Best Practise Guidelines
Venomous Reptile Management
In Zoos & Aquariums

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This document is presented only as a guideline to managing venomous reptiles in zoos and other institutions. The content and practises are based on the experience and opinion of the author. These guidelines offer a minimal contact approach to working with venomous species. All tables and figures in this document belong to the author unless stated otherwise.

Contents

Venomous reptile collection planning

In 1999 ZSL London Zoo housed 227 front-fanged venomous snakes, comprising of 89 *elapids* and 138 *viperids.* By 2014 this volume of animals maintained had been dramatically reduced to 22 front fanged venomous snakes comprising of 3 *elapid* species and 7 *viperid* species.

Like many other zoological collections across Europe, ZSL maintained a large number of venomous animals. Unfortunately, in recent years institutions have either reduced or completely removed venomous species from their collections. This is due to a variety of reasons:

- There is often a perception that working with venomous animals has a greater risk than working with other taxa
- Keepers not adopting safer or hands off approaches in maintaining venomous species
- Not having appropriately trained staff to maintain the animals
- Inadequate and unsuitable facilities to house and work with the animals safely
- The feasibility and/or availability of antivenom and medical cover

These considerations do need to be taken account and will be discussed later in this chapter. Also, in the forthcoming chapters of this document some possible solutions to the above obstacles will be provided, and in turn hope to increase the number of institutions keeping venomous reptiles.

Apart from public fascination and the interest of keeping staff, there are other important factors in maintaining and displaying venomous species in zoological collections. These are outlined in regional collection plans (RCP's). By following RCP recommendations the rationalisation of holding certain species can be conveyed. RCP's can provide institutions with support and co-operation with species breeding and conservation programmes. It also serves to provide guidance for carrying out relevant research, educational interpretation, and to some extent display species, as well as sources of further information and guidance.

An RCP is not intended to produce uniformity of collections across a region but to encourage common themes, sustainable animal populations, collaboration and the focus of our resources where they are most needed.

In addition to RCP recommendations, for conservation, research and education (Schmidt, 2010), when selecting venomous species there are other, more practical aspects that must also be taken in to account:

- Suitable facilities

  -Does your institution's facilities suitable to enable you to safely and effectively manage the chosen species, during routine and non-routine procedures?

- Staff competency

  - Are a sufficient number of staff trained and competent working / handling chosen species, beyond routine maintenance?

  - Is there a suitable and efficient bite protocol in place? are all staff members familiar with it?

- Anti-venom cover

-Depending on where in the EU your institution is zoo licensing may dictate that anti-venom must be held at your institution or your institution must be within a certain distance from appropriate anti-venom stocks. Some institutions may have a regional agreement, for snake bite cover, where funds are allocated to a central holding facility, where the required anti-venom is stored.

-Is there a specific anti-venom available for the species you want to maintain?

-It is recommended that whichever species is maintained that there is a suitable anti-venom available, in the event of a bite.

-Do you have enough antivenom? and is it available in time frame you require it?

-Does your institution have to pay for your anti-venom? and if so, is this financially feasible? Some anti-venoms are more expensive than others:

- Crofab for North American *crotalids* costs approximately €2600 for two vials, and up to 60 vials may be required for a single bite. European viper costs approximately €280 for two vials.

Anti-venom type	
Monovalent	Polyvalent
Only specific for one species.	Covers a number of species.
May be the only available treatment for that species and cost may reflect this.	Cheaper option if maintaining a number of species, but this may limit the institutions geographic diversity of species maintained.
More effective in neutralising venom	Higher risk of allergic reactions due to complexity of composition

Table 1: showing two main types of anti-venoms produced, and the advantages and disadvantages of both. One may suit needs better than the other.

At the time of writing this guideline few institutions maintain and / or breed venomous species. As a result, specimens may have been sourced from the private sector, where there is a large diversity of species available, and in large numbers. Best practise guidance would suggest that collections should adopt more stringent quarantine practises if acquiring animals from the private sector. Private health screening procedures may not be as rigorous as in zoological collections, and there is potential for novel pathogens being introduced to a collection.

Facilities and housing for venomous reptiles

Facility design and housing for venomous species may again be determined by legislation, depending on country. There are a number of key points to consider when designing facilities for venomous reptiles. Facilities need to be suitable for the species specific husbandry requirements, but also ensure that they promote and facilitate safe working practises.

Figure 1: showing a window looking in to a venomous room at ZSL London Zoo, UK.

It is important to consider the access of the location where a venomous facility / room or housing is located. Easy access points will help facilitate and simplify emergency procedures. Ensure that the bite victim can be accessed and easily moved in the event of an envenoming.

Figure 2: showing clear organisation and access to handling equipment. ZSL London Zoo, UK.

It is practical to have an adequate amount of workable space when servicing the species you are maintaining. Avoid narrow service areas, as there may not be enough space to retreat in an emergency. Also, ensure that areas are free of hazards and obstructions as this would be a hindrance during routine maintenance and incidents.

Prior to entering a facility an added advantage is having good visibility of the area, to identify and alert you to any immediate risks (see figure 1). To aid visibility, ensure ambient room / facility lighting is sufficient for keepers to see what they are doing. Also, consider emergency lighting for when power cuts occur, no- one wants to be dealing with venomous reptiles in the dark!

Avoid clutter and the presence of unnecessary equipment in venomous areas. Know the layout of these areas and where handling equipment is placed. This will enable you to quickly get to the equipment without obstruction. Organising equipment tidily will help you to do this (see figure 2).

Venomous areas should be secure and not accessible to unauthorised staff or public. It would be advisable that rooms or areas holding venomous species, are also escape proof as much as they practically can be.

Take precautionary measures to ensure that if an animal does escape that it cannot get in to an inaccessible space. Aspects to consider would be ventilation grids, under doors, electrical wiring, plumbing, behind enclosures and roof spaces.

As with housing non-venomous reptiles there are a number of possibilities that can be used, depending on requirements. This next section will look as ideal requirements for housing and focus on advantages and disadvantages of some commonly used housing for 'off – show' areas.

Figure 3: showing a glass locking mechanism incorporated in to the design of the vivarium.

When housing a venomous species, whether it is 'on' or 'off-show', there are a few basic considerations that need to be included. It is recommended that enclosures / individual units are lockable and secured (Trutnau, 2004). Most institutions have locking mechanisms on public display enclosures. For vivaria, a glass lock can be used. Alternatively, some types of vivaria have fitted locks built in to their design (see figure 3). This will also increase the level of security if within a locked room.

