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WELFARE PRINCIPLES FOR SNAKES AND MONITOR LIZARDS IN THE SOUTHEAST ASIAN SKIN TRADE

A guide for stakeholders

Authored by Patrick W. Aust, Grahame J. W. Webb,
Dale F. DeNardo and Daniel J. D. Natusch

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Contents

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About SARCA

SARCA is a membership-based organisation established in 2018 to provide industry stakeholders with a collaborative platform for ensuring sustainable, legal, and humane trade in reptile skins within Southeast Asia, and for understanding and appreciating the context that suppliers operate within. Principal focal areas include: understanding and assessing reptile skin supply chains; contributing to population monitoring; developing collaborative actions to promote sustainable, fair, and humane practices in supply chains; and facilitating collaboration and multi-stakeholder engagement.

About SFVO

The Swiss Federal Veterinary Office (SFVO) is the Swiss Federal center of excellence in the fields of food safety, nutrition, animal health, animal welfare and species conservation in international trade.

Preserving and promoting human and animal health (One Health) together with safe and healthy food are key priorities for the SFVO.

About the authors

Patrick Aust is a freelance conservation biologist and an honorary research associate at Oxford University and the University of Witwatersrand. He is currently exploring the potential role of reptiles within the context of global food security and biodiversity conservation and has carried out research in Asia and Africa. **Daniel Natusch** is a biologist working on the conservation and sustainable use of wildlife around the world. He has a particular interest in ensuring sustainable trade in reptiles that benefits both species and habitat conservation and the livelihoods of indigenous and local communities. **Grahame Webb** is a zoologist and Adjunct Professor at Charles Darwin University, who has worked on reptile anatomy, physiology, ecology, behaviour, embryology and population dynamics since the 1960's, has 120+ papers in peer-reviewed journals, and has contributed significantly to reptile conservation, management, sustainable use, trade and captive husbandry. **Dale DeNardo** is the Attending Veterinarian and an Associate Professor at Arizona State University. His research as an environmental physiologist focuses on how animals cope with resource constraints and changing environments, subjects on which he has published over 100 peer-reviewed articles.

Photo credits

All photos taken within the last five years at various locations in East and Southeast Asia by Patrick W. Aust and Daniel Natusch.

Preface

This guide is written specifically for stakeholders engaged in the Asian reptile trade. The focus is on the main snake and lizard species currently involved in the exotic skin trade. It is primarily intended to help those who have no coherent access to the large volume of information and skill necessary for the implementation of Science-based Animal Welfare (SBAW) standards. The guide also provides a summary of how the trade currently works. In this regard, it is important to recognise that the information contained represents a baseline; a platform designed to be built on in due course to help guide progressive improvements.

In Asia, the reptile trade has a very long antiquity. It was historically mainly for meat and medicinal products for human consumption. Skins have become an increasingly important element in trade over the last century. Generations of people have been involved in various elements of the reptile trade, and traditional knowledge and values still play a vital role within it. Within Asia in particular, production systems are evolving continually, with increased sophistication and the adoption of science-based production and husbandry systems, despite traditional knowledge still playing a major role. The target audiences for this guide are producers, harvesters, transporters, processors, traders, restaurateurs, and government inspectors, many of whom have a limited understanding of the reasons why welfare is becoming an increasingly important issue.

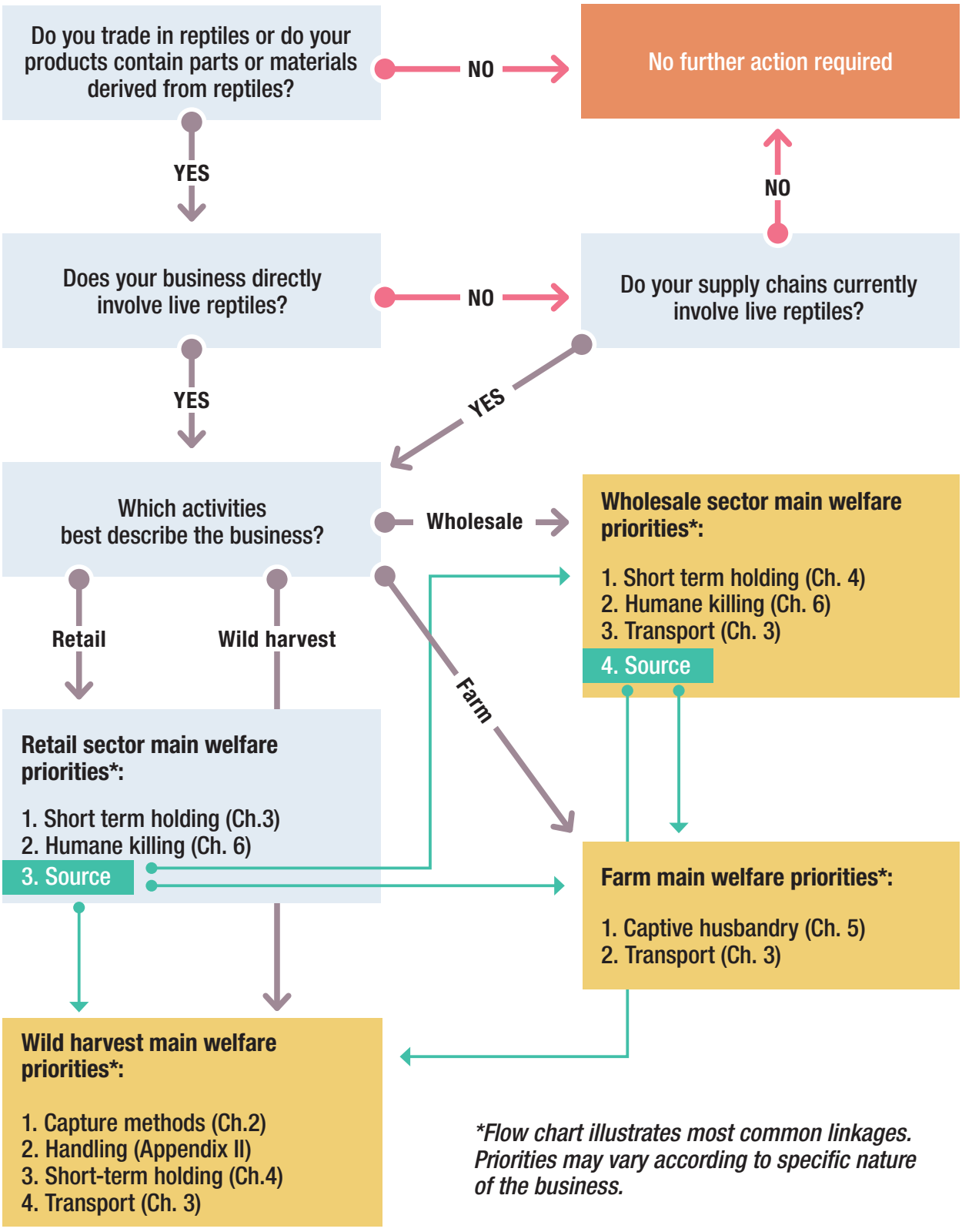
Wildlife managers, conservationists, animal welfare organisations, professional scientists, and anyone else interested in the science-based welfare of reptiles in commercial trade will hopefully find this guide informative and valuable. The focus is on the exotic skin industry, although, as a result of the multi-species and multi-product aspects of the trade, inferences drawn extend to other traded species and products. Fundamental to the guide is recognition that the trade involves large volumes of animals from diverse production systems, which are distinct from the context of individual reptiles kept as pets or maintained purely for exhibition where the resources allocated to husbandry exceed the meat and skin value of the specimens in trade.

Providing practical guidance to the existing industry will help stakeholders align their operational procedures with international SBAW standards and expectations but recognise this will be an evolving process. Since the industry comprises numerous small-scale, low value components, it is not intended to be overly prescriptive. Rather, it should be viewed as an exercise designed to introduce a broad spectrum of stakeholders to a broad range of welfare concepts that can be adapted and adopted in a manner that is implementable in the social and cultural contexts in which trade is taking place. The guidance provides a set of key principles for each of the major nodes in supply chains, ranging from wild harvests to humane slaughter. Background information is provided on the context of different elements in the trade, and supporting information enables science-based guidance on handling, welfare assessments, and remedial action.

