



**REPORT
2010**

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Examination of a dead Javan Rhinoceros Cat Tien National Park, Vietnam

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ACKNOWLEDGEMENTS

The authors would like to thank Professor John Cooper - Department of Veterinary Medicine, University of Cambridge, UK, for leading the examination and providing veterinary forensic pathology advice during construction of the report. We would like to express our gratitude to veterinary and other colleagues in the UK, USA, Europe, Thailand and Vietnam for their support, including but not limited to: US Fish and Wildlife Service, WWF US, WWF Switzerland, WWF Austria, WWF France, WWF International, Critical Ecosystem Partnership Fund and BirdLife International in Indochina, William Schaedla - TRAFFIC SE Asia, Leanne Clark - WCS, Daniela Schrudde – Cat Ba Langur Conservation Project, Milly Farrell and Martyn Cooke - Royal College of Surgeons of England, and Richard Sabine and Roberto Portela Miguez - Natural History Museum, London.

The authors would like to commend CTNP for their diligence in locating and recovering the dead Javan Rhinoceros, and for their support and assistance with this examination. We are thankful to Lam Dong Police, Tan Phu Police and CTNP, for the opportunity to perform this examination and hope that the information obtained will contribute to the police investigation.

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EXECUTIVE SUMMARY

In April 2010, a Javan rhinoceros was found dead in Cat Tien National Park (CTNP), Vietnam. WWF and Cat Tien National Park found a bullet embedded in the left forelimb (front left leg) and the horn had been removed.

Lam Dong Police asked Cat Tien National Park to assist with the police investigation by providing information related to the death of the rhinoceros. Cat Tien National Park requested WWF's assistance, who put together a team of experts to come to CTNP and conduct an examination of the skeleton and visit the site where the rhinoceros was found.

Pathological examination could not determine exactly when the rhinoceros died, but it is thought that the rhinoceros died in late January/early February 2010. WWF and CTNP conducted a survey of Javan rhinoceros from October 2009 to April 2010 in CTNP, collecting faecal samples for DNA analysis to determine population status. Rhinoceros footprints and dung were regularly encountered preceding Tet (Lunar New Year), but no fresh footprints or dung were located after Tet, from February to April. It is therefore suspected that the dead rhinoceros might have been the last Javan rhinoceros in Vietnam, but the DNA analysis of faecal and tissue samples that are currently being conducted will provide final confirmation on the population status.

Pathological examination of the bones revealed that the rhinoceros did not die of old age; it was estimated to be 15-25 years old, which is adult, but not elderly. Javan rhinoceros are estimated to live to up to 40 years in the wild (van Strien et al 2008).

The examination revealed that the horn was removed after the rhinoceros died. The bullet found lodged in the front left forelimb caused considerable injury and inflammation in the leg which would have resulted in impaired locomotion for the rhinoceros. The alteration of the bones suggests that at least 2 months passed between the time the rhinoceros was shot and the time of death.

A direct cause of death could not be found due to the absence of soft tissues. However, the injuries the bullet caused would have predisposed the rhinoceros to other hazardous factors.

It is strongly suspected that the bullet wound to the rhinoceros's leg contributed to its death. The authors of this report suggest that the final cause of death was most likely to be either: i) bacterial infection, probably chronic, arising as a result of the bullet wound, or ii) traumatic event, such as a fall, caused by the impaired locomotion of the rhinoceros due to the bullet wound and highly likely associated infection.

It was not possible to determine whether the person who shot the rhinoceros was the same person who removed the horn. It is highly likely that the horn has been traded and utilized for 'traditional medicine' purposes. The shooting of a Javan rhinoceros constitutes an illegal poaching event; poaching of a Javan rhinoceros, trade and consumption of rhinoceros horn are serious contraventions of Vietnamese law.

1. INTRODUCTION

1.1 Javan Rhinoceros status

The Javan Rhinoceros (*Rhinoceros sondaicus*) is Critically Endangered (van Strien et al, 2008) with only two small populations remaining, representing two distinct subspecies, one in Vietnam (*Rhinoceros sondaicus annamiticus*) and one in Indonesia (*Rhinoceros sondaicus sondaicus*). Cat Tien National Park (CTNP) was discovered to hold a small population of *R. sondaicus annamiticus* in 1988, after a rhinoceros was poached and body parts were found for sale at a local market place (Schaller et al, 1990).

WWF Vietnam has been working with Cat Tien National Park to conserve this globally important population since the 1990's. Although several surveys have been undertaken previously, the exact status of the population is currently not known, estimated at a maximum of 10-15 individuals in 1990 (Schaller et al, 1990), and 5-8 individuals by later surveys (Polet et al, 1999). The first comprehensive survey of Javan rhinoceros in Cat Tien National Park has recently been completed by WWF and CTNP. Faecal samples have been sent for DNA analysis to Queen's University, Canada, which should determine the true status of the population (number and sex of individuals). This information is crucial to develop conservation plans. Results of the DNA analysis are expected in December 2010.

The recent death of a Javan Rhinoceros in Cat Tien National Park is of great concern to WWF and to CTNP. It represents a considerable loss to the global Javan rhinoceros population. Furthermore, this rhinoceros could have been the last remaining individual in Vietnam, representing the global extinction of the Vietnamese subspecies.

1.2 Dead Javan Rhinoceros recovered

On April 29th2010, local people informed Gia Vien ranger station of the whereabouts of the skeleton of a large animal. Cat Tien National Park dispatched a team of staff from the Science and International Division, District Forest Protection Department and Gia Vien ranger station, to the location to secure the skeleton and to take photographs of the skeleton and the site. The rangers remained at the site overnight. A second patrol team from CTNP headquarters, including one WWF staff member (Luong Viet Hung) and the Vice Director of CTNP Technical Department, Bach Thanh Hai, went to the site on April

30th. The team excavated most of the skeleton which was removed from the site to Gia Vien ranger station and then on to CTNP headquarters. Cat Tien National Park staff confirmed that the skeleton was that of a Javan Rhinoceros.

Sarah Brook (Species Coordinator) and Ruth Mathews (Programme Manager) from WWF Vietnam went to CTNP from 4th-7th May 2010, following receipt of the news of the dead rhinoceros. During their time there, WWF and CTNP laid out all of the bones from the rhinoceros skeleton to take photographs and to remove samples of tissue and teeth. The teeth and tissue samples have been sent by WWF, to the institution that is conducting the Javan Rhinoceros faecal DNA analysis (Queen's University, Canada). On 7th May, Sarah and Hung discovered a bullet embedded in the left forelimb bone of the rhinoceros. Sarah immediately informed Tran Van Thanh, Director of CTNP. Thanh notified the Police and requested their presence at CTNP that same afternoon. The bullet was removed by the police on 7th May 2010 in order to conduct ballistics analysis.