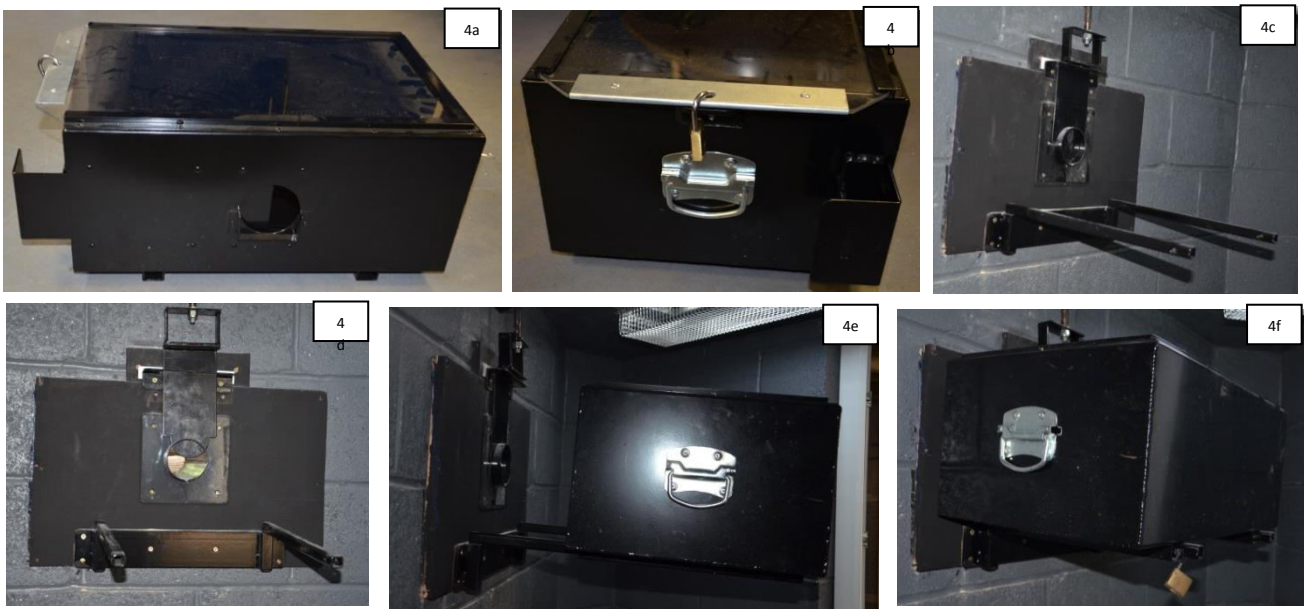
Different locks and locking mechanisms can be used to differentiate between an enclosure housing a non-venomous species and a venomous species. This is also useful as only authorised staff members can have access to keys to open enclosures housing venomous animals.

It is advised that any viewing glass panels on enclosures and vivaria etc, are either toughened or shatterproof. This is to firstly increase the strength of the barrier between people and animals. Secondly, if the glass panes do become compromised and break then the specification of these types of glass are likely to cause much less damage to people and animals, than standard float glass.

An added advantage for any enclosure housing venomous species, is the installation of heating and lighting units externally to the enclosure. This would enable keepers to replace lamps / tubes, ballasts etc without engaging with the animal in any way.

Staff need to be aware of the dangers of ventilation on enclosures, as it is a potentially compromised area. If a snake with large enough fangs strikes at a ventilation panel then the fangs can come through, causing an envenoming. Precautions also need to be taken with ventilation panels when housing 'spitting' species of snakes, as they can spit through the panels.

Housing should enable a keeper to work with species safely during routine and non-routine maintenance. This could be achieved with the use of trapping boxes / systems. Trapping systems are one of the most beneficial tools that could be utilised in the 'hands-off' approach to maintaining venomous species. The concept of a trap box is simple; the animal is isolated from the keeper allowing the safe maintenance of the enclosure (see figure 4a- 4f).



Figures 4 a-f: Showing an example of trapping system used for an on show enclosure, at ZSL London Zoo. The box is attached to the wall and locked in to place and the lockable slide, leading in to the enclosure and on the box, is opened allowing access in to the box from the enclosure. Once animal is in the box, the slides can be closed and locked containing the animal. The box can also be used in the enclosure too, but this is more suitable for 'off-show' enclosures due to aesthetics.

Trap systems can be utilised external to an enclosure or be placed within an enclosure; regardless the principle is always the same. The trapping system fitting can be installed on multiple enclosures so that animals can be contained from one enclosure and moved to another without any exposure or hands on interaction with the animal.

Figure 5: showing a much simpler design for a trap box, that can be used inside an enclosure.

Figure 6: showing a modification of the trap box, to aid bagging snakes for transport. A cotton bag / pillow case is secured to the tube attachment so when the slide is open the animal enters the hole and directly in to the bag. Then by using remote handling tools the bag is removed from the tube and tied, containing and securing the animal in the bag ready for transport.

In addition to the standard design of the trap box, modifications can be made to make this tool more versatile and be used in a number of other routine tasks: a bagging system to aid in transportation preparation (see figure 6), anaesthesia attachments for veterinary procedures, incorporated 'crush' system, etc. Also, if the trap box is made from acrylic, then closer visual inspections of the animal are possible.

The concept of a trapping system can be taken further when considering enclosure for venomous species. The entire enclosure can be divided to isolate the animal. Figure 7a-7c is an example of this in an off show facility.

Trapping systems are an excellent 'hands-off' approach to maintaining venomous reptiles, providing the animal/s will go into the box or isolation area. There are a few approaches that can be taken to encourage this:

- placing a prey item in to the box or isolation area can encourage the animal to enter into it.
- Odour enrichment can be used to entice the animal in.
- Making the environment in the box favourable to the animal, by manipulating the temperature, humidity and light levels of the trap box and / or the external enclosure.
- Remote handling tools can be used to guide the animal in to the area.

Not all species will use trap-boxes and it may be difficult to get some species to enter them. Therefore, animals may have to be coaxed or removed using appropriate remote handling tools and handling techniques (see next chapter).

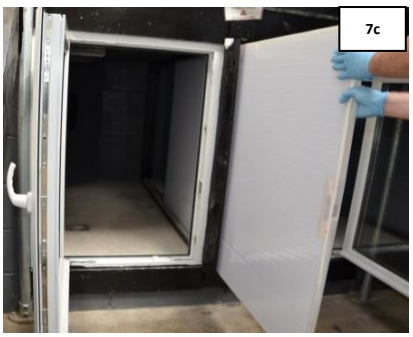


Figure 7a-7c: Showing a very simple way of managing a venomous species off show, by dividing the entire enclosure. The board slides in to place, shutting off and isolating the animal in another part of the enclosure.