Finally, this guidance on welfare principles for reptiles complements earlier work championed by the Swiss Federal Veterinarian Office on the humane killing of reptiles. The Swiss work led to the publication of the 'Analysis on humane killing of reptiles in the skin trade' https://recht.pogona.ch/data/_uploaded/file/3.0%20F%C3%BCtterung/5.2_BVET_Analysis%20on%20humane%20killing%20methods%20for%20reptiles%20in%20the%20skin%20trade%20frm%5B1%5D.pdf

The Swiss analysis formed the basis of new recommendations recently adopted by the World Organisation for Animal Health (OIE) https://www.oie.int/index.php?id=169&L=0&htmfile=chapitre_aw_reptiles.htm. The present work aligns with and includes the OIE recommendations.

How to use this guide:
The management of welfare in the reptile trade



**Flow chart illustrates most common linkages. Priorities may vary according to specific nature of the business.*

CHAPTER 1

A guide for stakeholders

1.1 Background

The rise of Asia's economies and middle class consumers over the last few decades has led to a dramatic increase in the local market demand for reptile products (Zhou and Jiang 2004, CITES 2010). A wide variety of species are sought for their meat, skins, pharmaceutical components, and as exotic pets.

Historically, the reptile trade relied solely on unregulated wild harvests. Trade was later augmented with stock from ad hoc ranching activities that depended on a combination of wild-caught stock and captive rearing. Closed-cycle reptile farming, which does not involve sourcing animals from the wild, and regulated science-based harvest programs, represent the latest industry developments. The dynamic 21st century transformation from wild harvest to captive production has been controversial. At one point it was considered one of the largest under-regulated components of illegal wildlife trade (Nijman 2010). Recent and ongoing developments in science-based animal welfare and sustainable sourcing have alleviated many of these fears, but not all. As trade in reptiles is evolving into a mainstream agri-industry, formal welfare standards and guidelines will be increasingly expected. Hence, this document.

1.2 Why reptile welfare is important

Ethical appropriateness

There is an increasing global expectation, especially among consumers, that human-animal interactions will be carried out humanely, which for practical purposes means minimising unnecessary pain and suffering, and thus avoiding cruelty. The intent of the reptile trade is to produce products, which involves activities such as the capture, transport, holding, farming and killing of live animals. In all contexts, efforts to provide the best conditions and welfare, and avoid unnecessary suffering, should be pursued.

Product quality

Despite widely held beliefs that animals should be treated with care and respect, difficulties with logistics, and the need for sufficient profit margins, may favour inappropriate over ideal treatments. This is especially true for species such as reptiles that show little to no emotion externally that enable the negative impacts of sub-standard conditions to be detected. But ignoring best practice comes at a real cost. Inappropriate treatment can jeopardize survivorship, the quality of the meat and skin products, and, ultimately, repeat and sustainable business.

The energy required for muscle activity in reptiles is obtained, in part, from sugars (glycogen) in the muscle. In a healthy, well-rested reptile, the glycogen content of the muscle is high. Stressed reptiles produce the hormone corticosterone, which results in the rapid depletion of glycogen (Sapolsky et al. 2000). Meat from stressed livestock has been shown to have poor taste and spoil rapidly (Heinz and Srisuvan 2001). Corticosterone also suppresses feeding activity and immune functions (Palacios et al. 2012, Silvestre 2014). Otherwise minor injuries, such as bruising and broken ribs, can result in secondary bacterial infections, abscesses, and septicaemia.

Reptile leather destined for the high-end fashion industry can only be made from undamaged skins (MacGregor 2006). Quality thresholds and rejection rates are very high, and even the smallest blemish can render a skin worthless within international markets. Proper handling of skins throughout the supply chain is important (Heinz and Srisuvan 2001).

Sustainability of the trade

If a business consistently produces poor quality animals or products, business opportunities in some markets will be seriously jeopardized. If a business relies on captive production of reptiles, poor quality can jeopardize reproductive output and the abundance and quality of stock for sale. Furthermore, it can create incentives to illegally harvest from the wild to make up for the reduced captive production. Excessive wild harvests can reduce the size and harvest productivity of the wild population, and, if extreme, can eliminate the species from trade due to conservation concerns (Hutton and Leader-Williams 2003). Research-based management tools for wild harvests work towards aligning harvest volumes with the natural productivity rates of the wild population, which is the essence of sustainable production (Thorbjarnarson 1999).

Growth in the reptile trade has been closely linked to globalisation of the industry. Markets are increasingly diverse, and outlets for Asian reptile products are now well-established worldwide. The ultimate retail consumer base is increasingly becoming an urbanised middle class one, where empathy towards animal welfare is the norm and where expectations of compliance with production standards are increasing. Big business within the food and fashion industries in particular are under increasing public pressure to integrate environmental, social, and governance factors into investment processes and decision-making. The prosperity of the Asian reptile trade is increasingly reliant on compliance with international SBAW expectations.

1.3 Key principles of animal welfare - the "Five Freedoms"

The Farm Animal Welfare Council of the United Kingdom formalized "Five Freedoms" for the welfare of animals under human control (FAWC, 2010). Because these Freedoms reflect the state of the animal rather than the conditions required to achieve an appropriate state, they Freedoms are broadly applicable across species and trades, and have been widely adopted by national veterinary associations, animal cruelty societies, and the World Organization for Animal Health. Accordingly, they apply to trade in reptiles:

- Freedom from hunger or thirst by ready access to fresh water and a diet to maintain full health and vigour.
- Freedom from discomfort by providing an appropriate environment including shelter and a comfortable resting area.
- Freedom from pain, injury, or disease by prevention or rapid diagnosis and treatment.
- Freedom to express (most) normal behaviour by providing sufficient space, proper facilities, and, as appropriate, company of the animal's own kind.
- Freedom from fear and distress by ensuring conditions and treatment which avoid mental suffering.

1.4 Physiological needs of reptiles

To enable the Five Freedoms to outline conditions that are meaningful to reptiles in trade, a general understanding of reptile physiology is essential. The way reptiles function physiologically is quite different from mammals and birds, and understanding the differences, and the basic needs of reptiles, will enable the reptile trade to function more productively and humanely.

Temperature

All animals are sensitive to temperature, and their well-being is dependent on being able to maintain an appropriate body temperature. Extreme temperatures, whether cold or hot, can kill an animal, and non-lethal temperatures can still have serious deleterious effects. Most animal functions, including growth, digestion, immunity, and locomotion, to name a few, are highly sensitive to temperature, and optimal performance usually occurs within a relatively narrow range of temperatures (2-3°C) (Haynie, 2001).

While mammals and birds can generate their own body heat, reptiles are much more dependent on their environment for heat (Pough 1983, Heatwole and Taylor 1987). This is often referred to as being "cold-blooded" in contrast to birds and mammals being "warm-blooded". While commonly used, these terms are problematic, since most reptiles actually prefer warm temperatures, with some species preferring temperatures higher than what mammals maintain. Use of "cold-blooded" can mislead people into thinking reptiles prefer to be cold. They do not. More accurately, and safer, reptiles should be referred to as "ectotherms" (in contrast to "endotherms" for birds and mammals), as this term refers to the fact that reptiles, unlike mammals and birds that generate their own heat, obtain their heat from their environment (Pough 1983). By relying on the environment for heat rather than needing to produce it on their own, reptiles require much less food than do mammals or birds. However, they are much more reliant on having an environment that allows them to heat and sometimes cool.

The functioning of all reptile muscle and organ systems are sensitive to temperature (Cowles and Bogart 1944, Angilletta 2009). To manage this sensitivity, reptiles behaviourally select different locations in their environments to heat or cool (Bogert 1949, Bartholomew 1964). For example, they bask in the sun and/or lay on warm objects to heat, and seek shade, water, or other cool environments to cool. When suitable temperatures are not available, reptiles often seek refuge until appropriate temperatures are available in their environment. Through behavioural thermoregulation, active reptiles in a variable thermal environment can be very effective at maintaining body temperatures at levels best suited to activity or physiological functions such as digestion.

Interestingly, the preferred temperature for normal functioning depends on the condition of the reptile. For example, sick reptiles will alter their behaviour to maintain a body temperature higher than what they would normally (Lang 1987, Rakus et al. 2017). Similarly, feeding and reproduction need body temperatures slightly higher than normal, achieved through behavioural adjustments (Lourdais et al. 2008; Sievert et al. 2013). Elevated body temperatures clear infections more rapidly, improve digestive efficiency, and optimise embryo development leading to more healthy offspring. Cooler temperatures can be beneficial to reptiles in some circumstances (Warwick 1991). It conserves energy and can trigger the onset of reproductive activity (Fitch 1970, Pough 1983). Because it is difficult to know the optimal temperature for a specific animal at any given point in time, it is best to house captive reptiles in enclosures that provide a variable thermal environment or thermogradient, which they can exploit as required to heat or cool to the level they prefer.