1.3 Police investigation

Cat Tien National Park was asked by Lam Dong Police to assist with the investigation into the cause of death of the Javan Rhinoceros. Cat Tien National Park requested WWF's assistance in providing the following information to support the police investigation (Appendix 2):

- i) Scientific name
- ii) Sex (male or female)
- iii) Age
- iv) Time of death
- v) Cause of death
- vi) Injuries caused by the bullet found in the leg bone

Consequently, WWF identified a team of international experts to come to CTNP to attempt to provide this information. This team consisted of:

- Veterinary Pathologist and forensic expert, *Professor John E Cooper*, University of Cambridge, UK
- Wildlife Veterinarian, *Dr Med. Vet. Ulrike Streicher*, Vietnam

- US Fish and Wildlife Service *Special Agent Ed Newcomer*, detailed to ASEAN-WEN, Thailand
- ASEAN-WEN Support Programme, FREELAND Operations Officer, *Douglas McCarty*, Thailand

The trip to CTNP was funded by WWF, organised and coordinated by *Sarah Brook*, *Species Coordinator*, WWF Vietnam. *Bach Thanh Hai*, *Vice Director of the Technical Department*, Cat Tien National Park, provided logistical and technical support.

2. METHODS

2.1 Preparation

Prior to the trip to CTNP, John Cooper conducted a literature search on the biology of Javan rhinoceros (*Rhinoceros sondaicus*), obtained a number of relevant scientific papers on Javan rhinoceros; and visited two museums in London, England, that hold specimens of *R. sondaicus*: these are the Royal College of Surgeons of England and the Natural History Museum. The prime purpose of these activities was to familiarise him with the anatomical features of the Javan rhinoceros.

2.2 Pathological examination

The pathological examination was led by John Cooper, who followed standard procedures for this sort of investigation (Cooper and Cooper, 2007), (Appendix 3). He was assisted by Ulrike Streicher. On 7th September, the team arranged the rhinoceros skeleton and associated tissues on the floor of the Museum in CTNP, to identify which bones and tissues were present and to try to determine which were missing; all bones/tissues were photographed and checked for abnormalities.

Any bones and other tissues that either showed clear pathological changes or warranted more detailed examination for other reasons, were identified, marked and weighed.

Following this, on 9th September, the team conducted an in-depth investigation of bones and hooves that were considered of particular relevance, together with microscopical examination of material from bones, and tests on soil and stones collected from the site where the rhinoceros had been found in April 2010.

2.3 Site visit

On 8th September, the team went to the location where the rhinoceros skeleton was found (0754889, 1289524), accompanied by rangers from the Gia Vien ranger station and Bach Thanh Hai, who had been present for the excavation of the bones in April 2010.

Ed Newcomer led the analysis of the site, with assistance from Doug McCarty. The team looked for any signs in the immediate environment that could help to determine the circumstances in which the rhinoceros died and how people might have gained access to the site. The rangers and Bach Thanh Hai provided more information on how the skeleton was found and excavated in April 2010. During this visit on 8th September a minor amount of excavation was conducted in the immediate location where the skeleton was found, to look for any remaining bones and intestinal contents.

2.4 Presentation of preliminary findings

On 9th September, CTNP invited representatives from Lam Dong and Tan Phu Police, along with CTNP staff and two journalists from Ho Chi Minh City, to attend a presentation of preliminary findings by the investigation team. Ho Thi Thanh Thuy of WWF Vietnam provided translation.

Lam Dong Police brought the bullet that had been extracted from the front limb bone of the rhinoceros and a copy of a police report on the ballistics analysis. The ballistics report has since been translated into English (see Appendix 5 for Vietnamese version, Appendix 6 for English version).

2.5 Follow-up tasks

The in-situ investigation was concluded on 9th September; the team returned to their respective countries on the following day and subsequently pursued queries that had arisen and other matters that required further attention.

Ulrike Streicher took the two front limbs (ulna/radius) and right rib to HCM city on 22nd September for CT scanning. This yielded more information on the internal bone structure and allowed better comparison between the healthy leg and the leg that had been damaged by the bullet.

Ed Newcomer analysed photographs of the bullet before and after it had been removed from the leg bone and enquired with colleagues regarding the calibre of the bullet.

John conferred with colleagues regarding bone-healing time in large mammals and pachyderms in particular, in order to try to pinpoint more accurately when the rhinoceros was shot relative to its time of death.

This report represents the final conclusions of the investigation team regarding the answers to the information required by Lam Dong Police, above, with the exception of the sex of the individual. The results of the DNA analysis conducted by Queen's University, Canada, (of the deceased rhinoceros teeth and tissue) will confirm the sex of the individual and the significance of the loss of this individual to the subspecies. This information is expected in December 2010.

3. RESULTS

3.1 Pathological examination

3.1.1 Summary

The remains examined consisted of bones and keratinous material (11 hooves). Virtually no soft tissues were present: a few pieces of skin, reported to have been obtained originally, had been destroyed allegedly due to smell. Later size comparisons with a skeleton kept at the Museum of the Forestry and Inventory Planning Institute (previously obtained from the Cat Tien area) confirmed that this was a Javan rhinoceros (*Rhinoceros sondaicus*).

The age of the animal was estimated on the basis of standard tests (closure of epiphyses, tooth type and wear, presence or otherwise of exostoses on the cranium (Cave, 1985)) to be adult, but not elderly – probably 15-25 years old. It may be possible to define this more accurately by a) retrospective comparison of the animal's dentition with those of specimens of *R. sondaicus* in London and Hanoi, and b) study of cementum lines and other features of the two teeth that are destined for DNA studies in Canada.

Although many of the animal's bones had been successfully retrieved, others are missing (for example, the axis and lumbar vertebrae, several ribs and the tail) and it is possible that these might have yielded information of relevance to this investigation (see Appendix 4).

Although the majority of bones showed no gross abnormalities, a number exhibited pathological or other changes that are relevant. These were:

- a.) the radius/ulna, metacarpal bones, carpals and hooves of the left forelimb
- b.) the skull
- c.) one of the right ribs

Each of these is discussed in detail below.

3.1.2 Radius/ulna, metacarpal bones, carpals and hooves of left forelimb

The ulna and radius of the left forelimb were heavier and darker in coloration than the corresponding bones from the right side. Proximal and distal, where the two bones are in close proximity they were completely fused. The space between the radius and the ulna is filled with bone material over nearly its complete length. The surface of the radius and ulna were markedly eroded with extended formation of exostoses. The proximal and distal joint surfaces were smooth. A small hole with a darkened rim marks the entry point of the bullet on the lateral surface of the ulna. Slightly cranial to this there was a second small hole with smooth margins. The latter is likely to be formed by a blood vessel as a means of providing increased blood-flow to an area of inflammation.



WWF/Doug McCarty. Photograph of left ulna/radius, showing exostoses formation and bullet entry hole.



WWF/Doug McCarty. Left (upper) and right (lower) ulna/radius, showing considerable difference between the right and left ulna/radius.

3.1.3 Skull and horn

Examination of the skull showed it to be intact other than a missing portion of rostrum (maxillary area). The edges of the rostral wound were jagged and there was no evidence of bleeding, strongly suggesting that the portion of bone and the horn had been removed after death.



WWF/Doug Mccarty. Photograph of upper part of skull, showing missing rostrum.

The mandible was complete. All incisors were missing. On the lower jaw, the first premolar on the right side was missing along with the second molar on the same side. In addition, the second premolar on the right side and the second molar on the left side were missing, the latter two were taken by Sarah Brook for DNA analysis on 7th May 2010.

