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Analysis on humane killing methods for reptiles in the skin trade

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1 Introduction

Trade in reptile skins, their parts and derivatives provides an important economic activity for a diverse range of stakeholders along the value chain from the hunters/breeders to skin traders, tanners, leather refineries to tailors and commercial luxury brand houses and finally consumers. Details of this trade, in particular relating to trade in Python snakes, can be found in the recently published report by the International Trade Center¹⁶. Exact trade figures for all reptile species are difficult to obtain, in particular for species for which no international trade controls exist. However, thanks to the trade data gathered by the Convention on International Trade in Endangered Species of wild Fauna and Flora (CITES), the volume of trade in those species listed in the Appendices to CITES can be assessed over the past 40 years. According to figures on the dashboard of CITES' official website, this volume has seen very high figures of between 1.5 and 2.25 millions skins per year in the past, but seems to be decreasing since 2006 to a level of around 800'000 skins traded per year. However, taking into account those species not listed by CITES and for which no trade data exist, the number of skins traded per year is likely to be considerably higher.

Increasingly in recent years, concerns have been raised about the potential welfare implications for snakes and lizards caught and killed for the skin trade. To improve the welfare of the animals involved in the trade and to reduce their suffering caused by inhumane slaughtering methods, it was felt that guidelines on how to humanely euthanize reptiles are needed. This need was also recognized by various stakeholders along the value chain starting from the countries of export, to the countries of import, international organizations and NGO's but, in particular, by the public and the companies which sell the finished products to the final consumer at the end of the value chain.

In 2011, Switzerland as an important hub in the trade of finished products obtained from reptile skins, directed it's Federal Veterinary Office to set up an Expert Panel composed of internationally recognized experts in the field of animal welfare, euthanasia and trade in reptile skins with the aim to examine the current literature and draft recommendations for the humane killing of reptiles. The list of the members of this Expert Panel can be found in the paragraph 5 of this document. In particular, the Expert Panel was tasked with assessing the humaneness, appropriateness and acceptability of the various existing euthanasia methods available for reptiles irrespective of the setting under which the killing takes place.

The Panel set about the task in three phases. The first phase was to review published scientific and gray literature on current methods used to euthanize, slaughter and kill reptiles. The second phase was to rate the list of published information according to the usefulness and relevance for the purpose of the panel's work. In the third and final phase the selected publications were used to gain consensus amongst the panel and to create a document, which represents the panel's recommendations for humane slaughtering of reptiles. These recommendations are therefore based on a thorough review of the current level of available knowledge. The analysis of the expert panel also revealed that there are gaps in our knowledge about various aspects that may influence the humaneness of the methods of euthanasia recommended in this document. Should new information become available the recommendations of this panel may have to be reviewed and updated accordingly.

The Panel stresses that these recommendations are only a first step towards assuring the humane treatment of reptiles in the production of leather for this trade. We hope that these recommendations will be put to work, closely monitored and research conducted to test their humaneness and effectiveness.

Switzerland will start by submitting these recommendations to the World Organization for Animal Health (OIE) for adoption as standards for humane slaughtering of reptiles and sharing them with the relevant working groups dealing with animal welfare issues in the fashion industry. The Panel also recommends the wider incorporation of humane killing methods into Best Management Practices (BMP's), and assessment of compliance through wildlife management authorities as well as capacity

building activities in the countries of origin of the species involved in the trade.

2 Criteria for the evaluation of a humane killing method

The methods used should¹:

- Attempt to cause no pain
- Lead to rapid unconsciousness and death
- Be performed with minimum restraint
- Avoid excitement
- Be appropriate for the age, species, and health of the animal
- Attempt to cause no fear and psychological stress to the animal
- Be reliable, reproducible, irreversible
- Be simple to administer
- Be safe for the operator
- Be aesthetically acceptable for the operator or observer

Considerations about the practicability of a method²:

- Compatibility with requirement and purpose
- Drug availability and human abuse potential
- Ability to maintain equipment in proper working order
- Economical³

3 Killing methods for reptiles: current knowledge

3.1 Mechanical Methods

3.1.1 Decapitation

This procedure involves the severing of the neck of the animal, exactly between the skull and the first cervical vertebra, using a sharp instrument (guillotine^{1,2,3,4,5}, axe or blade¹) ideally with a single very swift cut⁴ that leads to severance of the spinal cord.