In tropical environments, where temperatures are typically warm and stable, it is not as critical to provide enclosures with complex thermogradients, but thermal challenges can still occur. Captive environments are much less thermally

complex than natural environments and can restrict thermoregulatory behaviour. Reptiles kept in small enclosures in buildings, with limited insulation or air flow, especially if walls or roofs are made of highly conductive materials such as metal, are vulnerable to ambient temperatures reaching dangerous levels. Captive reptiles may have less options to escape hot or cold temperatures, whereas in the wild they can retreat to deep burrows or highly insulated objects such as tree hollows.

Energy

As ectotherms, reptiles acquire their heat from the environment instead of producing it themselves. While this makes reptiles more dependent on proper environmental conditions, it also greatly reduces the amount of energy they need compared to mammals and birds (Pough 1983). Reptiles need to eat less, and oftentimes less often, compared to endotherms (up to 96% less, Bennett and Nagy 1977). With reptiles, optimal food intake and frequency varies among species, and depends on their activity: the more active species need to eat more (Pough 1983, Greene 1997). The size of the meal they can eat, and the ability to store energy as fat, are also important factors. For example, large snakes can eat large meals and they store considerable amounts of fat. Accordingly, they can go considerable lengths of time (weeks to months) without eating. In contrast, small reptiles eat smaller meals, store less fat, and therefore need to eat more frequently, especially if they are an active species.

Juvenile and sub-adult reptiles that are growing need more food than the same sized reptile that has a smaller adult size and has ceased growing. Growth requires optimal body temperatures for the physiological processes involved and a considerable investment of energy in the new tissue being created. Fast-growing young and sub-adult reptiles may eat considerably more than their adult counterparts (Madsen and Shine 2002). Without sufficient food intake, growth ceases and energy resources are directed towards other internal organ functions required for life (Taylor and DeNardo 2005). This interplay between temperature, energy intake, and growth has been exploited by some reptile farms to adjust to market and environmental volatility. For example, slowing growth rates and food intake by lowering temperatures when conditions are suboptimal and reinstating them when conditions improve. In traditional livestock, such an approach would lead to health issues and runting, but with reptiles it can be implemented very successfully if body condition and general health are monitored closely throughout the process.

For successful reproduction, most female reptiles mobilise the energy in fat stores and redistribute it to the expanding ova that will fuel embryonic growth in the oviducts or eggs (Bonnet et al 1998). If fat stores are low, they will forego reproducing that year. Ensuring females have sufficient food to build large fat stores prior to reproducing improves productivity. In the wild, it can take two or three years to acquire and store sufficient energy in fat to produce a clutch of eggs, whereas the same species can often reproduce annually with sufficient food (Taylor et al. 2005).

The source of energy (i.e., diet preference) varies considerably across reptiles, but most Asian reptile species in trade are predominately carnivores. Their digestive systems are adapted to deal with high levels of protein consumption and a reliable intake of fats, and most rely heavily on fresh, whole vertebrates (Arbuckle 2010). Formulated carnivorous reptile diets need to reflect this balanced nutrition and most comprise a minimum of 40% high quality protein and 10% fat (dry mass).

Water

Asian reptiles in commercial trade live mostly in environments that have microhabitats with high humidity. In the wild, they spend much of

their time in relatively stable humidity conditions, often within shelters (Davis and DeNardo 2009; Guillon et al. 2014). If access to humid conditions is denied in captive environments, dehydration can result, adversely affecting the skin and leading to constipation, kidney failure, and in extreme cases death (Divers and Mader 2006). The importance of humidity is a welfare concern that is often not fully appreciated within supply chains, yet it may cause significant economic losses.

The body of most animals is 70-75% water, which provides the turgidity of all cells and is the media in which materials are moved within the bloodstream and digestive tract (Lang and Waldegger 1997). It is also important for moistening tissues, such as the eyes and respiratory tract, and for lubricating joints. Not surprisingly, access to sufficient amounts of water, either via drinking fresh water or moisture in their food, is vital to the well-being of reptiles (Wright et al. 2013).

Reptiles lose water through evaporation from their skin, through the humid air they expire whilst breathing, as well as in faeces and urine. How much water they lose via evaporation is dependent on the humidity of their environment (Lahav and Dmi'El 1996). Evaporative forces are much greater in drier environments, and reptiles that live in dry environments tend to have more oils in their skin, which reduce evaporation rates (Torri et al. 2014). Tropical forest species tend to have less resistance to dehydration, because high humidity microclimates are usually available. However, if tropical forest reptiles are kept in confined spaces where humidity is low, they are prone to unnaturally high rates of evaporative water loss. Dehydration can occur in captivity even if reptiles are provided with free access to water, because rates of water intake may be low: they may not increase water consumption sufficiently to counter dehydration.

Reptiles commonly excrete their stored liquid urine as a defensive response, but, in so doing, eliminate the water that could be reabsorbed from the colon to support internal water balance (Junqueira 1966). In environments conducive to water loss, it is important to handle reptiles as minimally as possible, and in the least stressful manner, so as not to provoke elimination of fluids.

While dehydration must be avoided, providing an excessively moist environment, without drier areas, can also be problematic. With no opportunity to dry the skin, blisters and fungal infections on the skin can develop (Divers and Mader 2006). If detected early, these can be treated effectively by providing a drier environment, but, if not, the condition can worsen and without veterinary care can lead to death.

Dehydration in captive reptiles can be avoided by keeping them in a humid environment, but continuously wet substrates may cause other problems. One approach is to provide a dry substrate in most of the enclosure, but include within the enclosure a refuge with moist, but not wet, substrate. This provides the animal with a choice to seek shelter in a moist environment but also to leave that environment for drier conditions.

Stress

All animals, including reptiles, are prone to stress. It occurs naturally when their physiological or psychological well-being is challenged by sub-optimal conditions (DeNardo 2006). The inability to maintain body temperature, water balance, or energy balance creates physiological stress, while psychological stress originates from confinement or unnatural interactions with other animals of the same or different species.

In response to stress, animals alter their allocation of resources to different needs. Immediate survival may require the rapid mobilization of energy stores to support an animal's ability to escape its current environment or defend itself. In contrast, body functions not critical for immediate survival, such as reproduction and immune function, are often suppressed (Sapolsky et al. 2000). Stress changes the behaviour of animals, and stressed individuals become less mobile and spend much more time in shelters (DeNardo and Sinervo, 1994). This restricts critical functions associated with normal activity, particularly thermoregulatory behaviour, resulting in suboptimal body temperatures which adversely affects feeding, digestion, growth, reproduction, immune function, and other factors.

Stress is a natural, adaptive phenomenon, and short-term exposure is not usually a problem. However, chronic stress, is maladaptive and can lead to compromised health and eventual death (Pinel 1993). As captivity is a previously unknown condition for recently captured individuals, it can be stressful (Greenburg 1992). Furthermore, since the duration of captivity is often lengthy, it can induce chronic stress if conditions are inadequate. To avoid chronic stress and its detrimental outcomes, newly acquired animals need environmental conditions that do not amplify the stress of being brought into captivity. Temperature, food, and water need to be provided as appropriate for the species. Additionally, psychological stressors should be avoided. Psychological stressors include overcrowding, co-housing conspecifics (especially territorial, cannibalistic, or reproductively active animals), or housing individuals where they can see or smell predators. Captivity-induced stress in new acquisitions can also be minimized by keeping them in an area where there is relatively low activity, providing them with ample shelter into which they can hide, and by limiting handling.

Minimizing stress, even in captured reptiles that are intended to be killed shortly after capture, needs to be considered at all times. Reptiles can demonstrate hormonal changes indicative of stress within 10 minutes of capture (Moore et al. 1991), and stress does not cease once an animal is placed in a bag or container - it can be greatest at this time (Kreger and Mench 1993). Psychological stress associated with capture and confinement happens rapidly and is unavoidable, but additional potential stressors such as rough handling or exposure to high temperatures are avoidable.