3.1.4 Right rib

One of the right ribs shows an increase in diameter at approximately its mid-point. The continuity is interrupted and there is a clear “step” in the bone. However, the structure is

completely ossified and apparently of similar consistency and stability as the other areas of the rib. This change is consistent with a healed fracture, not uncommon in large ungulates. It may or may not be relevant to the rhinoceros' forelimb injury.

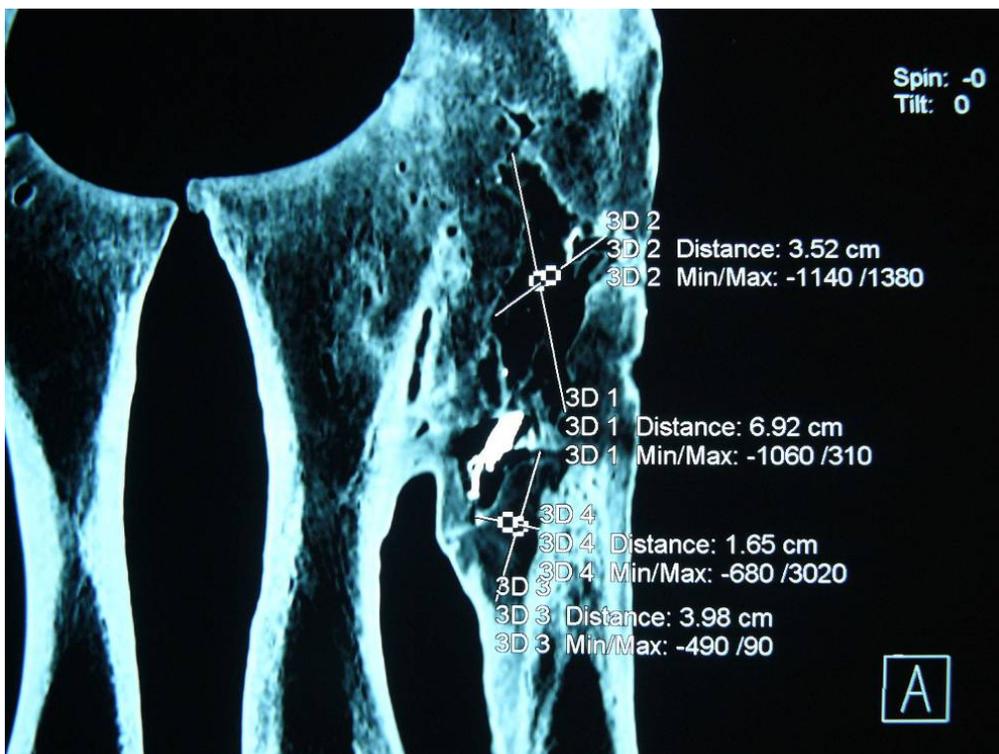
3.1.5 Discoloration and damage

Coppery-red discoloration of many of the bones, especially on the animal's left side, was attributed to staining as a result of contact with/immersion in the soil and not to any pathological processes. The finding may throw more light on the fate of the carcass after death and be relevant to estimating the period that elapsed between that event and the finding of the bones (*post-mortem* interval – PMI).

Damage to the extremities of ribs and elsewhere was attributed to invertebrate damage after the death of the rhinoceros. This is frequently a feature of cartilaginous material that has been exposed to the environment *post mortem*.

3.1.6. CT Results

Computer tomography (a form of radiographic imaging) was conducted on both lower forelimbs and the abnormal rib.



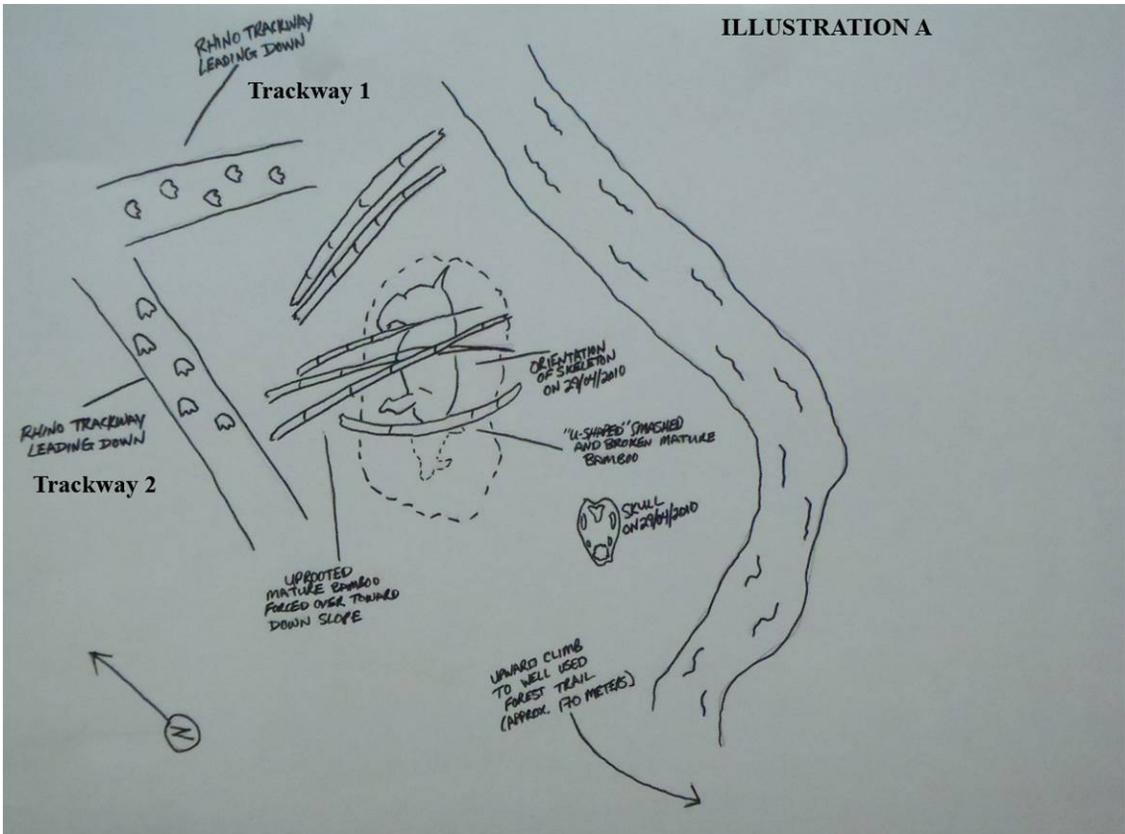
WWF/Ulrike Streicher. CT scan image of left ulna/radius.

The computer tomogramme shows the extent of the internal damage to the bone. From the point where the bullet entered the bone – and the place where it was found - the bullet continued until less than a centimetre before the median bone surface of the ulna. There the bullet came to a halt. Large fragments of the bullet have remained in this location (approximate measurement 2.4mm X 1.1mm). There is a large cavity above and below the bullet termination point. This cavity could have been caused by the primary impact of the bullet or – and this is more likely - by an inflammatory process, osteitis, which has decalcified the bone. The osteitis has also led to extensive fusion of ulna and radius. This process in a rhinoceros is likely to have taken at least two months, possibly in excess of 5 months.