Figure 8: showing a dividable wall in an enclosure at Rotterdam Zoo.

With modern themeing techniques trapping systems, in the form of a dividable partition can also be incorporated in to display enclosures (see figure 8).

There is a large variety of vivaria that can be commercially bought. Please be aware of potential safety issues with the mould formed fibre-glass units. Inside these enclosures there is often a lip, positioned all around the front. Smaller animals can sit out of view, either under or above this lip (see figure 9).

This can cause issues when trying to locate the animal or remove the animal from the enclosure. The advantage of these units is that the heating and lighting are located externally and can be changed or altered without removing the enclosure occupant (see figure 10).

Figure 9: showing the lip on the inside of the enclosures.

Figure 10: showing the back of a mould formed fibre glass vivarium where heating and lighting can be installed externally.

Vivaria in off show housing areas are stacked upon each other, usually for aesthetic reasons and to save space. It is advisable not to house venomous animals in high or inaccessible enclosures, as servicing can be challenging and dangerous. If there are limited housing options and a venomous animal does need to be housed in an enclosure at height, then be selective on which species is housed in that enclosure i.e. a large fast *elapid* would be very difficult to manage, where as a small arboreal *viperid* would be considerably easier.

Clear appropriate signage and labelling on rooms and enclosures is essential to highlight the potential risks and hazards to all staff and visitors. Below are examples of where suitable signage would be advantageous:

- Signage on entry doors to rooms, identifying that there is venomous species contained within
- Signage on enclosures, identifying species held within and making the signage different to signs used for non-venomous species. Important additional details can be incorporated in to the enclosure labels (see figure 11 as an example of an enclosure label)
- It is really important to indicate whether there is more than one species or specimens housed in an enclosure. This can be done by either stating the number of animals on one enclosure label or have one label per animal

Figure 12: showing an example of enclosure signage used on a rear access venomous snake enclosure at ZSL London Zoo.

ZSL LIVING CONSERVATION

Herpetology Identification Card

ARKS: E0001	**Sex:** M	**Arrival:**
Species: *Bitis arietans*		
Common name: Puff adder		
Anti-venom number: 2		
Pressure bandage required: NO		
Identification: More yellow base colour, darker chevrons. Transponder - 941000014051164		

Figure 11: showing an example of a species enclosure label. In addition to the animal details, if appropriate anti-venom is available for a species, the anti-venom number can be stated on the card, which would correspond to the same numbered box located in a designated refrigeration unit holding anti-venoms. The label can also state whether a pressure bandage is required in the event of a bite.

- Signage on entry doors to facilities and/or on the enclosure, can indicate what type of protective equipment is required to deal with the animals in the room e.g. do goggles need to be worn when handling?
- For reference purposes and a reminder to all staff, having several copies of the bite protocol, handling protocol and safety procedures in a visible location would be advantageous

Two final features to consider for a facility: emergency lighting / power supply in the event of a power failure. If procedures with venomous animals were being carried out and a power cut occurs this could potentially be a serious situation. When working in a room with venomous animals a light, external to the room, can be put on indicating to everyone outside that there is work with venomous animals taking place. This would be useful as colleagues will be mindful not to distract a handler mid routine and will enter a room more cautiously.

Handling and restraint of venomous reptiles

The aim of this section is to provide an account of the array of equipment used to work with venomous reptiles. This chapter will also describe commonly used practises and techniques to handle venomous reptiles. There are number of remote handling tools that are used to manipulate and aid handling of venomous animals. A number of different of handling tools and handling techniques may be used in conjunction with one another, in order to get the desired result.

Figure 13: showing the array of snake hooks that are available.

Snake hooks always feature amongst a snake keeper's collection of tools regardless of whether they are working with venomous species or not. Hooks come in a multitude of shapes, sizes, weights and designs (see figure 13). As a handler it is important that you find a specific hook build that you are comfortable with. Hooks are used as an extension of your arms to lift, move and guide animals from point to point (see figure 14). They can also be used to move décor, open and close doors on enclosures or trapping boxes etc. They provide the flexibility needed to work at a distance from the animal.

Figure 14: showing the use of a snake hook to lift and move a snake from a safe distance.

To use hooks effectively a few considerations should be made in selecting the right hook for the job. It is important to know the strike range and capability of the species you're dealing with and selecting a hook of an appropriate length; as a rough guide, if the snake is 30cm then use a snake hook at least 30cm long to keep yourself at a safe distance from the animal. This works as a general rule, however, with large snakes it does not make sense to use hooks longer than 150cm.

Figure 15: showing the double hooking technique to distribute weight of a heavy bodied snake.

Take in to consideration the size and shape of the animal you are using the snake hook on. Damage, including bruising, broken ribs etc. could be easily caused to heavy bodied snakes if traditional snake hooks are used to lift them on. Using two hooks will distribute the weight of the animals and provide more support when lifted (see figure 15).

Also, consider the size of the hook part of the snake hook, and ensure that the animal will actually fit comfortably on the hook. A too small a hook could again cause damage to an animal.

Modifying hooks to have an enlarged hook plate (ie larger surface area) will distribute the weight of a heavy bodied animal, more so than the double hooking technique using traditional hooks (see figure 16).

Figure 16: showing a modified hook plate with a larger surface area to distribute weight of a heavy bodied snake when handled.

Figure 17: showing the use of grab sticks for seizing animals.

Telescopic style hooks are popular in the trade and are readily available from retailers. Before using this type of hook, ensure that the telescopic mechanism is secured and locked in place. This is to avoid the hook collapsing during handling. It is advisable to avoid telescopic hook models that do not lock in to position.

Grab sticks / snake tongs are generally used to seize and restrain fast moving or defensive animals (see figure 17). Caution should be exercised when using this piece of equipment, as application of as excessive pressure may have irreparable effects on an animal, resulting in broken ribs, damaged vertebrae, damaged skin and soft internal tissue (Rollin, 1995).

There are a few adaptations to the basic design of the grab stick to reduce the amount of pressure that could be applied to an animal during handling. The grab ends are typically narrow and made from metal. Advances on this design are made from plastic and have wider grab ends in order to distribute the pressure applied on an animal.

Figure 18: showing different types of grab stick that are available to use.

Figure 18 shows the array of grab sticks that are available on today's market. Grab sticks are also often used to remove items out from enclosures (e.g. faeces, sloughed skins, water dishes, décor etc), as well as for feeding and any other procedure requiring the keeper to grip / grasp / seize items from a safe working distance.