1.5 How does the trade operate?

The Asian reptile trade is characterised by unique systems, processes, traditions, and values. In the region as a whole, reptiles are traditionally regarded as a commodity - a cultural norm as much a part of mainstream society as chickens and fish are in the West. The magnitude of the trade remains unknown, but the authors estimate that the industry supports at least a million livelihoods in Asia. It has a long history, but until the last few decades, it has been obscure and poorly understood outside the region. What were once traditional small-scale rural livelihood systems, operating locally or nationally, are now evolving and expanding in response to increasingly cosmopolitan and complex market forces, such as international demand. It is important within this new and developing industry to acknowledge and accommodate the cultural teething problems of a transitional industry. The lack of synergies with established livestock sectors, and with euro-centric worldviews, should not impede the sustainable growth of this new and innovative industry that supports so many livelihoods.

Supply chains

Supply chains in the reptile industry vary with species, intended market, and geographical area (Table 1). Legal wild harvests have always been and remain the major source of reptiles entering the trade. This is particularly so in situations where human activities (such as agriculture) have indirectly boosted wild reptile populations (Murphy 2007, Fitzherbert et al. 2008, Meijaard et al. 2018). Science-based harvest programs have yet to be developed for most species, but based on what is known about species' population ecology and harvest histories, the majority of wild harvests for species in the skin trade are probably sustainable, at least at the species level (e.g., Shine et al. 1999; Natusch et al. 2016b). In general, supply chains for more niche and discerning markets, such as the exotic pet industry or pharmaceuticals, are less formalised and more nuanced than those supplying the skin trade. For all species, including those in the skin trade, it is vital that responsible approaches to collection of reptiles be used to ensure sustainability.

Well-managed harvest programs have been developed for a few species, mostly those listed in CITES appendix II (e.g., Natusch et al. 2016a). Wild harvests usually entail harvesting mature individuals from the wild for direct sale. Harvesting eggs, hatchlings, and/or gravid females for captive production (i.e., ranching) is uncommon for most reptiles, but crocodilians are a significant exception. Harvesting is carried out using a variety of methods ranging from traps to active hunting. Harvests are often seasonal and timed to coincide with periods of peak reptile activity (e.g., warm, humid conditions). Most harvesting is carried out as a part-time activity, but professional, full-time harvesters do exist. In terms of meat and traditional Chinese medicinal value, live, wild-harvested animals are traditionally worth up to 40% more than captive-farmed animals because of perceived benefits of unadulterated origins (e.g., superior quality, free-range, and chemical-free) (Aust, unpublished data 2018, Lui et al. 2016), but this phenomenon has been dampened in recent years due to the lack of providence and the proliferation of sophisticated farming systems (Aust et al. 2017, Aust, unpublished data 2018). Well-regulated wild reptile harvest systems and ranching activities are closely linked to biodiversity conservation because they provide an economic incentive for humans to value and conserve indigenous species and the natural ecosystems they depend on (Hutton and Leader-Williams 2003, MacGregor 2006). Similarly, they improve rural livelihoods, particularly in situations where commercial agriculture struggles to gain traction and economic viability. Important beneficiaries in the reptile trade include impoverished and marginalised communities living in remote regions (Shine et al. 1999, Micucci and Waller 2007, Natusch et al. 2016a; Nossal et al. 2016a, Nossal et al. 2016b).

Production techniques for captive breeding and rearing of reptiles have been developed for many commonly traded species, and reptile farming now represents a rapidly evolving mainstream agri-industry in Asia. Over the last two decades it has undergone a process of transformation in order to adapt to the unique physiology of reptiles, which differs substantially from traditional endothermic, "warm-blooded" livestock. Many species of snakes, turtles, lizards, and crocodiles are now produced in legitimate closed-cycle production systems. Reptile farming is recognised as a viable enterprise for small-scale farmers in rural, peri-urban, and urban areas, where it is known to increase food security, generate a steady cash flow, alleviate poverty, contribute to the empowerment of women and children, and give value to underutilised resources (Revol 1995, Eilers

et al. 2001, Wilson 2011). The attainment of viable livelihoods in areas where conditions are unsuitable for conventional agriculture is a global challenge, in which the reptile trade has been credited for providing a resilient and sustainable response to a range of threats including land shortages, climate change, and infectious diseases (Aust et al. 2017, Nossal et al. 2016b). The prevalence of commercial reptile farming is growing in terms of the numbers of businesses and the diversity of species within them. For some species in trade, farms are now technically capable of supplying 100% of market demand.

Markets

Wild-harvested and farmed reptiles are typically traded live from the source - sometimes through a series of local hubs or trading nodes - to central processing facilities or wholesale markets. From there, most animals are killed and processed (e.g., skinned & deboned) or traded live direct to the retail sector (e.g., restaurants, food markets). Processed carcasses, meat, and skins are usually sold air-dried, frozen, or smoked. The supply chain cycle time from source to killing/processing is often protracted compared to conventional livestock (weeks vs. hours), but steadily improving trade, communications, and transport networks are driving rapid change. For example, cheap smart phones are enabling rural small-scale farmers to bypass conventional trade routes and exploit online marketing strategies to sell direct to high-end city restaurants. Skins are often sold to local tanneries or exported to specialist exotic skin processing facilities. Most processing and manufacturing are carried out in Asia and Europe with the end products marketed worldwide. Skins occasionally reach their final destination via a complex chain of middlemen and agents.

The primary value of most reptile species in trade lies in their meat and skin, but various 'by-products' are often economically significant. China represents the biggest and most important global market for reptile meat and non-skin products. Markets are dynamic and can be volatile, with demand fluctuating on a cyclical basis.

Reptiles as traditional medicine

Virtually all reptiles are perceived to have at least some pharmaceutical benefits in Traditional Chinese Medicines (TCM). The species and assortment of body parts that are used are multifarious and are used to treat a wide range of medical problems, from minor to major ailments, including cancers. Within TCM, snakes in particular are valued for their warming qualities, or Yang (as in Yin-Yang), and their ability to stave off cold-related ailments. The stated rationale is the unique amino-acid profile of the meat, which is purported to be superior to that of other meats for these purposes. Snake bile and snake wine are widely consumed as general healing tonics and are popular with the elderly. Reptile-centric restaurants often distinguish between purely culinary dishes and medicinal dishes. Medicinal dishes are mostly popular amongst the older generation, and demand is believed to be declining amongst the younger generations, at least in some urban areas (Aust, unpublished data 2018).

Reptiles as food

The demand for reptile meat is a primary driver of the Asian reptile trade. Reptile meat is widely consumed in many parts of East and Southeast Asia as a traditional culinary delicacy. In Cantonese cuisine, the consumption of snake meat is highest during the winter months when the Yang is most valued. Reptile-centric restaurants exist, but reptiles also feature on the menus of many mainstream restaurants. Numerous speciality dishes exist, utilising virtually every part of the animal – meat, skin, bone, blood, heart, liver, intestines, venom, and gall bladder. Demand for snake meat for culinary purposes is reported to be growing throughout

China, both in terms of geographical distribution of demand and the volume in trade. Annual trade in live snakes in China currently exceeds 10,000 tons (Aust, unpublished data, 2018).

Reptiles as a source of skin

Reptile skin is regarded as a luxury exotic leather product by the fashion industry. It is a durable leather coveted mainly for its scaly appearance and intricate patterns. It is used to make clothing such as vests, belts, boots, and shoes, or accessories such as handbags and wallets. Snake skin is also used to cover the sound board of some traditional string instruments, and lizard skin is commonly used by indigenous people to make drumheads or drum skins. Traditionally, only the larger species such as pythons and crocodiles were utilised, but nowadays even relatively small skins hold commercial value. Pythons and crocodiles are the only Asian reptile taxa that are farmed primarily for their skin value. This is mainly because their larger skins are more versatile for manufacturers and therefore hold disproportionately greater value in the fashion industry.

Reptiles as pets

Compared to the meat and skin trade, the overall volume of reptiles in the Southeast Asian pet trade is limited. However, the popularity of reptiles as pets has grown in recent years due largely to their perceived compatibility with modern urban lifestyles. Climate-control technology and improved understanding of reptile biology has made husbandry simpler and more affordable for many species. Unfortunately, the industry is generally focused on collectible rarities and ornamental value more so than sustainable harvest and ease of care, the latter leading to an inefficient harvest relative to demand. As a result, the conservation impact of the reptile pet trade on rare or range-restricted species can be significant (e.g., Jensen et al. 2018).