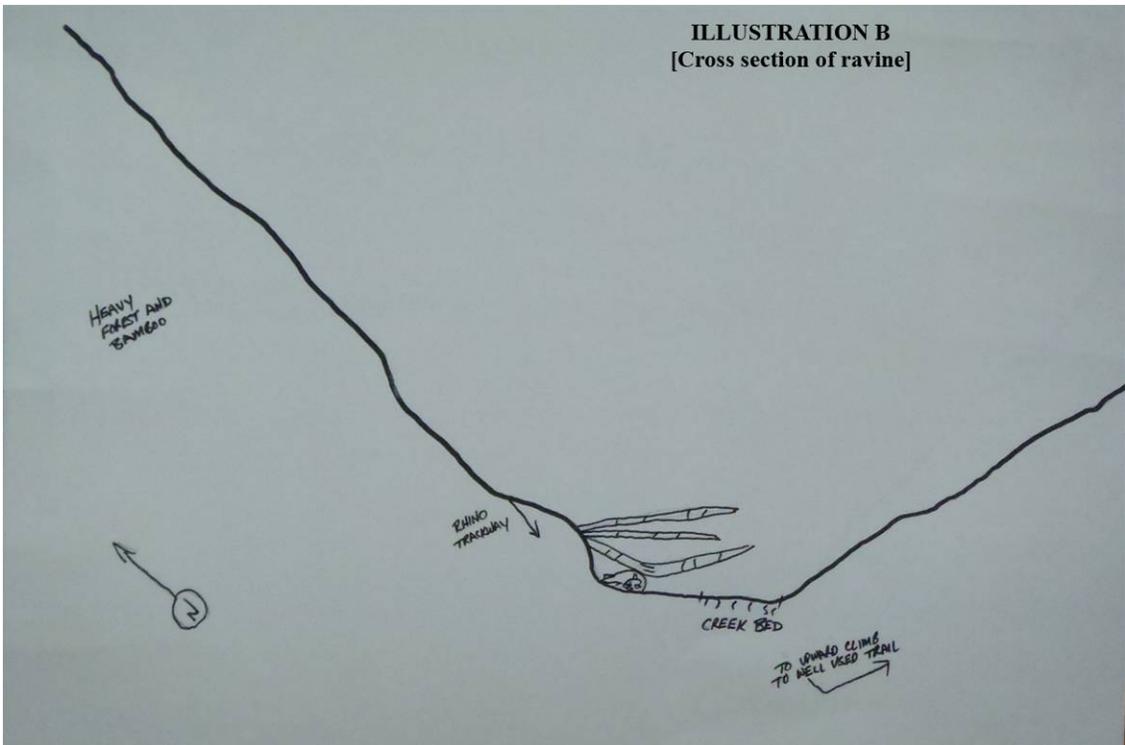
3.2 Site analysis

The location where the rhinoceros bones were found is at the bottom of a ravine surrounded by steep forested inclines on both sides to the north and south. The north slope is much steeper than the south slope. A small shallow creek runs through the ravine. At the time of the site visit, the creek was approximately one to two metres wide and flowing with water eight to ten centimetres deep. The creek flowed roughly from east to west.

Based on information provided by Bach Thanh Hai and a number of the FPD rangers who participated in collecting the bones, the rhinoceros' carcass was found with its hindquarters (tail) approximately facing to the southwest and its shoulders and neck facing to the northeast. The bones of the feet were found closest to the edge of the slope on the north side of the ravine. The skull was found several metres away from the rest of the carcass (See illustrations A and B).



Schematic diagram of the site where the rhinoceros was found, birds-eye view.



Schematic diagram of site where rhinoceros was found in cross section.

According to Bach Thanh Hai, at the time when he and others collected the bones, he personally observed rhinoceros tracks forming two diverging trackways in the mud on the north side of the slope leading down to the area where the rhinoceros bones were found. During the site visit, he described those trackways to the team and indicated the direction the tracks came down the slope. Although the tracks could no longer be seen at the time of the site visit on September 8, 2010, it was still possible to see the trails through the foliage (See illustration A – Labels “Trackway 1” and “Trackway 2”).

Along the steep north slope, immediately above the area where the rhinoceros bones were found, there was a stand of mature bamboo trees. At the edge of the trail (Trackway 2) where Bach Thanh Hai reported having seen rhinoceros footprints in April 2010, a number of these bamboo trees had been pushed over into the ravine and uprooted at their base. At least one of those trees was cracked and broken in a distinctive “U-shaped” pattern. Several of the pushed over bamboo trees had unusual marks on them that appeared to be caused by something rubbing against them. The trees, including the trunk with the “U-shaped” break, were directly over the area where the bones were located. Bach Thanh Hai confirmed that these trees were in the same condition in April 2010 when the bones were excavated. There was no evidence that these trees had been cut or chopped by tools.



WWF/Doug Mccarty. Photograph of site where rhinoceros was found in April 2010.

3.3 Ballistics evaluation

After evaluating the police ballistics report, Ed Newcomer took additional photos of the bullet fragment and the leg bone next to a measuring device. These were compared to the photographs taken of the leg bone before the bullet fragment was removed. For comparison, Ed transposed a scaled measuring device over the photographs of the bullet still lodged in the leg bone. The photographs were also sent to the US Fish and Wildlife Service Forensics Laboratory for review.



WWF/Doug McCarty.
Measurement of the length of
the bullet hole on the left ulna.



WWF/Ed Newcomer.
Measurement of the bullet
fragment extracted from the left
ulna.



WWF/Sarah Brook & Ed
Newcomer. Measurement of
the bullet when still lodged in
the left ulna.

4. DISCUSSION

4.1 Time of death (*Post-mortem* interval - PMI)

4.1.1 Pathology

The circumstances are far from ideal for a precise pathological assessment of when the rhinoceros died. Environmental conditions (temperature and relative humidity) were not recorded at the site at the time of recovery nor were soft tissues and/or invertebrates (maggots, carrion beetles) collected for study. Most, not all, of the bones were transported back to CTNP and were not stored under controlled conditions. Pieces of skin were discarded and only osseous (bones) and keratinous (hooves) elements were retained. Numerous people have handled the specimens, largely without gloves and not, so far as is known, following any standard protocols. Another factor that has to be taken into account in attempting to assess PMI is that we were told that the bones had been treated by park staff using calcium hydroxide, some time between May 9th and September 6th. This appeared not to have had much effect on the appearance of the bones but could, in theory, mask or accentuate *post-mortem* changes.

The bones and hooves had been stored since their removal from the forest in two large baskets. As a result, invertebrates were found that were not likely to have been present originally. Most dominant amongst these were harvestmen (Arachnida: Opiliones). Small lepidopteran larvae were also seen and taken for examination but subsequently released. These and other invertebrates were, almost without exception, alive and motile, suggesting that there were no significant levels of pesticides in or on the bones.

Other invertebrate remains were considered more likely to assist in determining time of death. These were puparia of flies (Diptera) which were taken to The Institute of Ecology and Biological Resources in Hanoi, but could not be identified.

Examination of the skull showed it to be intact other than a missing portion of rostrum (maxillary area). The edges were jagged and there was no evidence of bleeding, strongly suggesting that the bone portion and horn had been removed after death.