A Jigger is a 'u' shaped piece of metal with a handle attached to the cup of the 'u' and a form of rubber or elastic connecting the open ends (see figure 19). These have traditionally been used to immobilise the head of snakes allowing the handler to grasp the animal from behind the back of the head. However, as there are safer methods to physically restrain snakes, approach this form of restraint with caution. Jiggers can be used in a similar way to grab sticks, to momentarily restrain an animal from moving. The same precautions as the grab stick should also be exercised due to the potential of a handler applying excessive force to the snake.

Baggers or bagging systems are extremely useful when containing an animal for transportation. The bag is held open, at a distance, by the frame and handle making it easier for the animal to be manipulated in to the bag. Figure 31a – 31g demonstrates the use of a bagger.

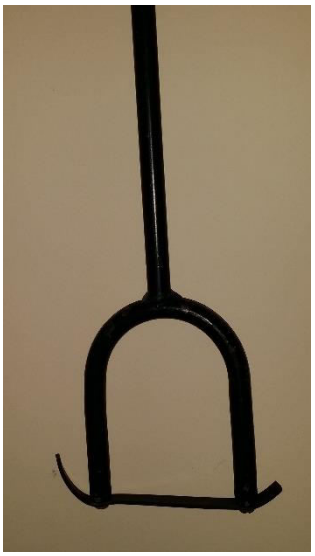


Figure 19: showing a design of a jigger.

Figure 20: showing the handling of a *Heloderma suspectum* using a tested brand of gloves.

The use of gloves in handling venomous reptiles has always caused controversy amongst venomous reptile keepers, as the penetrable properties of the material cannot be guaranteed and also provides a false sense of security. Also, when using protective gloves the handler often looses dexterity and the amount of pressure applied to the animal is more difficult to judge. It is strongly advised not to free handle venomous snakes with or without gloves. Tested brands of gloves (see appendix 1) can be used alongside handling tools and handling techniques when carrying out activities, to provide an added level of protection. Gloves can also be used to remove substrate / faeces from an enclosure, once an animal has been isolated. These types of gloves are often used to handle and work around *Heloderma spp*. The author's experience of this is that *Heloderma* are much calmer if they are not restrained and can be carefully handled using suitable gloves however, still exercise caution when performing this (see figure 20).

Tailing

Tailing venomous snakes is a commonly used 'hands-on' technique and should only be attempted by experienced handlers, if at all. It is questionable if the technique of tailing ever needs to be used, as other much safer practises can be applied. However, this tactile approach does have its advantages if carried out correctly and safely, as animals will eventually tolerate being handled in this way, making them much more amenable to deal with.

If performed incorrectly, this handling technique can be dangerous for both handler and snake (Smith, 2005). When tailing avoid 'dangling' the snake from its tail, especially heavy bodied specimens, as this can cause unnecessary damage to the spine and ribs of an animal (Smith, 2005). The size of the animal must also be considered when tailing.

There is no guideline on what size of animal can and can't be tailed however, it is not recommended for small specimens, as the distance between the grasping point on the tail and the head of the animal is too short, placing the handler within the striking range. This method is more often used on medium to large sizes elapids and large *viperids* (Smith, 2005). Be extremely careful when tailing arboreal species as their prehensile tail will give them added leverage to come back over their body.

Figure 21: showing the author tailing a sub-adult female *Oxyuranus microlepidotus.*

If tailing is going to be attempted, then the animal's behaviour at the time must be taken in to consideration. Ensure that the animal is not behaving defensively or erratically, as the animal's demeanour is likely to worsen if tailed, and will put the handler at greater risk.

Grasping the tail in the first instance is often the most challenging aspect of tailing. Timing and hand placement are imperative, as the keeper must choose the exact moment to administer a firm, yet gentle grip, appropriately placed for the length and mass of the specific specimen (Smith, 2005). Hand placement is vital, as a number of species often use their prehensile type tails to wrap around and grasp objects including a keeper's leg, hand (be aware of tails entangling wrist watches and jewellery etc), arm or handling equipment. This grasp would give an animal unwanted leverage to perform very elaborate and acrobatic acts, whilst trying to escape restraint (Smith, 2005). The animal will be calmer and feel more secure if a large portion of its ventral surface is in contact with the floor. Snake hooks or grab sticks are often used when using this technique, to support the upper part of the snake whilst the handler holds the tail, but they are also used to keep the head of the animal at a safe distance from the handler.

Physical restraint

Please consider your options before restraining a venomous snake! Identify why a venomous snake needs to be restrained and explore the safest possible way that this can be achieved. There are a number of scenarios, in a zoological institution, where a venomous snake would need to be physically restrained:

- Sex determination of a specimen
- Obtaining samples, blood etc.
- Examination of a medical issue
- Treatment of a medical issue
- Assist feeding of a specimen
- Removal of retained slough skin

Figure 22: showing a *Bitis rhinoceros* being restrained behind the head, using two finger pinned method.

Historically, when restraining any snake, handlers would favour 'pinning and necking' a snake in order to carry out the above procedures (see figure 22). Restraining a venomous snake behind the head is a dangerous procedure, and there are a multitude of factors that need to be considered before performing it. With a decline of venomous species being kept in zoos, and an increase of more stringent health and safety regulations, the author would strongly advise against this kind of restraint and adopt less risky techniques.

A much safer restraint technique is the use of restraint tubes. All of the above procedures can be performed with the use of these tubes. The tubes are transparent and can be made from plastic or acrylic, depending on supplier. Snake tubes are available in various lengths and diameters and will suit the needs of most, if not all, species (see figure 23).

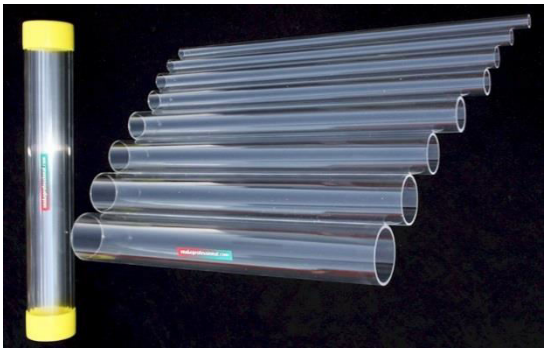


Figure 23: showing a set of acrylic snake restraint tubes (Snake professional, 2013).

The principle of tubing is simple. The animal's head is gently guided into the tube and when the head is far enough inside the tube, that the animal cannot quickly or easily back up, the snake's body is grasped gently but firmly at the junction of the tube. The handler should immediately reach down to restrain the rest of the snake's body with their other hand (see figure 24).