Regulation

The Asian reptile trade is governed by a number of national and international laws. Legislation differs among species and countries. Several species, mostly those valued for their skins, are listed in CITES Appendix II and protected by national laws. Farms are typically licenced and audited at the national level. Commercial processing facilities and wild harvests are usually regulated through a series of permissions, including permits and annual quotas. The monitoring and management of trade is rigorous in some areas but is not uniform. There is typically a lack of capacity and funding to enforce laws, and to do so at all levels down to opportunistic capture for food or trade is clearly problematic. Laundering of illegally sourced animals is known to occur between national and international trade hubs. However, the rise in legal reptile farming and regulated wild harvests for reptiles generally, with increased controls through national and international laws, have reduced rather than enhanced illegal trade (Hutton and Webb 2003, Aust et. al. 2017, Natusch et al. 2016a, Natusch et al. 2016b).

table 1

Species of Asian reptile known to be traded for skins, including their major exporting country, source, and purpose of trade. Additional taxa may be used for their skins from time to time, but the taxa listed herein represent the mainstay of the current reptile skin industry

Species	Important source countries	Commercially farmed	Wild Harvested	Purpose (in order of importance)	CITES
Acrochordus javanicus	Indonesia	no	yes	skins, meat	no
Boiga dendrophilia	Indonesia	no	yes	skins, meat, TCM*	no
Cerberus rynchops	Indonesia	no	yes	meat, skins, TCM	no
Coelognathus radiata	China, Vietnam, Indonesia	minimal	yes	meat, skins, TCM	no
Cylindrophis ruffus	Indonesia, Cambodia	no	yes	meat, skins, TCM	no
Daboia russelli	various	no	yes	meat, skins, TCM	III
Elaphe carinata	China, Vietnam	yes	yes	meat, skins, TCM	no
Enhydris boucorti	Vietnam, Cambodia	yes	mostly	meat, skins, TCM	no
Homalopsis buccata	Vietnam, Indonesia, Cambodia	no	mostly	skins, meat, TCM	no
Lapemis curtus	Malaysia	no	yes	skins, meat	no
Naja kouthia	China, Vietnam, Malaysia	yes	minimal	meat, TCM, venom	II
Naja naja	China, Vietnam	yes	minimal	meat, TCM, venom	II
Naja sputatrix	Indonesia	no	yes	meat, skins, TCM	II
Orthriophis taeniurus	China	yes	yes	meat, skins, TCM	no
Python bretensteini	Indonesia, Malaysia	no	yes	skins, meat, TCM, pets	II
Python brongersmai	Indonesia	no	yes	skins, meat, TCM, pets	II
Python curtus	Indonesia	no	yes	skins, meat, TCM, pets	II
Python bivittatus	Vietnam, China, Thailand	yes	no	skins, meat, TCM, pets	II
Python reticulatus	Indonesia, Vietnam, Malaysia, Thailand	yes	yes	skins, meat, TCM, pets	II
Ptyas mucosa	Vietnam, China, Indonesia	yes	yes	meat, skins, TCM	II
Varanus salvator	Malaysia, Indonesia	no	yes	skins, meat, TCM	II
Xenopeltis unicolor	Indonesia	no	yes	skins, meat, TCM	no
Xenochrophis vittatus	Indonesia	no	yes	meat, skins TCM	no
Xenochrophis piscator	Cambodia	no	Yes	meat, skins, TCM	no
Enhydris enhydris	Indonesia, Cambodia	no	Yes	meat, skins, TCM	no

*TCM = traditional Chinese medicine


CÓ MUA

CHAPTER 2

Principles of wild capture of reptiles

The majority of commercially harvested wild reptiles are destined for live sale. Capture methods are therefore designed to be non-lethal and non-injurious. Welfare procedures at this point in supply chains are critical but challenging. In addition to the welfare of the individual animal harvested, the well-being of the remaining wild population and its environment is paramount, because this ensures preservation of the resource, and the fulfilment of biodiversity conservation obligations.

OUTCOME

Optimal methods are designed to catch and restrain reptiles quickly and securely while ensuring minimal physical injury or stress to the captured animal and minimal impact of the capture method on the environment.

KEY PRINCIPLES

2.1. Harvesters employ capture equipment and methods that minimise the risk of injury and stress to the reptile.

2.2. Harvesters employ capture methods that have minimal impact on the environment.

2.3. Reptiles are handled and moved in an appropriate manner to ensure the animal's well-being.

2.4. Traps are removed or deactivated if not in use.

Good practice: general

- Acceptable capture methods, tailored to local circumstances and resources, include snares, nets, cage traps (including funnel traps) and direct capture (*Fig. 1*). Snares may be passive or include mechanical actions. Direct capture includes any form of hand capture or hand-held device used to restrain a free-ranging reptile (e.g., gloves, sticks, catch-poles).
- The use of fire, smoke, electricity, explosives and noxious chemicals (e.g., petroleum) in capture is not acceptable. Reptiles are slow to react to many physical and chemical stimuli, including burning, which can result in severe injuries. Inhalation of smoke or toxic gases may harm the animals and contaminate carcasses. These practices can also cause unwanted and adverse effects on the environment.
- Traps and catching equipment are well maintained and fit for the purpose. They should be fully functional and free from defects that may accidentally or unintentionally harm the reptile (e.g., burrs, faulty mechanisms).
- Terrestrial traps are set in shaded locations that are out of direct sunlight throughout the day. The combination of stress and tropical sunlight, even for a few minutes, can result in rapid overheating and death.
- Attempts are made to reduce the risk of predation of trapped reptiles. Traps are situated away from footpaths and trails frequented by carnivores, including dogs and cats, and hidden from aerial predators by covering with vegetation or other means.
- Trap methods and mechanisms are incapable of injuring the animals caught, either through intrinsic means such as trap springs and wires or through the actions of the trapped animal: rolling, rubbing, entanglement. Capture methods must be tailored to the strength and capabilities of the target species. The trapping area

must be free from obstructions that may compromise the action of the trap.

- Reptiles are never thrown, dropped, or dragged. Dropping snakes, even from a relatively low height, may cause internal injuries, and dragging can cause friction burns and skin lacerations. There are situations, for example removing large reptiles from capture sites, where some dragging may be unavoidable.
- When capturing large reptiles, the head and body, in that order, should be restrained in rapid succession. Reptiles may bite, thrash, or contort their bodies as an escape strategy and can injure themselves while doing so. Two or more people may be required.
- In times of distress, most reptiles seek shelter in dark and confined spaces where threat stimuli are minimised. Mimicking these conditions, by covering captured animals with a towel or similar strategies, may reduce stress levels during and immediately after capture.
- Capture, restraint, and transport times are minimised. Traps should be checked regularly, and trapped animals removed as soon as they are found. Snares and nets should be checked daily, or more frequently if environmental condition (e.g., extreme heat) necessitate it (*Fig. 1*). Stress levels start to rise from the moment of capture, continue during transport, and do not attenuate until the animal begins to settle in a quiet, secluded location.

Good practice: large terrestrial snakes

- Direct capture is the preferred method.
- While handling, the body of larger snakes is well supported at two or more points at all times (Appendix II).

Good practice: monitor lizards

- Cage traps are the preferred method, followed by nets and snares.
- Once captured, monitor lizards are restrained around the neck and lower body to minimise stress and injury (see appx. II).

Good practice: aquatic snakes

- Cage traps and direct capture are the preferred methods.
- Traps allow the animal to breath. They should operate such that they do not hinder access to the water surface, even if the animal is exhausted.
- Traps allow the animal to stay submerged in water, or at least prevent the animal from drying out.
- Aquatic snakes are a common fisheries bycatch, and commercial fisheries represent an important source of aquatic snakes entering trade. It is the responsibility of proximate stakeholders within the reptile trade (e.g., buyers) to ensure these incidental supply chains are appraised of relevant Science-based Animal Welfare (SBAW) principles.

Good practice: terrestrial venomous snakes

- Preferred methods include direct capture and cage traps.
- The harvesters' safety is a priority. Safe capture protocols for the harvester invariably lead to reduced stress and injury to the snake.
- Direct contact between the snake and the harvester is minimised. Passive methods are used where possible (i.e., snakes are allowed to crawl into the bag rather than manhandled). Restraint behind the head, or 'necking,' causes stress and is only used as a last resort (see appx. II).
- Snakes are never defanged or milked during capture. These activities cause stress, injure the snake, and do little to reduce the overall risk of envenomation.
- When using mechanical tools such as grab

sticks, care is taken to manage the force used to restrain the animal. Soft tissue and skeletal damage can result from improper use of tools.