4.1.2 Javan rhinoceros survey

The rhinoceros survey conducted by WWF and CTNP from 5th October 2009 to 15th April 2010 may yield significant information on the suspected time of death of the rhinoceros. The survey team used detection dogs to find and sample rhinoceros faeces throughout the rhinoceros's range in Cat Loc, CTNP. Areas regularly visited by rhinoceros were targeted and surveyed frequently, including wallows, swamps, streams and animal trails. Up until late January/early February, the survey team regularly encountered fresh rhinoceros footprints and multiple faecal samples were collected during this time. However, following Tet, from early February until mid April 2010, no new rhinoceros footprints or faeces were found anywhere in the known range in Cat Loc. The team also searched outside of the main area for rhinoceros signs, but no footprints or faeces were found there either. It is therefore suspected, that the rhinoceros died during Tet 2010, in late January/early February. These survey observations suggest that this dead individual might have been the last Javan rhinoceros in Vietnam, but we need to receive the DNA results from the survey before we are confident of this deduction.

4.2 Likely effect of the pathological changes (bullet wound)

The reduced wear on the hoof of the left forelimb, in comparison with that on other hooves, indicates that this limb was not functioning normally. This in turn can be traced to the severe and extensive osteitis in the left front leg which would have caused stiffness and severe pain. The cause of the osteitis was the severe damage to the lower left forelimb, brought about by the impact of the high calibre bullet found in the bone in April 2010. This bullet led to destruction of parts of the internal structure of the bone and had also caused marked inflammation, presumably in response to the trauma and the foreign material (metal) it left in the bone. However the alteration of the bones indicates that this process happened some time prior to the death of the animal; at least two months but probably more time passed between the rhinoceros receiving the bullet injury and the time of death.

It is likely that the injuries that the bullet caused, culminating in a stiff, painful, arthritic left forelimb, would have severely hampered the movement of the rhinoceros. Septicemia is likely to have been present with such a degree of osteitis, but the extent of this cannot be assessed. These injuries would have helped predispose the animal to other potentially hazardous, possibly fatal, factors.

Falls have accounted for a large number of rhinoceros deaths in zoological facilities. Respiratory difficulties caused by the pressure of the rhinoceros's bodyweight are the predominant cause of death following a fall (Ruempler 1991). Furthermore, for a rhinoceros, lying on one side can cause nerve damage to the legs as a result of the rhinoceros's bodyweight, which puts pressure on the muscles and tendons of the lower limbs and can result in temporary paralysis (Nielsen, 1999). This Javan rhinoceros, with its severely injured leg, would probably not have been able to get up again, if it suffered from a fall.

4.3 Cause of death

4.3.1 Pathology

At the time of writing a direct, immediate, cause of death has not been found. However, we can state categorically that the bullet found in April 2010 did not, kill the animal outright. It is, however, likely that the injuries that the bullet caused, culminating in a stiff, painful, arthritic left forelimb would have predisposed the animal to other potentially hazardous, possibly fatal, factors. An animal this way compromised in its locomotion might easily stumble in difficult terrain and is less able to escape from humans. Also, the possibility remains that a septicaemia developed as a result of the osteitis in the forelimb and that the rhinoceros finally died as a result of this.

The fractured (now healed) right rib was unlikely, *per se*, to have contributed to death – such healed fractures are not uncommon in large ungulates – but may be contributory to the overall story if, for example, it was the result of a fall or a separate ballistic injury.

The final (direct) cause of death of the rhinoceros could have been infectious (due to pathogenic organisms), non-infectious or a combination of the two. In the case of this rhinoceros the following can be put forward as possible causes:-

a) Infectious

- A bacterial infection acquired from the environment
- Other more chronic bacterial infections, possibly arising as a secondary to the shot wound

b) Non-infectious

- Traumatic – firearm, a fall
- Toxic – various poisons

In consultation with other members of the team we have excluded many other categories, such as old age, or a parasitic infection.

The injuries to the left forelimb, with the attendant pain and impaired locomotion would have predisposed the rhinoceros to any of the above apart from toxic causes (or more than one of them). Further investigations such as bacteriological and toxicological analyses might produce interesting results, but we do not believe these analyses are necessary.

4.3.2 Site analysis

Based on the topography of the ravine and information provided about the tracks seen in April 2010, the rhinoceros was apparently accessing the creek from the steep slope on the north side of the ravine. The two trackways indicate that when the rhinoceros was descending along Trackway 2, its left front leg would have been on the downhill side.

As the rhinoceros descended using Trackway 2 along the steep slope toward the creek, it would have been putting a large amount of its bodyweight on its left side. Given the extensive injuries to the left front leg, there is a possibility that the rhinoceros fell. Such a fall would have resulted in the rhinoceros falling through the stand of bamboo, causing them to be uprooted, then into the depression in the creek bed, cracking and bending the bamboo trunks with its bodyweight. Based on the location and condition of the uprooted trees, the team concluded that if the rhinoceros did fall from the slope into the ravine, it may have become entangled in the bamboo trees and may have suffered unknown injuries or become exhausted trying to escape. The rub marks on the bamboo trees would be consistent with a large animal rubbing its horn or other body parts against the tree(s).

The fallen bamboo trees show no sign of cutting or chopping. Normally, people moving or removing bamboo use an edged tool to chop or cut away unwanted growth. These bamboo trees, by comparison, were pushed over at their roots.

As noted earlier, the skull was found by rangers in April 2010 several metres away from the rest of the rhinoceros' bones. This probably occurred when the skull was moved away from the rest of the carcass to facilitate removal of the horn.

Based on an evaluation of the site, the most likely approach by humans would be from the south slope. The team evaluated the terrain to determine the most likely approach made by the individual(s) who removed the rhinoceros' horn from its skull. The south slope is not as steep as the north slope and it is closer to trails used by local villagers when accessing this area of forest. The north slope, in addition to being very steep, is heavily forested. It would have been difficult for a person to have seen the rhinoceros carcass or bones from the north slope. In addition, the rangers who accompanied the team on the site visit reported that they had not encountered anyone on the north slope for over two years.

4.4 Ballistics evaluation

Ed Newcomer consulted with a firearms examiner at the US Fish and Wildlife Service Forensics Laboratory who agreed that the photographs were consistent with the conclusions in the ballistics report provided by the Vietnamese police. Based on this information, it appears as if the rhinoceros was shot by a person using a rifle that fired a 7.62 x 39mm round of the type used in AK-47 and CKC rifles. The bullet was most likely a fully-jacketed metal round. Deterioration and damage to the bullet caused by its impact with the bone and the time it was exposed to the elements and biological processes prevents any comparison of the bullet to a particular firearm.

5. CONCLUSIONS

The examination of the Javan rhinoceros remains and the site where these were found has yielded significant information on the events leading up to the death of the animal.

Although it has not been possible to identify the immediate (direct) cause of death due to the absence of soft tissues, we strongly suspect that the bullet wound to the rhinoceros's leg contributed to its death. Based on the injuries caused to the rhinoceros by the bullet wound and the analysis of the site where the rhinoceros was found, we suggest that the final cause of death is most likely to be either: i) bacterial infection, probably chronic,

arising as a result of the bullet wound, or ii) traumatic event, such as a fall, caused by the impaired locomotion of the rhinoceros due to the bullet wound and highly likely associated infection. Further injury or death due to a second shooting event cannot be ruled out; if an additional bullet lodged in the soft tissues, it would now be retained in the ground.