Some reptiles may remain conscious for up to an hour after decapitation^{4,6,7}, which makes this procedure acceptable only if the brain of the severed head is immediately destroyed by pithing^{2,4,6,8} or by blunt trauma.

3.1.2 Cervical Dislocation

This method involves separation of the skull and the brain from the spinal cord by applying pressure³ in a simultaneous ventral-cranial motion at the base of the skull with an appropriate tool.

The operator must be confident of performing this technique quickly and effectively. It requires mastering of technical skills to ensure that loss of consciousness is rapidly induced³. Although suitable for small rodents, rabbits and birds, the method is not appropriate for larger reptiles (> 200 grams) owing to the resistance of the reptilian brain to hypoxia⁴. Also, for taxon specific anatomical reasons, and especially in large specimens, it is extremely difficult to dislocate vertebrae.

3.1.3 Shooting: Free Bullet, Gunshot

Shooting should be performed by personnel trained in the use of firearms.

A high level of skill is required in order to hit the brain through the two brain cases found in many reptiles⁹. In addition, with small species, and/or where the target is moving, shooting may not be effective. However, apart from this, shooting in the head to ensure immediate destruction of the brain is an effective and humane way of killing large reptiles¹. It is occasionally recommended that even when this method is used the spine is severed and the brain destroyed by pithing^{10,11}.

3.1.4 Captive-Bolt Pistol

Captive bolt pistols are powered by gunpowder or compressed air and must provide sufficient energy to penetrate the skull² (penetrating captive bolt) or cause fatal stunning (non-penetrating captive bolt) of the species on which they are being used.

The animal must be properly restrained to ensure that only a single shot is required. Both penetrating and non-penetrating captive bolt guns must be placed directly on the skull over the brain cavity to ensure their effectiveness. All personnel must be trained in these techniques to ensure the correct positioning of the weapon to ensure a direct hit into the brain¹. An appropriate charge of the gun (air or gunpowder) must be selected to match the size of the animals. It has been shown to be very efficient for the slaughter of Pantanal caimans and American alligators, and can be used for all sizes of crocodilian^{12,13} given that appropriate charge is selected. It is considered an acceptable and humane method for large reptiles but should only be carried out by trained personnel who know where to position the pistol⁵ and thereby ensure a direct hit into the brain. In snakes the captive bolt would have to be shortened to avoid wrist injuries and damage to the equipment. However, there are ways of using the standard equipment in snakes by placing soft materials (foam, etc.) beneath the animal to soften the trajectory of the bolt after penetrating the head. Alternatively the non-penetrating bolt would not need modification although the head is quite large for some species.

3.1.5 Stunning: Blow, Concussion

This involves striking the head of the animal directly over the cranium with some hard implement or object and with sufficient force to cause immediate loss of consciousness and/or death^{9,14}.

If many animals are to be killed within a short time by the same operator it is difficult to ensure consistency in performance and therefore only a few animals should be killed by the same person using this method at any time¹. Larger reptiles (crocodilians) may be rendered unconscious by this method but are less likely to be killed. The brain must be destroyed before the return of consciousness^{3,4,9,14}, either by a further blow or by some other method such as pithing. It is considered an acceptable method for all reptiles but should only be carried out by experienced operators⁶ who know exactly where to strike.

3.1.6 Exsanguination

By cutting the major blood vessels in the neck i.e. the carotid arteries and jugular veins³.

This method of euthanasia is not acceptable for reptiles and other ectothermic vertebrates because of their slow metabolic rate and hypoxic tolerance^{1,3,6}.

3.1.7 Rapid Freezing, Supercooling, Cooling, Hypothermia

Killing of animals by placing them in very cold temperatures such as deep freezers.