Good practice: environmental considerations

- Traps should be set such that they avoid or minimise bycatch. They should be target-specific in terms of size (e.g., appropriate mesh or noose diameter), location (e.g., off the ground, in water), bait (e.g., baits scented and hidden from view) and access (e.g., size of exclusion funnel at a trap entrance).
- Unwanted bycatch should be safely released at the site of capture, or humanely killed if critically injured or to be used as food.
- Excavations to unearth reptiles from subterranean habitats should be back-filled.
- Discarded or unused equipment should be removed from the environment and safely destroyed or stored.

Fig. 1 Nets are a common means of capturing a wide range of Asian reptile species, including pythons, water snakes, and monitor lizards. They can be quite effective, but they must be used carefully to avoid unnecessary stress or injury which is more prevalent with nets compared to direct capture. Importantly, nets must be checked at least daily. The animal in the inset photograph spent several days in a net before it was recovered. As a consequence, its well-being and commercial value were severely compromised (arrows illustrate injuries). It is critical to remove nets after use to prevent entrapment in unmonitored nets and likely a slow, inhumane death.

CHAPTER 3

Principles of transportation of reptiles

Compared to many conventional livestock species, most reptiles adapt well to dark, confined spaces and can survive without food and water for relatively long periods of time (weeks vs. days). As a result, many are tolerant of standard livestock transport conditions, and supply chains can be comparatively protracted over space and time. For example, a snake harvested in a remote village may pass through several trading nodes over a period of several weeks before it is sold live in a city marketplace. These conditions may not necessarily impact on the well-being of the reptile, but considerable variation exists between taxa and life stages which needs to be understood. Common modes of transport used in the industry include foot, motorcycle, car, truck, canoe, and river boat, and each may employ different shipping methods.

OUTCOME

Procedures for the transport of reptiles are developed and include prevention and mitigation of possible risks to reptile welfare.

KEY PRINCIPLES

3.1. Adequate, reliable, and functional equipment and facilities are available for the transport of reptiles.

3.2. Procedures for the transport of stock are developed that include prevention and mitigation of risks to the well-being of animals.

3.3. Procedures are in place to ensure effective communication between the relevant actors along supply chains.

Good practice

- Transport personnel are made aware that reptiles are easily stressed and sensitive to vibrations, chemical pollution, and excessive human activity/interaction.
- Reptiles are treated with care and respect throughout the transportation process. Once bagged and packed, it should not be forgotten that reptiles are living animals rather than inanimate commodities. Animals/bags/boxes/crates need to be moved in a gentle and purposeful manner and never thrown, kicked, shoved, jolted, tilted, turned over, or dropped.
- During transport, reptiles are never exposed to direct sunlight, hot surfaces and prolonged damp conditions. Optimal transport conditions should be cooler than average ambient temperatures to suppress activity, but not cold (e.g., maintain >21°C for most tropical reptiles). Reptiles are always protected from inclement weather.
- During transport by motorized boat, care is taken not to store reptiles close to fuel storage areas or equipment. Even low concentrations of petrol fumes can cause stress in reptiles.
- Aquatic snakes are transported in waterproof containers filled with just enough fresh water to ensure animals remain wet during transport. Aquatic reptiles tire quickly with the constant motion of transport and may drown if the water level is too deep.
- Terrestrial reptiles are transported inside well-ventilated mesh bags within robust crates. The materials, design, and packaging of crates should ensure free-drainage and good air-flow throughout. This configuration promotes a healthy transport environment and allows for periodic watering of animals (see appx II).
- Monitor lizards have powerful forelimbs and sharp claws and are capable of escaping from all but the most robust confinements. Accordingly, snug fitting bags that restrict

movement of the limbs are permissible for transport and short-term holding. Binding or mutilating the limbs or claws in any way is inappropriate.

- Captive-raised reptiles transported in a timely fashion direct from farm to market do not require watering or free-draining crates. In this situation, cotton bags and polystyrene boxes are acceptable.
- For temporary, short-term transport (e.g., by foot from point of capture), all species up to a suitable size may be transported in ventilated bags carried inside a well-padded backpack (Caution: venomous snakes can bite through most fabrics).
- Stocking densities vary according to species and size. Individuals should be able to move freely around the bag or container. Species and size classes should not be mixed (cannibalism is common in reptiles). Stackable plastic crates are space efficient and cost effective in many contexts (*Fig. 2*).
- Sick or injured reptiles are isolated as soon as possible. If a veterinarian or similarly trained professional is available, animals may be quarantined for treatment. Otherwise they should be humanely killed. Transport personnel should be made aware of the risks posed by the spread of infection. If an infectious disease is known or suspected, the individual(s) should be disposed of appropriately and authorities notified.
- The handling of reptiles during transport is planned and executed efficiently and timeously. Shipping paperwork should be prepared prior to packing, and 'double handling' (unloading and reloading) en route should be minimised.
- Food is withheld for at least three days prior to transport and for the entire transit period to reduce the likelihood of regurgitation while in transport.
- All reptiles, captive and wild-harvested, are well hydrated prior to transport. Wild caught reptiles can be watered by periodically spraying the animals with a light mist of clean, fresh water (see appx. I). Proper hydration prior to transport improves welfare and body condition. It also encourages pre-transit voiding of the bowels and thereby improves in-transit conditions and end-market appeal.
- Equipment and facilities are free from defects (e.g., holes, cracks, loose ends, burrs, sharp projections, residues) and fit for the purpose. Holding bags, containers, crates, and handling equipment are free from abrasive or chemically active materials. Substandard materials often cause abrasions on the rostrum of reptiles, and open wounds readily lead to secondary infections and chronic stress. Levels of wear and tear are high, and regular maintenance is essential.
- Equipment and facilities are cleaned and disinfected on a regular basis to maintain a high standard of hygiene. Household bleach (3% solution with water) followed by thorough rinsing is preferable to strong chemicals.
- All actors along the supply chain are made aware of key shipment parameters, including species and number, method of containment, origin (date, location), destination, and expected delivery date.

Fig. 2 The combination of well-ventilated nylon bags and plastic crates is a cost-effective, hygenic, and humane way to transport reptiles. Species and size classes should always be separated, and animals should be able to move freely within the bag.

CHAPTER 4

Principles for temporary holding of reptiles

The reptile trade often requires live animals to be held on a temporary basis. Although considerable overlap exists with both transport principles and longer-term captive husbandry principles, transit housing should be viewed as a distinct welfare context with unique challenges.

Temporary holding can occur for any number of reasons and at virtually any point in supply chains and is common when reptiles are held in people's homes prior to transport, at markets or processing facilities prior to sale or slaughter, and at restaurants prior to consumption. Each of these three main scenarios warrant specific welfare considerations. Other scenarios may arise from time to time, and relevant principles and best practice should be adapted and applied accordingly.

OUTCOME

Procedures for the temporary holding of reptiles are developed and include prevention and mitigation of possible risks to reptile welfare.

KEY PRINCIPLES

4.1. Adequate, reliable, and functional equipment and facilities are available for the temporary holding of reptiles.

4.2. Procedures for the temporary care and management of stock are developed that include prevention and mitigation of risks to well-being.

4.3. High levels of health and safety are maintained throughout holding facilities.

Good practice: general

- Reptiles are not exposed to vibrations, chemical pollution, or excessive human activity/interaction. Reptiles are highly sensitive to changes in visual, olfactory, and tactile stimuli. Darkened rooms or covers over enclosures may help to reduce stress levels, especially in recently wild-caught individuals.
- A double-locking system is employed to ensure reptiles are safe and secure. Reptiles are notorious escape artists, and escapees are highly vulnerable to a wide range of welfare abuses. Double-locking may include a range of mechanisms such as securing one bag inside another or placing bags inside escape proof crates/boxes.
- Housing facilities and equipment are free from defects (e.g., abrasive materials, holes, cracks, loose ends, burrs, sharp projections, chemical residues) and fit for the purpose. Wear and tear rates can be high, and imperfections can lead to injuries and escapes. Inspections and general maintenance are carried out on a regular basis.
- Housing facilities and equipment are cleaned and disinfected on a regular basis to ensure a high standard of hygiene and reduced risk of disease.
- Reptiles are never exposed to direct sunlight or hot surfaces. Reptiles are vulnerable to burns and can overheat quickly if temperatures exceed 40°C. The confines of holding enclosures constrain the ability of reptiles to thermoregulate. As a safety precaution, ambient temperatures in holding facilities should be maintained well within tolerance limits (e.g. ~25°C).
- Terrestrial reptiles are never exposed to prolonged damp or cool conditions. Short periods of wet and cold are tolerated, but prolonged conditions can lead to the onset of skin and respiratory ailments. For most species under holding conditions, temperatures should be maintained above 21°C and never allowed to fall below 18°C for more than 12 hours.