Remote handling tools can be used to guide the snake's head in to the tube, but also can be used to hold the tube (Murphy, 1971).

For faster moving species, a cap on the end of the tube would be highly recommended to stop the animal from moving rapidly through the tube and out the other side. (Snake getters, no date).

The process of getting the snake in to the tube can be difficult and may take time. It is often advantageous to work with a handler who has experience with this technique, to show you how best to do this. With practise and patience this technique is invaluable.

The diameter of the tube must be carefully selected for the species being tubed. If the tube is too small, then there is a risk of the animal getting stuck. If the tube is too big, then the snake could potentially turn around in the tube and head towards the handlers grip. If you find yourself in a situation where you feel the snake is able to turn around in the tube you are holding then a smaller tube can be inserted in to the top of the larger one to restrict the snake's movements further (see figure 25).

When ready to release the snake, if the right tube size is selected, the tube can be directed away from the handler, in to an enclosure or holding container, and the snake can be allowed to pass all the way through the tube, keeping the handler at a safe distance (see figure 26). If the snake cannot or will not pass through the tube then, the handler can safely let go of the tube on to the floor and retreat. A grab stick or tongs can then be used to slide the tube away from the snake.

Figure 24: showing author safely restraining a large *Naja melanoleuca.*

Figure 25: showing how to restrict snakes movement if a too large of a tube is selected.

Figure 26: showing a safe method of releasing the restrained snake from the tube.

Many ‘old school’ keepers find it difficult to adapt to modern handling practises and often don’t see the benefit of these often, safer techniques. The use of tubes can be time consuming, and more experienced handlers do find that physically restraining an animal from the back of the head is a quicker way to complete certain procedures. Some handlers would often argue that specific tasks can only be performed by ‘pinning and necking’ an animal. It is the view of the author that, with practise, most, if not all procedures requiring restraint can be done with the use of tubes, admittedly some procedures being trickier than others.

By modifying restraint tubes, the possibilities of carrying out different tasks increases. Perforating the tube will allow you to access specific areas of the snake, to carry out blood draws or inject medication etc. (see figures 28a – 28c) (Ball, 1974). A larger aperture can also be created in the tube to allow eye caps to be manually removed, if retained (Murphy, 1971).

Tubing is a much more considerate way of restraining snakes and the majority of animals seem to tolerate it much more than pinning. In the author’s experience when probing a snake to determine the sex, more accurate results are obtained if an animal is tubed rather than other forms or restraint. This is due to the animal being calmer under confinement of the tube.

Figure 27: showing how a juvenile *Acanthophis praelongus* can be assist fed within a restraint tube.

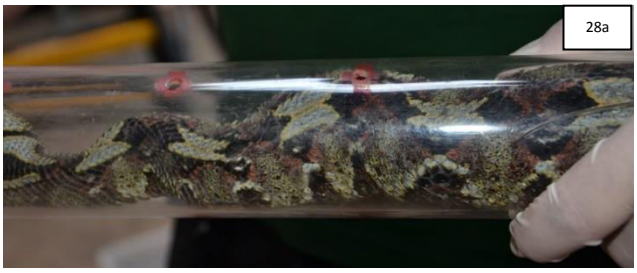


Figure 28a-28c: showing how a modified tube can be used to inject medication, safely, to a *Bitis nasicornis*. Note how the perforations are marked in red, this is to highlight, to handlers, that the tube at that point is compromised.

In order to maintain high standards of husbandry, it is recommended to disinfect handling and cleaning tools between use to minimise cross contamination between species or individuals. Whichever disinfectant is used, ensure that manufacturers guidelines are followed regarding the recommended concentration rates and contact time.

Venomous reptile management procedures

This chapter will focus further on some important recommendations for practical management procedures of venomous reptiles in an institution, which have not already been covered in the housing and facilities section. These recommendations are made to ensure the safety of staff working with venomous species, but also in some cases these may be legislative requirements that need to be adhered to.

ZSL
LIVING CONSERVATION

Category 1 dangerous species
Husbandry & handling proficiency

Staff member **2014**

To be reviewed annually

Trained by

Task - date completed on

Species	Routine servicing	Remote handling	Tubing	Physical restraint	First aid / bite protocol	Transport procedure
Boiga dendrophila						
Hydronastes gigas						
Vipera spp.						
Bothriechis / Parias / Trimeresurus						
Protobothrops spp.						
Crotalus spp.						
Bitis spp						
Naja spp						
Oxyuranus spp						
Dendroaspis spp.						
Ophiophagus spp						
NOTES						

Table 3: A staff proficiency record card used at ZSL, London Zoo. A traffic light system is used to highlight how challenging a species is to work with. Animals highlighted green being easier / lower risk than animals being highlighted in red. This will be determined case by case and influenced by a number of factors: toxicity of species; size of individual; temperament of individual. Staff begin their training with the species highlighted in green and then once proficient and signed off, they work their way through the list.

It is imperative that keeping staff working with venomous species are given appropriate training and are assessed prior to working with potentially dangerous species. This training and assessment could be provided by a more experienced member of staff or an external mentor / instructor. In Europe there are formal venomous reptile management courses that staff can attend to expand their practical skills and knowledge. Proficiency records for each member of staff should be kept and reviewed on an annual basis to ensure that staff are continually being monitored. (see table 3 as an example). This is a rational way to identify which staff are authorised to work with which species and to indicate their level of competency.

It is recommended that any work with venomous animals is carried out during the zoo operational hours, to ensure that staff relied up on in emergency situations are present and available to assist when required.

Staff members feeling unwell, tired, nervous, hung-over or otherwise compromised should avoid working with venomous species. This could be hazardous as a person showing these characteristics may have slower reaction times and may not be concentrating on the task at hand.

Most staff at zoological institutions have some form of direct communication contact. This is often via radio but mobile phones may also be used. It is wise that all staff do have some kind of direct communication link when working with venomous species as this could be vital in raising an alarm in an emergency situation.

Many institutions have a minimum of two trained staff present when working with venomous species. This is obviously a safe measure to take, but some institutions may not have the resources to dedicate two members of staff to work together, especially if there are a large number of animals to be dealing with. In instances like this, categorising the species you are working with would be beneficial i.e. higher risk species require two staff, lower risk species can be serviced by one person. Another way of approaching this is allowing one member of staff to carry out routine servicing, but two staff must be present when actual handling of the animals or other non-routine procedures occur. Whichever protocol is adopted, it would be recommended that two people are always present when servicing any species requiring a pressure bandage on an envenoming, as this needs to be applied immediately to the bite victim (see chapter on envenoming first aid).