Immobilization of reptiles by cooling is considered inappropriate and inhumane even if combined with other physical or chemical methods of euthanasia². Quick freezing of deeply anesthetized animals is acceptable². In the laboratory situation dropping an animal into liquid nitrogen at minus 196°C – a very extreme form of freezing, far removed from a domestic freezer may be acceptable for animals of less than 40g bodyweight (i.e. less than 1cm in diameter) as liquid nitrogen would freeze an entire body of that size instantaneously⁴. This methods as a standalone method is not acceptable for euthanasia of reptiles^{1,9,15}

3.1.8 Heating, Hyperthermia

Raising the temperature above the critical temperature of the species⁴. This method is not acceptable for euthanasia of reptiles^{1,9,12}.

3.1.9 Suffocation¹⁶

Depriving animals of oxygen. This method is not acceptable for euthanasia of reptiles.

3.1.10 Drowning

This method is not acceptable for euthanasia of reptiles⁴.

3.1.11 Pithing

Carried out by inserting a sharp metal rod or probe through the foramen magnum into the base of the brain to ensure quick brain destruction³.

Method acceptable for unconscious reptiles^{1,2,9} (e.g. stunned, anaesthetized). It may also be acceptable when performed immediately after decapitation or cervical dislocation. Pithing can be carried out in reptiles without crushing the skull⁴.

3.2 Chemical Methods

3.2.1 Inhalation (Halothane, Enflurane, Isoflurane, Methoxyflurane, Ether, CO₂, CO)

With inhalant anaesthetics, the animal can be placed in a closed receptacle containing cotton or gauze soaked with an appropriate amount of the anesthetic, or the anesthetic can be introduced from a vaporizer. The latter method may be associated with a longer induction time. Vapors are inhaled until respiration ceases and death ensues².

Many reptiles are capable of holding their breath and converting to anaerobic metabolism, and can survive long periods of anoxia (up to 27 hours for some species)^{2,4,6}. Because of this ability to tolerate anoxia, induction of anaesthesia and time to loss of consciousness may be greatly prolonged when inhalants are used^{2,17}. Death in these species may not occur even after prolonged inhalant exposure². Therefore euthanasia by inhalation of toxic gases is not an acceptable method for Euthanasia in reptiles^{1,3,4,18}.

3.2.2 Injection (Barbiturate, Tricaine methane sulfonate, T-61, Others)

Various methods of applications are available (e.g. intravenous, intraperitoneal, intrapulmonic, intramuscular, subcutaneous, intracardiac, oral, rectal).

Sodium pentobarbitone is an effective and humane method of euthanasia in reptiles^{3,4,9,12}. The intravenous route can be used by well-trained personnel⁹ and result in quicker death¹. Where intravenous injection is difficult the intraperitoneal route may be used but it is slower acting^{3,4,9}. Intracardiac injection may only be used on a fully anaesthetized animal as this is very painful and is therefore not considered acceptable^{3,9}. Intramuscular or subcutaneous should not be used as they are not effective and may cause pain⁴.

Tricaine methane sulfonate (TMS, MS-222) may be administered by various routes to euthanize. These are expensive means of euthanasia² and because there is little information on the humaneness of this method, it is not considered acceptable for reptiles⁹.

T-61 must only be injected intravenously and slowly as it is otherwise painful¹. The animal must be sedated prior to administration of T-61¹ and is acceptable in all groups of animals¹⁵.

Some authors recommend the intramuscular injection of **ketamine** as a premedication minutes prior to intravenous injection of sodium pentobarbitone, but ketamine should never be used as a sole agent for euthanasia².

4 Conclusions

4.1. Animal Welfare Considerations

We exclude the following methods (alone or in combination with other methods) as being inappropriate and inhumane:

- Exsanguination
- Freezing
- Heating
- Suffocation
- Drowning
- Inhalation

4.2. Recommendations

Key issue in the appreciation of humane methods of Euthanasia for reptiles is that the brain has to be destroyed by either chemical or mechanical methods.