- Aquatic snakes are held in containers filled with fresh, clean water. Water depth should be no more than half the length of the occupants, and water changes are required on a regular basis to maintain a healthy environment. Aeration of the water is unnecessary. Regurgitation and excrement, particularly in recently captured reptiles, can foul water and lead to stress and disease.
- Stocking densities are such that they allow individuals to move freely and not be obstructed by forced stacking on top of one another. Overcrowded conditions can lead to stress and injury, particularly in weaker or smaller individuals. Forced stacking should not be mistaken for natural aggregations, where individuals group together voluntarily to buffer against environmental stresses such as thermal flux.
- Aquatic snakes are highly vulnerable to drowning in overcrowded conditions. A useful indicator for safe stocking densities is to ensure that at least 25% of the bottom of the holding container is visible from directly above the container and occupants.
- Sick or injured reptiles are isolated as soon as possible to safeguard the health of the remaining population. If a veterinarian or similarly trained professional is available, animals may be quarantined for treatment. Otherwise they must be humanely killed. If an infectious disease is suspected, the authorities should be notified. Carcasses should be disposed of appropriately (e.g., incinerated). Sick or injured reptiles should never be sold into trade where there is a health risk to people nor released into the wild where they may pose a health risk to native animals.

Good practice: reptiles held in people's homes

- Keepers are familiar with the basic biology of the species held. Different reptile species may require different husbandry requirements. Temperature, humidity, and dietary requirements can vary considerably, even within the same genus.
- Most snakes may be held under transport conditions (e.g., dry, well-ventilated bag protected from the weather) for up to four weeks, provided they are in good condition (e.g., no signs of injury or starvation) and are offered water on a weekly basis (light showering with water for ~1 minute). Small snake species, juvenile animals, and monitor lizards should not be held for longer than two weeks.
- For longer periods (up to 8 weeks), reptiles are housed under suitable captive husbandry conditions (see chap. V) where appropriate food, water, temperature, and shelter are provided.
- Individuals are inspected weekly to ensure they are healthy and in good condition.

Good practice: reptiles held at processing facilities and wholesale markets

- Animals are offered clean, fresh, drinking water on arrival (e.g., lightly showering bags for ~1 minute). Hydration aids recovery from the stress of transport and improves the quality and appearance of the animals.
- Animals are held no longer than one week.
- Reptiles are held under transport conditions (e.g., dry, well-ventilated bags in stacked crates and protected from the weather). Placing animals into new holding enclosures at markets and processing facilities often introduces unfamiliar stimuli, which can increase stress and injury.
- Animals may be unpacked into fresh, clean transport bags. The grading of animals may take place at this time. Animals should not be placed back into the same bags if those bags are damp or contain excrement. Preventing this will allow reptiles to be kept in a healthy condition for longer and will maintain the quality of the final product (e.g., skin, meat).
  The flushing, or forced removal of cloacal contents (using a vigorous pinching motion

to remove faeces and mature eggs from live animals), during grading is unacceptable as it leads to stress, injury, and poor meat quality.

Good practice: reptiles held at restaurants and retail markets

- On-site holding facilities and management practices must meet legal requirements and industry standards (e.g., health and safety standards).
- Public display areas, where patrons can view reptiles prior to sale, necessarily increase the risk of stress and injury (Fig. 3). Display enclosures should contain a minimum number of representative animals at any one time, for most contexts no more than five, and be replenished with animals held off-display, where stress levels can be better managed.
- Display enclosures contain a bowl of clean, fresh drinking water at all times. Proper hydration of display animals prior to sale improves well-being and the quality of the meat and skin.
- Reptiles may be held off-display under transport conditions (e.g., dry, well-ventilated bags inside crates) for up to four weeks, provided they are in good condition (e.g., no signs of injury or starvation) and are offered water on a weekly basis (see appx. I). During this time, stress levels and the loss of body condition can be minimized by keeping the reptiles at the cooler end of their preferred temperature range (e.g., ~21 - 25°C for most species).
- Reptiles may be held indefinitely if they are provided with suitable captive husbandry conditions (see chap. V). The individuals will typically be farm animals accustomed to captive routines (e.g., diet, temperature), which should be replicated where possible.
- Reptiles that are gravid, recently fed, or going into a shed cycle should not be placed on display, as these conditions put the animal under increased physiological demands, which, when combined with display conditions, can cause considerable stress.

Fig. 3 Typical display enclosures in the retail market. This situation is stressful for the animals and needs special consideration. Enclosures should be constructed from non-abrasive materials (e.g., PVC-coated mesh), hold a minimum representative sample of animals only, and contain fresh drinking water at all times. Proper welfare improves the well-being of the animals and the quality of the product.

CHAPTER 5

Principles of captive breeding and rearing of reptiles

Commercial production in closed-cycle farms represents an increasingly important source of reptiles entering the trade. The industry has emerged relatively recently as a result of agri-innovation at the local farm level. Approaches to biologically and economically viable production systems are somewhat experimental and vary widely across Asia. As a result, the principles and best practice guidelines presented in this document are not intended to be overly prescriptive, but rather offer general welfare principles to cover all species and production scenarios. They are geared towards intensive commercial meat and skin farms and do not necessarily cover all types of production systems (e.g., semi-natural ponds, pet trade).

Welfare standards are closely linked to productivity in the reptile farming industry. Snakes and monitor lizards may take an extended period of time to succumb to improper husbandry practices. However, high reproductive and growth rates require standards of care that minimize stress and optimize body condition. Accordingly, most successful reptile farms in Asia employ high welfare standards as a de facto economic imperative.

OUTCOME

Commercial reptile production systems are developed and maintained to ensure prevention and mitigation of risks to reptile welfare and thus maximize productivity.

KEY PRINCIPLES

5.1. Adequate, reliable, and functional equipment and facilities are available for the captive care and well-being of reptiles. This includes species-specific provisions for all life stages and biological functions.

5.2. Procedures for the captive care and management of stock are developed that include prevention and mitigation of risks to well-being.

5.3. High levels of health and safety are maintained throughout production facilities and systems.

Good practice: general

- Policy objectives for farms include SBAW standards and a commitment of proprietor(s) and manager(s) to this objective.
- Adequate resources provided for the well-being of reptiles including:
  - Clean enclosures
  - Food
  - Water
  - Humidity
  - Temperature
  - Breeding facilities

Good practice: facilities and equipment

- Design and layout of a farm takes into account the importance of climate. Environmental conditions are critically important in reptile biology. Reptiles ideally need access to a wide-spectrum of thermoregulatory options

(direct sunlight to deep shade), allowing preferred temperature ranges (~21-32°C for most species) to be attained when needed. Direct sun, rain, draughts, and humidity levels need to be monitored and managed according to species (*Fig. 4*).

- Artificial climate control systems are acceptable. Exposed heated surfaces should not exceed 50°C, and electrical components (wires, elements, connectors) should be water-proof and protected from reptiles by physical guards/barriers.
- Reptiles are protected from nuisance animals (e.g., dogs, cats, rats, insects). A predator-proof perimeter wall around the farm is recommended.
- Reptiles cannot be unduly stressed by excessive vibrations, chemical pollution, or human activity/interaction.
- The area of the farm and number of enclosures should be sufficient to accommodate the maximum number of animals held at any one time.
- Enclosures are designed to prevent injury. This includes the use of non-abrasive and sanitisable materials (e.g., coated wooden slats, PVC coated wire mesh, or plastic mesh), provision of adequate ventilation, and the absence of materials or structures that may result in injury or entrapment.