Because the rhinoceros was not immediately killed by the bullet wound to its leg, it is impossible to determine whether the person who shot the animal in the leg is the same person who ultimately removed the horn. While it is possible that the original shooter continued to track the animal for months, knowing that the rhinoceros was injured, and eventually located the body once the animal died and stopped moving, it is equally possible that the horn was removed by someone who accidentally found the animal in the creek bed.

The shooting of the Javan rhinoceros in Cat Tien National Park, a species protected by Vietnamese law, constitutes a poaching event and a serious breach of the law. Decision 186/2006/QĐ-TTg states that “All acts of hunting, trapping or catching wild animals in special-use forests being national parks or nature conservation zones are prohibited; where those acts are necessary, they must comply with the Government’s Decree No. 32/2006/NĐ-CP of March 30, 2006, on management of endangered, precious and rare forest plants and animals.”

The Javan rhinoceros, *Rhinoceros sondaicus*, is listed under Group IB of Decree 32/2006/NĐ-CP: “Prohibiting exploitation and use for commercial purposes, including wild plants, animals, which are especially valuable to science and the environment or have highly economical value, or for which populations are very small in the wild or are in high risk of extinction”.

It is highly likely that the rhinoceros horn has been traded and utilized for ‘traditional medicine’ purposes, which are also illegal activities contravening Vietnamese law.

Joint Circular 19-2007-TTLT-BNN&PTNT-BTP-BCA-VKSNDTC-TANDTC, defines violation of protection laws relating to precious and/or rare wildlife (*Article 190 of the Criminal Code*). “Illegally hunting, killing, or transporting precious and/or rare wildlife

as prohibited under the Government's Regulation will be subject to criminal prosecution in accordance with Item 1 of Article 190 of the Criminal Code if belonging to one of following cases:

a) Illegally hunting, killing, transporting, or trading precious and/or rare wildlife listed in Group IB is defined as “*causing extremely serious consequence*” if the activity involves the minimum number of individual animals outlined in the Appendix attached to this Circular.” The minimum number of individuals for *Rhinoceros sondaicus* is 1 individual.

We hope the information obtained from this examination will contribute to the police investigation to find the perpetrators, and consequently that anyone identified as being involved in this serious wildlife crime will be held responsible and punished accordingly.

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7. APPENDICES

Appendix 1. Letter from WWF to Lam Dong Police investigation team

Hanoi, May 26th, 2010

To:

- **Lam Dong Police Investigation Team of Rhino death case**

CC:

- **Dong Nai, Lam Dong and Binh Phuoc Provincial People's Committees**
- **Ministry of Agriculture and Rural Development**
- **National Forest Protection Department**
- **Ministry of Natural Resources and Environment**
- **National Environmental Police**
- **Management Board of Cat Tien National Park**

Subject: Rare Javan rhino death in Cat Tien National Park, Vietnam

Dear Sirs/Madams,

WWF appreciates the efforts of the Vietnamese government in investigating the death of the rare Javan rhino in Cat Tien National Park. As you know, many rare and precious species like the Javan rhino are in danger of extinction in Vietnam and if not properly protected, they will disappear forever. Therefore, exposing the cause of death is essential to conservation efforts. In case the Rhino was killed, if the perpetrators of these crimes are brought to justice to the full extent of the law, this case will help avoid the possible death of other endangered species in Vietnam.

In support of ongoing investigations by provincial authorities into the suspected poaching of the Javan rhino in Cat Tien National Park, WWF would like to highlight some certain detailed facts below and expects these facts to be seriously considered during the investigation.

- There is physical and photographic evidence that the animal was shot. A bullet was found in the front leg of the rhino. Also, the rhino's horn was removed. (Please see the photos enclosed).
- WWF experts in rhino biology identified unnatural cut marks on the skull in the area where the horn should be indicating that the horn had been forcibly removed and a large portion of the upper jaw-bone was removed when the horn was taken.
- While samples were being collected for DNA analysis the WWF team discovered a bullet embedded in the leg of the skeleton on 7 May 2010. This was shown to Cat Tien National Park authorities. The bullet was found in the front left leg. Ballistic analysis of the bullet found in the rhino's leg is said to be underway by government authorities.

- Photographs of the bullet in the leg bone were shown to a WWF expert in wildlife crimes, with many years of experience managing rhino protected areas, who confirmed that the photo showed a high caliber bullet in the front left leg of the rhino. (Please read full statement below)
- Rhino horn, is a highly valued commodity in the illegal wildlife trade, the skin and faeces are also used for alleged medicinal purposes.
- Vietnamese law protects the rhino. Decree 32/2006/ND-CP prohibits hunting, catching, keeping, slaughtering, trading, or transporting rhinos, parts of rhino, or any items containing rhino.

An analysis of the photographic evidence and information regarding the recent rhino death in Vietnam was conducted by Mr. Craig Bruce, Wildlife Crimes Specialist, WWF. Based on the photographs, Mr Bruce offered the following conclusions.

1. *“ The enlarged photograph and statements from those on the scene is evidence that this rhino was seriously wounded. A fairly heavy caliber bullet seems to be lodged in the bone, this could certainly not be considered a flesh wound.*
2. *I have managed large rhino populations for over a decade and been at the scene of a variety of natural and unnatural rhino deaths. Despite the age of the discovered carcass, the bullet lodged in the bone and the harvested horn are clear indicators that this rhino was poached for its horn.*
3. *In my experience opportunistically harvested horn is very rare and 98% of the time a rhino found with a horn removed has been killed by poachers for that horn. Cut marks on the skull indicate that someone was there with the right tool prepared and ready to remove a rhino horn.*
4. *It is not atypical for a rhino to be shot many times in a poaching incident, the deteriorated carcass unfortunately would not have allowed the rangers on site to confirm this but it is certainly common. The evidence we have of one wound is in all probability one of many.*
5. *It is finally therefore highly likely that this rhino was poached for its horn.”*

WWF respectfully urges the Police Investigation Team to conduct a full investigation into both the shooting of the rhino and the likely illegal trading of its horn. WWF would like to express our willingness to support the investigation in any way we can which could include providing an international specialist in wildlife pathology and forensic science to assist the investigation. Determining the cause of death of this rhino and ensuring a full investigation is carried out is essential to national conservation efforts.

We hope the results of this investigation will be available to the public soon.

Yours sincerely,

Huynh Tien Dung
 Chairman of Management Committee
 Vietnam Country Programme - WWF Greater Mekong,

Appendix 2. Letter from CTNP requesting assistance from WWF

Date: 1st July 2010

WWF Viet Nam

On behalf of Cat Tien National Park, I would like to express our great appreciation for the support and cooperation of WWF to conservation efforts in Cat Tien National Park in general and for the Javan Rhino in particular. Regarding to the investigation of the dead rhino found in April 2010, Cat Tien National Park has been requested by Lam Dong Police to provide the following information:

1. Cause of death
2. Injuries sustained by being shot with a high caliber bullet
3. Time of death
4. Age and overall health of the individual

Since this request is beyond our ability at the moment to answer, we would like to ask for the assistance of WWF Vietnam in providing more information relating to the death of the rhino. Specifically, we would like to ask WWF to identify and support a team of international experts in wildlife crime and veterinary pathology, to determine the factors above where possible.