If two people are required for a procedure with a venomous species then there are a few points that need to be taken in to account. The role of a ‘back-up’ or ‘support handler’ needs to be clearly identified. Another person in the room / area when dealing with a venomous reptile can be useful, but also very distracting. The main handler, prior to carrying out a task, should give clear instructions to the ‘back –up’ on what they are required to do.

This may be opening and closing enclosure doors, taking lids on and off holding containers, handing over requested equipment. There should be one person handling and making decisions, the 'back-up' handler should take their directions from the main handler and not take part in the process unless requested to do so. An experienced team will get to know how the other prefers to work and what is expected from each other (Engelmann, 2006, Smith, 2005).

If you intend to work in an enclosure without isolating the animal first, be sure to know the capabilities of that species and what the strike range of the animal is. Avoid reaching in to an enclosure with your hand to remove décor, water bowls, faeces or slough, etc. Remote utility equipment or grab sticks can be used for this purpose, keeping your distance from the animal at all times. Use remote handling tools to open and close enclosure doors, again keeping a safe distance from the animal.

When working with a species that spits venom, ensure that appropriate personal protective equipment is worn at all times (i.e. eye protection / goggles etc). Any cuts, abrasions, open wounds or broken skin should be sufficiently covered up, to avoid a secondary envenomation. Consider placing eye wash stations near enclosures that house species that spit, for a quicker response to rinsing the venom from the targeted area.

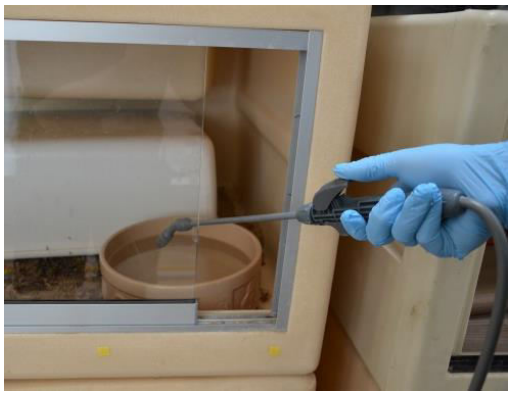


Figure 29: showing that strategic placement of water sources can make routine maintenance safer.

Consideration of water source placement can make routine water changes / fill ups a lot easier. Placing water sources nearer to the enclosure access will allow keepers to fill up water sources without getting too close to the enclosure occupant (see figure 29).

Figure 30: showing a single fang, from a *Bitis arietans,* that has been passed in faecal material.

An over sight that is often made is that snake fangs can be found in faecal material and can also be found in/on enclosure substrate (see figure 30). Staff should be aware of this and take precautions accordingly. As the fangs are hollow they potentially harbour a small amount of venom. It would be advisable to wrap up and contain faecal material to ensure it does not pose any risk once disposed of.

When a venomous animal is moved, either temporarily in to a holding container during routine maintenance, permanently in to a new enclosure, or for transport, it is vital that the relevant signage (especially species label) goes with it. This is to indicate to all who pass it the fact that there is a dangerous species contained within.

There are a number of methods to transport venomous animals and it is often determined by personal preference and/ or the species in question. When transporting a venomous species prepare yourself for a worst case scenario. There are a series of recommendations that should be considered:

- Animal/s are to be securely bagged, boxed or both (see figures 31a – 31g)
- Transportation bags and boxes / containers etc to be appropriately labelled
- Take a secondary holding container with you during transportation, as it may be required if an emergency occurs
- Consignment to be secured during transit to prevent it moving around in the vehicle
- Appropriate handling equipment to be present during transport
- A clear route to the destination is to be identified and ensure other people in the sending and receiving institutions are aware of it
- A GPS device and mobile phone is to be carried during transport in case of an emergency
- Bite protocol, pressure bandages (if required) and any other bite related information to be carried during transit
- Appropriate contact details, easily accessible by emergency services in the event of an accident

Figure 31a: Showing animal being placed in to snake bag using a bagger.

Figure 31b: Once animal is in the bag the bagger is twisted to stop the animal come back out of the bag.

Figure 31c: A grab stick is used to create a barrier between snake and handler. Snake are able to bite through bags.

Figure 31d: Before a knot is tied to seal the bag, a secondary barrier is put in place using a hook. This is in addition to the grab stick.

Figure 31e: Once knotted, a grab stick is used to keep the snake at a distance.

Figure 31f: Using the grab, the bag is lifted and placed in to the transport container.

Figure 31g: The box is locked down and labelled with appropriate species label.

Envenoming protocols and first aid

Venoms are highly complex mixtures of hundreds of different proteins and peptides, secreted by special oral glands related to the salivary glands of other vertebrate animals. It first evolved as a means of immobilising prey before ingestion; it's secondarily used for defence. In most species, it initiates the digestive process by breaking down the other animal's tissues. It is capable of producing one or more harmful changes in several organ systems or tissues, and is able to promote these changes simultaneously (Russell & Brodie 1974). There are many toxins found in snake venoms, which cause different detrimental effects (see Table 4). It is crucial to be aware of the type of venom each of the species being maintained possesses.

Toxin	Clinical effects on humans
Neuro-toxin *Presynaptic* *Postsynaptic* *Anticholinesterase*	Flaccid paralysis. *Resistant to late antivenom therapy.* *Often reversal with antivenom therapy.* *Fasciculation.*
Haemorrhagins	Damage vascular wall, causing bleeding.
Cardio-toxins	Direct cardio-toxicity.
Necro-toxins	Direct tissue injury at the bite site/bitten limb.
Nephro-toxins	Direct renal damage.
Haemostatic system toxins	Interfere with normal haemostasis, causing either bleeding or thrombosis.
Myo-toxins	Systemic skeletal muscle damage.

Table 4: Showing broad classification of toxins found in snake venoms and their clinical effects on humans (Toxinology-WCH, 2013).

It is imperative that a suitable envenoming protocol is in place. This is to ensure that if someone is bitten by a venomous species, the most appropriate action is taken in the shortest amount of time. This section of the guideline will look at information that should be considered when designing a bite protocol. The protocol will differ from institution to institution and also dependent on whether antivenom is held on or off site. If the antivenom is not held by the institution then be sure that there is an appropriate system in place to obtain the correct antivenom when required. The protocol should be practical, relevant and, most importantly, simple.