Based on the current knowledge, we consider the following methods as acceptable at this time:

Method	Acceptability
Captive-bolt pistol	Alone or with a subsequent method to ensure death (pithing) if the brain is not immediately destroyed.
Blow to the head with a hard implement	In combination with a subsequent method to ensure death (pithing) if the animal is only stunned.
Decapitation	With a subsequent method to ensure death (pithing or blunt trauma).
Shooting	With appropriate bullet for size of the animal and in line with relevant legislation, training and safety protocols (effective, quick and humane). Particularly in conjunction with spinal severance and pithing. Minimizing the distance between the animal and the shooter will reduce margin for error for "missing" the brain.
Pithing	After prior stunning (captive-bolt or blow) or decapitation and as method to ensure death.
Cervical Dislocation, if performed in the correct size animal (<200g)	With proper technique and followed by another procedure to ensure death.
Injection	Depending on the context and the experience/training of the person (e.g. veterinarian, researchers).

Remarks:

The selection of killing methods for reptiles depends on the expertise, proper administration, trained personnel and setting for humane euthanasia. A heavy **blow** to the head and the use of the **captive bolt pistol** are simple and fast to perform. **Cervical dislocation** requires a proper technique and can not be easily carried out, even in small reptiles. **Injection** could only be considered practicable in facilities where the necessary equipment, man-power and capacities are available (laboratories, zoos etc.).

5 Expert Panel

Composition of the expert Panel on humane euthanasia of reptiles:

- **Ashley Don** (Alligator and Crocodilian Trade Consultant; International Alligator/Crocodile Trade Study (IACTS), IUCN Crocodile Specialist Group (CSG), Industry Committee, Louisiana Dept. of Wildlife & Fisheries and Alligator Advisory Council).
- **Auliya Mark** (PhD, Dept. Naturschutzforschung - Dept. of Conservation Biology).
- **Briner Alexandra** (Dr.med.vet., Scientific Officer for Food Hygiene, Veterinary Office, Switzerland).
- **Cooper Margaret** (MARGARET E COOPER, LLB, FLS, Solicitor (not in private practice), Visiting Lecturer, Faculty of Veterinary Medicine, University of Nairobi, Kenya. Honorary Research Fellow, DICE, The University of Kent, UK).
- **Cooper John** (JOHN E COOPER, DTVM, FRCPath, FSB, CBiol, FRCVS Diplomate, European College of Veterinary Pathologists. European Veterinary Specialist, Zoological Medicine. Visiting Professor, Faculty of Veterinary Medicine, University of Nairobi, Kenya).
- **Dublin Holly** (PhD., Director and Special Adviser, sustainability at PPR to 31/12/2012. IUCN ESARO, Senior Adviser and Chair, IUCN/SSC African Elephant Specialist Group, P.O. Box 68200, Nairobi, KENYA, 00200, currently).
- **Loup Fabien** (Substitute Chief Animal Welfare, Veterinary Office, Switzerland).
- **Manolis Charlie** (Chief Scientist, Wildlife Management International).
- **Martelli Paolo** (Chief Veterinarian, Ocean Park Hong Kong).
- **Micucci Patricio Alejandro** (Biologist at the University of Buenos Aires. Member of the Crocodile Specialist Group of the World Conservation Union (IUCN), Technical Director-Yellow Anaconda Conservation and Management Plan, Formosa-Argentina).
- **Morgan Guy** (BSR, Manager, Advisory Services).
- **Nevarez Javier** (DVM, PhD, Dipl ACZM, Dip ECZM (Herpetology), Assistant Professor of Zoological Medicine, Wildlife Hospital of Louisiana Director, LSU School of Veterinary Medicine
Veterinary Clinical Science, Skip Bertman Dr., Baton Rouge, LA 70803).
- **Karesh William** (D.V.M, Executive Vice President for Health and Policy, President, OIE Working Group on Wildlife Diseases, Co-chair, IUCN Species Survival Commission - Wildlife Health Specialist Group, Technical Director - Emerging Pandemic Threats - PREDICT program).
- **Kelly Andrew** (Head of Wildlife Department, Royal Society for the Prevention of Cruelty to Animals (RSPCA) to 31/12/2012, BSc(Hons) Zoology, PhD Ecology and Evolution, Visiting Researcher, Centre for Ecology and Conservation, University of Exeter, Cornwall Campus).
- **Waller Tomas** (Chair IUCN/SSC boa & Python Specialist Group).
- **Wenger Sandra** (Dr.med.vet; MSc. Dipl. ECVAA).

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