We would like the team of experts to come to Cat Tien National Park to conduct a full examination of the skeleton, to provide the above information and identify any other factors which may be important to this case.

Following the mission, the team should submit a full report on their methodology, findings and conclusions, to Cat Tien National Park, Lam Dong PPC and Provincial Police, MARD, Environmental Police and other relevant ministries and agencies.

Signed



Trần Văn Thành

Appendix 3. Reference notes – forensic investigation of the skeleton

John E Cooper, DTVM, FRCPath, DTVM, FRCPath, FSB, CBiol, FRCVS,
Diplomate, European College of Veterinary Pathologists,
RCVS Specialist in Veterinary Pathology
Department of Veterinary Medicine, University of Cambridge, UK

The skeleton is often neglected in routine diagnostic, health-monitoring and forensic studies. It can yield important information.

Radiography is valuable, before and during osteological examination.

Basic rules

1. Prepare equipment before starting to examine the bones. Check agreed protocol and explain it carefully to any assistants or new colleagues.
2. Have protective clothing available, even if not immediately needed. Remind all present of the importance of health and safety and check the Risk Assessments.
3. Handle bones carefully. They can be damaged easily. Hold them over a table top or bench, preferably with two hands. The wearing of gloves helps to minimise trauma and may reduce the risk of spread of pathogens, but they reduce dexterity. If forceps are to be used, pad them or employ those made of plastic. Always use plastic/padded forceps when handling metallic objects, such as bullets.
4. Be particularly careful when moving or transporting bones, even over a short distance. Carry them on a tray or in a box. Wrap bones individually in paper to reduce damage. If soft tissues are present, place them in jars or plastic bags to prevent or delay desiccation.
5. If the bones are dirty, clean them with care, using a damp cloth or a soft brush. Do not apply hot water and do not scrub bone surfaces, especially of joints. Record on the record sheet if the bones have been cleaned. Remember that dirty bones are likely to present more of a health hazard than do dry bones.

6. When material is not properly labelled, work on one skeleton at a time, so as to avoid mixing and possible transposition of bones. Ideally, arrange the bones in a skeletal arrangement on a table.
7. Use standard record sheets for your work, to avoid inter-observer bias and to facilitate later analysis. Use clear, correct, unambiguous language – and be consistent in what you say. Write dates in full – for example, 11th September 2009, not “11/9/09” or “9/11/09”.
8. When possible, supplement written records with photographs, drawings and tape-recordings. Ensure that the photographs and drawings are labelled with the animal’s reference number and the date of the study (see above).
9. Make one or more photocopies or electronic scans of completed record sheets as soon as possible and keep in a safe place separate from the original.
10. Do not remove bones for study overseas unless specifically authorised to do so, in which case both CITES permits and animal health documentation are likely to be needed (see Cooper, ME, Abstract of paper presented at PASA meeting, Kenya, 2009).

Equipment needed

Paper, pens (black), pencils including marking pen/soft pencil for labelling bones

Record sheets and clipboard

Protective clothing, including goggles

Scales/balance

Tape measure (for circumferential measurements)

Rules (for linear measurements and as a scale on photographs)

Self-sealing plastic bags

Sticky labels and dry labels

Hand lens or magnifier

Brushes

Probes

Reference texts (photocopies, printouts or books)

Camera

Tape-recorder

Appendix 4. List of Javan rhinoceros bones present and missing, Cat Tien National Park

Scientific name	Number in skeleton	Number found
Skull	1	1
Mandible	1	1
Cervical vertebrae	7	5
Thoracal vertebrae	17	12
Lumbar vertebrae	2	-
Os sacrum	1	1
Caudal vertebrae	?	-
Costa	34	23
Os sternum	1	1
Pelvis	1	1
Scapula	2	2
Humerus	2	2
Radius/Ulna	2	2
Carpals /tarsals	32	28
Metacarpals /Metatarsals	12	10
Phalanges	36	10
Hooves	12	11
Sesamoids		2 (1 patella)

Thành phố Hồ Chí Minh, ngày 07 tháng 6 năm 2010

KẾT LUẬN GIÁM ĐỊNH

Kính gửi: Cơ quan Cảnh sát điều tra - Công an tỉnh Lâm Đồng

Ngày 19 tháng 5 năm 2010 Phân viện Khoa học hình sự tại thành phố Hồ Chí Minh đã nhận được quyết định trưng cầu giám định số 72/PC14 đề ngày 18 tháng 5 năm 2010 của Cơ quan Cảnh sát điều tra Công an tỉnh Lâm Đồng yêu cầu giám định dấu vết súng đạn trong vụ phát hiện bộ xương Tê giác ở dưới suối tại tiểu khu 513, khu Cát Lộc Vườn Quốc gia Cát tiên, thuộc địa phận huyện Cát Tiên, tỉnh Lâm Đồng, vào ngày 29 tháng 4 năm 2010

Theo sự phân công của lãnh đạo Phân viện khoa học hình sự tại thành phố Hồ Chí Minh.

Chúng tôi gồm:

Ông: Lê Đức Sơn - Giám định viên tư pháp kỹ thuật hình sự về dấu vết súng đạn, số thẻ 1703/TP - GDTP đã tiến hành giám định tại Phân viện Khoa học hình sự tại thành phố Hồ Chí Minh từ ngày 20 tháng 5 năm 2010 đến ngày 31 tháng 5 năm 2010.

1- Nội dung vụ việc

Như ghi trong Quyết định trưng cầu giám định số: 72/PC14 đề ngày 18 tháng 5 năm 2010 của Cơ quan Cảnh sát điều tra Công an tỉnh Lâm Đồng.

2. đối tượng cần giám định

01 (một) mẫu kim loại

3. Yêu cầu giám định

3.1- “Đầu đạn thu được trên xương ở chân trước bên phải con Tê giác là loại đạn gì, được sử dụng cho loại súng nào có phải được sử dụng cho súng quân dụng hay không? nếu phải thì loại súng gì?”

3.1- “Dấu vết trên đầu đạn đã được thu giữ gửi giám định có đủ yếu tố truy nguyên khẩu súng bắn ra hay không?”

4 - Phương pháp và kết quả giám định

4.1-Phương pháp giám định

+Nghiên cứu hình dạng, cấu tạo, kích thước, đặc điểm và dấu vết để lại trên mẫu vật gửi giám định ghi ở mục 2.

+Nghiên cứu các tài liệu liên quan đến đạn

+So sánh đối chứng giữa hình dạng, cấu tạo, kích thước, đặc điểm và dấu vết để lại trên mẫu vật gửi giám định ghi ở mục 2 với hình dạng, cấu tạo, kích thước, đặc điểm của các loại đầu đạn của các loại đạn tiêu chuẩn được lưu tại Phân viện Khoa học hình sự.

4.2- Phương tiện giám định: sử dụng các tiện chuyên dùng như kính lúp, kính hiển vi soi nổi MZ8, kính hiển vi so sánh với ánh sáng chiếu xiên và các công cụ hỗ trợ cần thiết.

4.3- Kết quả giám định: đã ghi nhận đầy đủ các thông tin, đặc điểm liên quan đến mẫu cần giám định. Quá trình giám định bảo đảm chính xác, khách quan đủ cơ sở để kết luận giám định.