In case of envenoming, doctors will need to know specific details about the bite victim before any treatment can be given. This is to ensure that the best possible course of action is taken and to highlight any potential difficulties that may arise. It is recommended that this important information is provided on a pre-filled out form and placed in a named envelope, ready to be taken to the hospital with the bite victim. This process may also save time in an emergency situation. The information that may be required is listed below, and these should be clearly distinguishable:

- Full name and age of bite victim
- Full name and contact details of next of kin
- Own doctor's name and contact details
- List of known allergies
- Medical conditions under treatment and medication currently being taken, include strength, dosage and frequency taken
- List of previous envenomings, date of occurrence, type and amount of antivenom administered and state if any reactions occurred as a result of being given the antivenom

In the protocol procedure, making formalised notes about the bite incident and the condition of the bite victim is highly recommended. The bite incident details will provide information about the species in question, the time of the envenoming and also location of the bite site. The bite site can be circled using a non-toxic marker, in order to make it clear where it is. Monitoring the condition of the bite victim is also important as it identifies certain symptoms associated with the bite and can indicate how severe an envenomation is. All of this information is again extremely valuable to the medical team dealing with the emergency.

A list of emergency contact numbers on the bite protocol can be beneficial, but please remember not to list too many and make the ones you do list relevant. The most relevant contact to have listed would be a direct contact to the hospital where the bite victim will be taken, to alert them to the imminent arrival of an envenomation case. A contact to request an ambulance would also be useful.

If a person has been envenomed it is crucial that the numbered actions below are carried out in the fastest possible way without causing panic. This is to make sure that the appropriate steps are taken to aid a swift medical response and facilitate medical treatment, if required:

1. Ensure that the offending species is contained and is no longer a threat. **Do not place yourself or others at further risk.**

2. Reassure casualty, stay calm and **do not panic.** Panicking can potentially accelerate the effects of the venom.

3. An envenoming is a **medical emergency**: phone emergency services to arrange transport to hospital. An ambulance is recommended but do consider that it may be quicker for colleagues to take the bite victim to the hospital.

4. Remove **all** jewellery and any other constrictive items from the victim's bitten limb, including the shoe and sock if the bite is on the foot. Most bites cause swelling to different levels and constrictive items may be difficult to remove, if not removed in time, and resulting in further complications. Ring cutters, scissors etc. should be used if necessary.

5. If the species bite in question is a **neurotoxic** elapid, apply compression-pad immobilisation to bitten limb. If the species in question is **not neurotoxic** then the bitten limb is just to be immobilised. See section below, describing techniques. This needs to be done **immediately**.

6. Rest bite victim on floor in the **first-aid recovery position** (lying face-down on their left side). Putting someone in the recovery position will ensure their airway remains clear and open. It also ensures that any vomit or fluid will not cause them to choke.

7. In the case of venom to the eye: **Immediately** wash eye with cold running water for 10-15 minutes. Alternatively, use the sterile solution from eye wash stations, if available.

8. Fill in the **bite incident details form** and **monitor condition,** using a suitable and legible recording table.

9. Do not tamper with the bite site: Do not suck / slash or apply tourniquets or apply a hot/cold compress. It has been documented that these actions can cause undesirable issues to an envenoming.

10. In a container / box place: **Correct antivenom (if being held), victim's pre-filled out medical form, incident bite details of the victim and record of monitored condition. This box then goes with the bite victim to the hospital.**

11. It is important that the bite **victim does not move** and is carried out to the response vehicle by staff and a colleague goes with them. Keep bite victim in recovery position if possible.

12. Monitor vital signs and be prepared to perform full cardio-pulmonary resuscitation (CPR). This will require formal training.

It is highly recommended that timed and documented drills are regularly performed. This is to ensure that all staff working within a department are familiar with the protocol. Drills also provide a good opportunity to identify how long the process takes and to highlight any areas needing improvement.

Compression pad immobilisation

Be aware that compression pad immobilisation (CPI) is very different from a tourniquet (a tight compression band or ligature that cuts off the arterial blood supply to the limb). If applied on a victim of envenoming, tourniquets are extremely likely to cause further issues and complications. One of the problems caused by this technique is severe reduced limb tissue oxygenation, which will compromise wound healing and also potentially result in the loss of the limb (Toxinology-WCH, 2013).

This first aid measure, combining compression bandaging and immobilization, was compared with the pressure immobilization crepe bandage techniques (Anker et al, 1982) and proved to be more effective in reducing the spread of venom through the lymphatic and venous systems from the site of the bite (Mirtschin & Davis, 1982). This therapy has two components: pressure to reduce lymphatic and venous drainage and immobilization of the bitten limb to prevent the pumping action of the skeletal muscles.

A pad of rubber or cloth, approximately 6 x 6 x 3 cm is applied directly over the bite site. This is then securely tightened with an inelastic bandage at a pressure of approximately 70mmHg (Warrell, 2014). The bitten limb is then immobilised using splints. For details on how CPI should be applied, see figure 32a – 32d.

Figure 32a – 32d: Showing how compression pad immobilisation should be applied. Figure 47 shows the pad being placed directly over the bite site. Figure 48 shows the pad secured in place using inelastic bandaging, with a pressure of 70mmHg. Figure 50 shows the final stage where the leg is immobilised using a splint (Warrell, 2014). Images courtesy of Dr. David Williams, Papua New Guinea.

The bandage/pad should NOT be removed until the patient reaches hospital and a decision has been made by a medical professional, whether or not to give antivenom, based on assessment of symptoms. If antivenom is to be administered, the pressure bandage should be kept applied. Once antivenom treatment has started, it can be removed (Warrell, 2014).

The pressure pad technique is appropriate only for victims of bites by neurotoxic elapids, but immobilization of the limb should be used for bites by all species. The most crucial part of CPI method is the splinting and immobilisation of the bitten limb (Warrell, 2014).

Epi pens

An epi-pen should be used if, after a bite, the victim develops any signs of severe anaphylaxis (syncope/collapse, wheezing-like asthma, swelling of the throat, generalised itching rash with "nettle rash" etc.). These symptoms suggest that the victim has become hypersensitive to venom (Warrell, 2014). See section on hypersensitivity, below.

It would be advantageous to have specific first aid boxes containing equipment specifically for snake bite first aid. These specific first aid boxes can be distinguished by using a different colour box to those used for general first aid. Having the snake bite first aid boxes clearly labelled and listing contents of the box on the front, will also make it easier to identify its purpose (see figure 44).

Figure 33: Showing a specific first aid box for envenomings, and its contents.

