

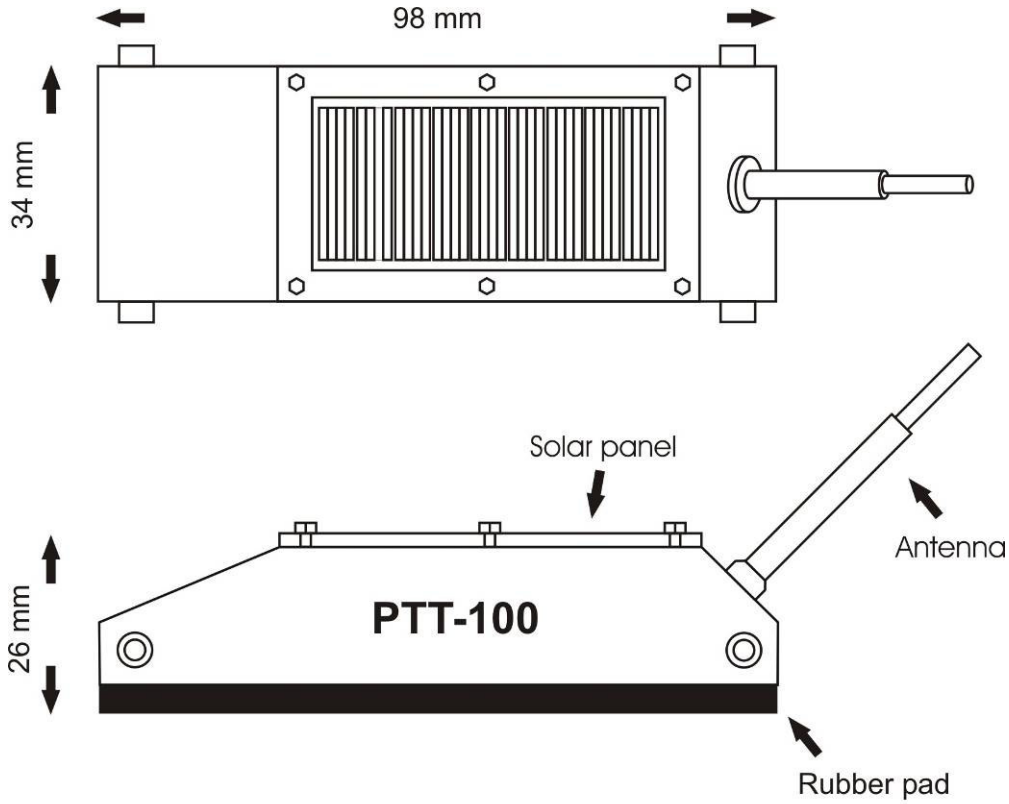

Fig. 2(a) PTT-100 GPS/ARGOS transmitter

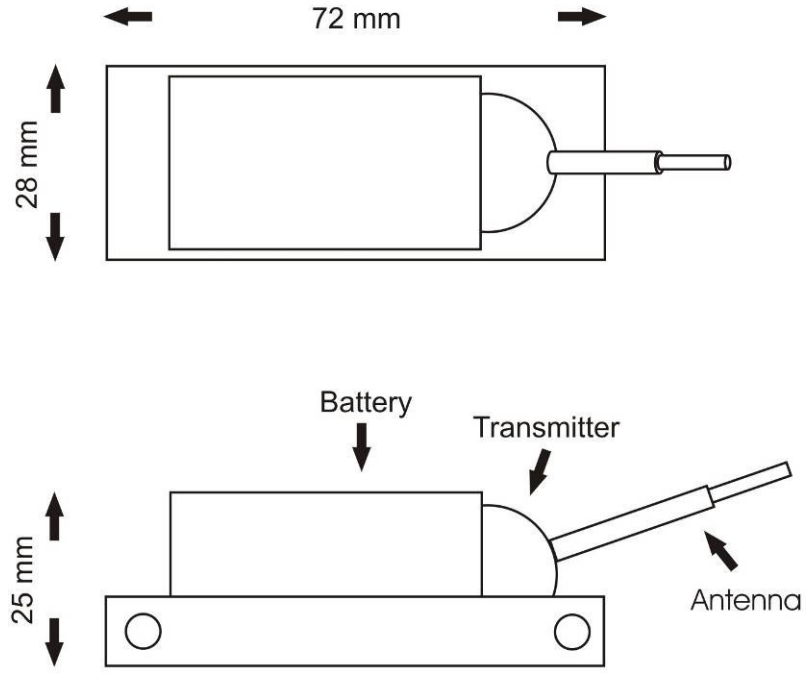

Fig. 2(b) H-module SB2 VHF radio transmitter

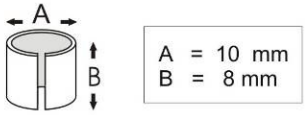

Fig. 2(c) Steel crimp lug

Fig. 3 The first Cape Griffon Vulture fitted with a PTT satellite tracking device and harness (18 January 2004)

Fitting zones

Zone **A** = Transmitter to back of neck
Zone **B** = Back of neck to sternum
Zone **C** = Sternum to above tail
Zone **D** = Above tail to transmitter

Harness

1 = Transmitter
2 = Weak link
3 = Plastic tubing with hang-glider cord
4 = Steel crimp no.1
5 = Steel crimp no.2

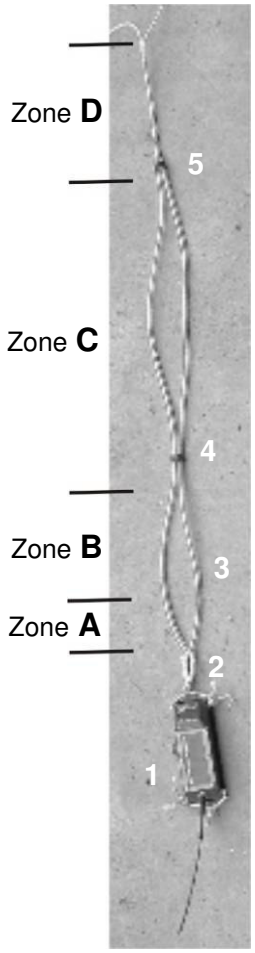

Fig. 4 Fitting zones for harness for PTT satellite-telemetry and VHF radio-telemetry devices