5 - Kết luận giám định

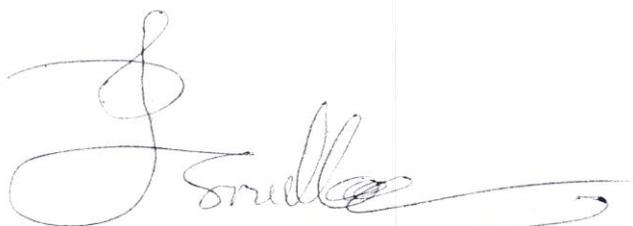
5.1- Mẫu vật bằng kim loại đã bị han rỉ thu ở vụ phát hiện bộ xương Tê giác ở dưới suối tại tiểu khu 513, khu Cát Lộc thuộc Vườn Quốc gia Cát tiên, tỉnh Lâm Đồng, vào ngày 29 tháng 4 năm 2010 gửi giám định là phần ống chứa thuốc cháy nằm trong lõi đầu đạn của loại đạn vạch đường cỡ 7,62mm x 39mm (đạn K56).

5.2- Đạn cỡ 7,62mm x 39mm (đạn K56) là loại đạn sử dụng cho các loại súng quân dụng có cỡ nòng 7,62mm, như AK47, CKC...

5.3- Dấu vết để lại trên mẫu vật bằng kim loại đã bị han rỉ ghi ở mục 5.1 không có cơ sở để giám định truy nguyên khẩu súng bắn.

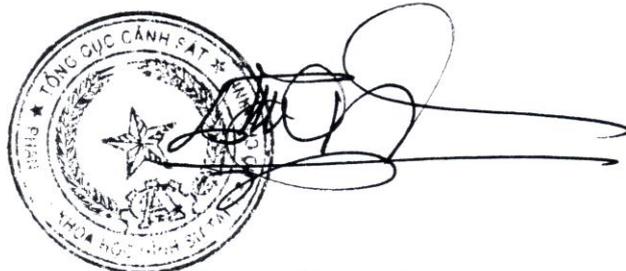
Hoàn lại toàn bộ đối tượng gửi giám định như ghi trong QĐTC.

GIÁM ĐỊNH VIÊN



Lê Đức Sơn

**PHÓ VIỆN TRƯỞNG VIỆN KHHS
KIỂM PHÂN VIỆN TRƯỞNG**



Đại tá Phạm Ngọc Hiền

Appendix 6. Lam Dong Police ballistics report, unofficial English translation

Assessment result

Report to: Police agency – Police Department, Lam Dong province

19/5/2010, Ho Chi Minh Criminal Science Institute has been informed on announcing an assessment referendum number 72/PC14 on 18/5/2010 from the Policy agency, Police Department; Lam Dong province which had required an investigation on bullets when a dead rhino had been found near the spring in sub-division 513, Cat Loc sector, Cat tien national park, Cat Tien district, Lam Dong province on 29/4/2010.

Follow the assignment from the management of Ho Chi Minh City Criminal Science Institute.

We are:

Le Duc Son – Ballistics Expert, card number 1703/TP – GDTP did make an examination in Ho Chi Minh Criminal Science Institute from 20/5/2010 till 31/5/2010.

1. Job description:

As mentioned in the examination referendum number 72/PC14 on 18/5/2010 from the Policy agency, Police Department; Lam Dong province.

2. Assessment object:

01 sample of metal

3. Assessment requirements:

3.1 “What kind of bullet tip obtained on bone in the right front leg of the Rhino, for what kind of gun – specifies more on whether it is one of military guns”

3.2 “Is this enough evidences to know the exact kind of gun if there is only a trace on the bullet tip?”

4. Assessment methodology and result:

4.1 Assessment methodology

- Study of the shape, structure, size, characters and traces on the specimen mentioned on part 2.
- Study of gun documents
- Compare and contrast between the specimen with its shape, structure, size, characters and traces and the shape, structure, size and characters of bullet tips that kept and stored at Criminal Science Institute.

4.2 Assessment tools: Specialized tools such as magnifier, microscope MZ8 (floating check), microscope which is used to compare with oblique light and other supporting tools.

4.3 Assessment result: All outcomes have been collected. Assessment process has been completely qualified and transparent to give out the final conclusion.

5. Assessment conclusion:

5.1 The rusty metal specimen that people found it in the dead Rhino’s bone near the spring in sub-division 513, Cat Loc sector, Cat tien national park, Cat Tien district, Lam Dong province on 29/4/2010 is a part of a fire tube in the bullet tip which is the bullet of size of 7.62mm*39mm (bullet K56).

5.2 Bullet 7.62mm*39mm (K56) is used for military guns with caliber of 7.62mm such as AK47, CKC...

5.3 The remaining trace on the rusty metal specimen which mentioned on part 5.1 is not enough to tell exactly what gun it belongs to.

Resend all assessment objects as mentioned.

Appendix 7. Advice on Preserving Bones of Javan Rhinoceros – John E Cooper

The following notes apply to the preservation of non-articulated bones, as a collection. If the rhinoceros bones are articulated (put together) for mounting as a skeleton, some different instructions will be needed:

- Have protective clothing available, even if not immediately needed. Remind all present of the importance of health and safety. Bones can transmit pathogens.
- Handle bones carefully. They can be damaged easily. Hold them over a table top or bench, preferably with two hands. The wearing of gloves helps to minimise damage and minimise the risk of spread of pathogens, but they reduce dexterity.
- Be particularly careful when moving or transporting bones, even over a short distance. Whenever possible, carry them on a tray or in a box.
- Give a unique reference number to each bone, linked to the reference number of the rhinoceros, write this in soft pencil or ink on the side of the bone (not over a joint). Make a list of all bones, with numbers and identification, where known.
- Identify as many bones as possible. Write the identification (name) of the bone in English or Latin in pencil or pen as above. Use for guidance the book “Anatomy of the Domestic Animals” by Sisson, which was left with Mr Thanh. If there is any doubt about the identification of a bone, give it a reference number but do not add a name until an authoritative opinion has been obtained.
- If the bones are dirty, clean them with care, using a damp cloth or a soft brush. Do not apply hot water and do not scrub bone surfaces, especially of joints. Record on a record sheet if the bones have been cleaned. Remember that dirty bones are likely to present more of a health hazard than do dry bones.
- Do not treat the bones with chemicals or attempt to boil them until a decision is made about their long-term future.
- If the bones are to be stored at Cat Tien, they should be wrapped in dry paper and stored in secure, labelled, boxes (preferably cardboard). They should be checked regularly - at least once every three months.
- Do not use insecticides on the bones or wrappings. Instead, seal them in a secure, dry, cupboard or display cabinet.
- Check the bones every three months for signs of mould, insect damage or other changes. If any changes are visible, seek further advice.

**Why are we here**

To stop the degradation of the planet's natural environment and to build a future in which humans live in harmony with nature

wwf.panda.org/vietnam

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WWF is one of the world's largest and most experienced independent conservation organizations, with over 5 million supporters and a global Network active in more than 100 countries.

WWF's mission is to stop the degradation of the planet's natural environment and to build a future in which human live in harmony with nature, by: conserving the world's biological diversity, ensuring that the use of renewable natural resources is sustainable, and promoting the reduction of pollution and wasteful consumption.

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