It is recommended that regular documented training and refresher session are carried out, on how to correctly apply pressure pads and how to immobilise limbs. This will ensure that a sufficient number of staff are aware of this procedure and can perform it when required.

All points mentioned in this chapter need to be systemised in to a functional envenoming protocol. ZSL has presented the required information in to simple posters, which are used as the herpetology department's procedures for managing an envenoming. Please see appendix 2, 3 and 4.

Acquired hypersensitivity (allergy) to snake venom

One thing that is often overlooked when working with venomous species is the development of allergies to venom. This is a common occupational disease of habitual animal handlers who have long term exposure to venoms. Early symptoms include; sneezing, itching skin resulting in rashes, itchy and watering eyes, coughing, wheezing (asthma). These could be through contact or merely when entering a room or house containing venomous species. Severe symptoms include; debilitating asthma, rhinitis, cough and conjunctivitis. In severe cases sudden death from anaphylaxis following envenoming could occur. Skin tests might detect such specific allergies but the blood test for specific Immunoglobulin E (IgE) (Radio Allergo Sorbent Test - RAST) is available only for bee, wasp and ant sting allergies (Warrell, 2014).

The author wishes to thank Professor David Warrell (*Emeritus Professor of Tropical Medicine, John Radcliffe Hospital, Oxford)* for his recommendations and editing of this chapter.

Basic principles to avoid getting bitten

Refrain from opening any cage with your hand, always open using a tool

Refrain from servicing a cage without isolating and securing the occupant first

Refrain from pinning and restraining a venomous animal behind the head

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Recommended Resources

Antivenom Suppliers

- Munich Antivenom Index (MAVIN)

http://www.toxinfo.org/antivenoms/

- Clinical Toxinology Resources

http://www.toxinology.com/

Handling equipment

- Snake Professional Limited

P.O.Box 5699
Alfreton
Derbyshire DE55 3ZP
United Kingdom

Phone: +44 (0)1773-863349

Fax: + 44 700 6081912

Email: info@snakeprofessional.com

Website:
http://www.google.co.uk/url?sa=t&rct=j&q=&esrc=s&frm=1&source=web&cd=1&sqi=2&ved=0CCwQFjAA&url=http%3A%2F%2Fsnakeprofessional.com%2F&ei=TxReU_WhI6jX7AbXk4CADg&usg=AFQjCNH4aDEQaWvSoHW5Q87KU-Nis5Th9A&bvm=bv.65397613,d.ZWU&safe=strict

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- Midwest Tongs

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Toll-free Phone: 1 (877) 87TONGS
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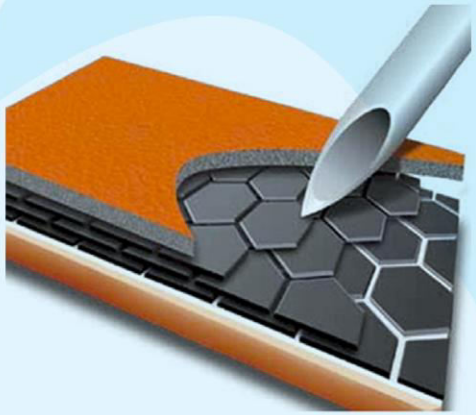

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Appendix 1

ZSL
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Venomous Reptile Envenomation Protocol

ACTION BY STAFF

1. Ensure that the offending species is contained and is no longer a threat. Do not place yourself or others at further risk.
2. Reassure casualty, stay calm and do not panic.
3. An envenomation is a medical emergency. Phone emergency telephone number 6333 (east service gate) and say: "Snake bite, emergency action".
4. Remove all jewellery and any other constrictive items from the victim. Including shoes and socks.
5. If species bite in question is a neurotoxic species, apply compression-pad immobilisation to bitten limb. If the species in question is not neurotoxic then the bitten limb is just to be immobilised. This needs to be done immediately.
6. Rest bite victim on floor until stretcher arrives.
7. In the case of venom to the eye: Immediately wash eye with eye solution or cold running water for 10-15 minutes.
8. Fill in the information on incident details of victim and monitor condition using the table.
9. Monitor vital signs and be prepared to perform full C.P.R.
10. Use epi-pen as and when required, trained staff only.
11. Do not tamper with the bite site: Do not suck / slash or apply tourniquets and hot/cold compress.
12. Take Poly box from antivenin refrigerator and place inside:
    - Correct antivenin
    - Epi-pen
    - Victims medical card
    - Compression-pad immobilisation protocol (if appropriate)
    - This card
    - Thermometer & data logger. (activate logger)

    This box is to go with the bite victim
13. It is important that victim does not move and is carried out to the response vehicle by staff (stretcher is outside Rep 97).

INCIDENT DETAILS OF BITE VICTIM

Name: .....

Date & time of bite: .....

Bite site: .....

Species involved
Common name: .....

Scientific name: .....

MONITORING CONDITION

Time																							
Swelling																							
Faint / collapse																							
Vomiting																							
Gums bleeding																							
Eyelids drooping																							
Speech deterioration																							
Discolouring of bite site																							
Discolouring																							

Appendix 2

ZSL
LIVING CONSERVATION

Venomous Reptile Emergency Contact Information

East service gate to call **A & E University College Hospital** to warn of imminent arrival.

Bite victim to be taken to

Accident and Emergency Department
University College Hospital

Beaumont Place
London,
Greater London

(Access from Tottenham Court Road)

Emergency phone numbers

- **A & E University College Hospital:**
  07768 313980

Hospital reference numbers

- **Liverpool School of Tropical Medicine (Duty doctor):**
  07909910899

For any enquiries relating to an envenomation outside of the society advise that this is an medical emergency and to seek emergency medical help via their local hospital.

For any enquiries relating to an envenomation outside of the society made by a medical professional then the number for the **Liverpool School of Tropical Medicine (Duty doctor)** can be provided.

Appendix 3

ZSL
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Compression-pad Immobilisation

Pictures show how compression pad immobilisation should be applied.

A pad is placed directly over the bite site.

The pad is then secured in place using inelastic bandaging, with a pressure of 70mmHg.

The leg is immobilised using a splint. A bite to the arm / hand can be immobilised using a sling (Warrell, 2014).

All bites from venomous species are immobilised. Compression and immobilisation is required for bites from 'neuro-toxic' species.

Images courtesy of Dr. David Williams, Papua New Guinea.

The bandage/pad should NOT be removed until the patient reaches hospital and a decision has been made whether or not to give antivenin, based on assessment of symptoms.

If antivenin is to be administered, the pressure pad should be kept applied. Once antivenin treatment has started, it can be removed.

Appendix 4