Good practice: management

- Stocking densities are such that they allow individuals to move freely and unobstructed by other individuals. Overcrowded conditions should not be mistaken for natural aggregations, where numerous individuals group together voluntarily to buffer against temperature flux or other environmental stresses. All occupants should have comfortable access to available resources/niches (e.g., sufficient basking space for all individuals).
- Mixing of sexes and sex ratios needs consideration, particularly during the breeding season. Reproductive cycles and courtship behavior increase activity and stress levels. Male combat in some species may cause chronic stress and physical injury.
- Gravid females are sensitive to suboptimal environmental conditions (particularly temperature) and are vulnerable to physical injury in crowded conditions. They should be isolated in a suitable environment prior to oviposition or giving birth.
- Eggs should be afforded the same general welfare standards as other life stages. Handling and environmental conditions need extra consideration.
- Size classes are separated. Frequent grading is advised as growth rates can vary within age groups. Smaller animals are vulnerable to crushing, cannibalism, and competition for food.
- Equipment for handling and maintaining reptiles is in good working order and maintained on a regular basis.
- Feeding regimes minimise the risk of a feeding conflict between animals. Reptiles are powerful predators prone to aggressive feeding behaviour and hyperphagia (i.e., excessive, unregulated eating). Severe injuries can occur in crowded conditions. Physical separation of animals or feeding ad libitum may reduce risks.
- Live food is never offered. Exceptions include enticing stubborn hatchlings to start feeding and animals recovering from illness. Live food animals should be afforded the same welfare considerations as livestock.
- Assist-feeding a reptile is permissible (i.e., assisting a reptile to voluntarily ingest a meal through manipulation of the food item and/or the reptile) (Fig. 5). Force-feeding (i.e., forcing food into an animal's stomach) is not recommended under normal circumstances. Exceptions include stubborn hatchlings and animals in recovery. In these cases, it is best to use a homogenated liquid rather than a solid diet to avoid internal injury.
- Clean, fresh drinking water is available at all times.

- Humidity levels facilitate healthy shedding cycles (i.e., intact, whole sheds) but enclosures for terrestrial species are never damp.
- Reptiles are inspected by staff on a daily basis to monitor health and well-being.
- Standard Operating Procedures (SOPs) are in place to ensure reptiles are handled, restrained, and moved in an appropriate manner consistently over time.

Good practice: health and safety

- A system is in place to ensure periodical cleaning of enclosures and equipment. Enclosures are kept free from leftover food and faeces. If temporary substrates are used, they should be replaced on a regular basis.
- Equipment and enclosures can be disinfected with household bleach (3% solution with water) before rinsing thoroughly. Strong chemicals should be avoided, or used with caution, with treated surfaces thoroughly rinsed before contacting the reptiles. Chemicals and procedures for their use should comply with national legislation and environmental guidelines.
- Feed storage and feed management are carried out under hygienic conditions. Meat-based feeds should be stored in freezers and food preparation facilities should be cleaned and sterilized after use. Frozen food items are best used within one year.
- Liquid and solid wastes produced by the farm are disposed of in a safe and environmentally responsible manner.
- Sick or injured reptiles are isolated as soon as possible and quarantined for treatment by a trained veterinarian or humanely killed. If an infectious disease is suspected, the authorities should be notified and the carcass disposed of appropriately (e.g., incinerated). Sick or injured reptiles should never be sold into trade where there is a health risk to people or released into the wild where they may spread the disease or pose a risk of becoming invasive.

Good practice: other

- Monitor lizards present considerable welfare challenges. They are generally solitary animals and are prone to conspecific and co-occupant aggression. They have good eyesight, hearing, and olfactory capability, and are easily stressed. Enclosures should include appropriate secluded areas for all occupants. Light and photoreception play an important role in monitor lizard biology and well-being, and access to direct sunlight is highly preferred.
- Aquatic species require high water quality in terms of physical and chemical properties to prevent infections. Extensive, semi-natural pond systems appear to negate some of these issues.
- Individuals of unknown origin, or wild-caught animals, should not be introduced to established closed-cycle captive breeding populations. Wild caught reptiles carry a host of parasites and pathogens. There is also evidence to suggest genetics and selective breeding have played an important role in the success of closed-cycle reptile farms, and wild caught animals may dilute desirable traits.
- Diet is a potential source of stress and injury. Reptiles are vulnerable to over-feeding and obesity. Sessile species (e.g., pythons) are most at risk. Artificial diets are increasingly common but seldom based on scientifically balanced formulations (Fig. 5). Nutrient deficiencies may represent an emerging welfare concern.
- The provision of secure shelters or ‘hides’ is not essential for farmed reptile species, but they do appear to help reduce stress in most species.

Fig. 4 Modern snake farms can provide a variety of thermal gradients including a) access to natural sunlight (visible along the sides of the warehouses), b) vertically oriented, well insualted shelters, and c) thermostatically controlled electric or hot water heating elements (not visible).

Fig. 5 Assist feeding minced pork and poultry offal to farmed pythons in the form of 'snake sausages'. These snakes are feeding voluntarily; the keepers are merely aligning the relatively delicate sausages with the snakes powerful strike-and-swallow response. Waste protein from agri-food chains is economical and envionmentally sustainable, but not necessarily nutritious in terms of a well-balanced diet.

CHAPTER 6

Principles of humane killing of reptiles

The killing of the animals is an inherent component of the trade in reptile skin, meat, and byproducts. Despite this end result, the animals' well-being must be considered from the initial contact with the reptile until it has been killed.

Historically, reptiles destined for the Asian reptile markets were killed using the most convenient means available. Priority considerations were religious beliefs, safety, cost, efficiency, and impact on the product. The rise of reptile welfare as an economic imperative has focused more attention on humane killing. Current welfare principles for the humane killing of reptiles are derived from a synthesis of current practices and information extracted from a variety of science-based sources, but largely from non-commercial contexts. New research efforts conducted within the trade, combined with development work by stakeholders, will further refine the ways by which reptiles can be killed humanely. This section of the guidance should be read together with recent guidelines on humane killing methods for reptiles in the skin trade.

When determining the appropriateness of a killing method, within a given context, consideration needs to be given to the principles discussed below, which also highlight methods that should never be used. Some of the methods mentioned have already been discontinued but are mentioned here to reinforce the preferred options.

OUTCOME

The method used for killing reptiles should be as pain-free, rapid, and as fail-safe as possible, and they should be performed only by competent individuals who have been thoroughly trained.

KEY PRINCIPLES

6.1. The killing process should involve immediate unconsciousness followed by death whilst unconscious. If unconsciousness is not achieved immediately, then the process should not be unduly aversive to the reptile (without pain and distress).

6.2. The killing process should be as rapid as possible.

6.3. The killing method is accurate and precise to minimize errors and unintentional injury.

6.4. The killing method should be safe for the operator performing the killing.

Good practice: general

- Death can be difficult to ascertain in reptiles. Deeply anesthetized reptiles that are not yet dead may have no muscle movements and an undetectable heartbeat. On the other hand, in some situations, after destruction of the brain (and therefore death), the skeletal and heart muscles can continue to contract for an hour or more, even though the reptile is dead. Such movements are aesthetically displeasing, but do not indicate pain or suffering. With dangerous reptiles, for example venomous snakes or very large specimens, there remains a risk of injury due to bites from post-death movements.
- Equipment used in killing reptiles, especially items that require a sharp point or edge, must be kept in prime working condition. Dull or dysfunctional equipment may cause unnecessary pain and distress.

Good practice: Chemical killing agents

- While chemical agents are specifically manufactured for the humane killing of animals (e.g., phenobarbital-containing euthanasia solutions), extreme care must be used to avoid human and environmental exposure to these agents. As parts of nearly all reptiles killed in Asia are intended for human consumption, chemical killing agents should be avoided.
- Chemical killing agents may be appropriate in some situations such as veterinary or research purposes. Many of these agents have legal restrictions on their use that must be adhered to.

Good practice: Carbon dioxide as a killing agent

- Carbon dioxide (CO2) is widely used for the humane slaughter of livestock, but its value as a killing agent for reptiles has been doubted. However, there has been virtually no investigation into the use of CO2 in reptiles.
- Reptiles have very low metabolic rates and can hold their breath for extended periods of time. Therefore, death by CO2 inhalation is a potentially slow process. Further scientific research is needed to determine whether the extended process of death from CO2 is distressful to reptiles.
- Recovery from apparent "death" by CO2 is possible. Therefore, whenever possible, killing by this method should be followed with a second, physical method that ensures death – preferably decapitation followed by pithing to destroy the brain, or harvesting vital tissues and organs to assure recovery is not possible. Pithing is performed using a sharp needle directed into the brain from the base of the skull and is a very effective means to confirm death. It requires training and can be excessively time-consuming, which is not logistically feasible in situations where large numbers of reptiles are being killed.

Good practice: physical methods of killing

- In reptiles, a captive bolt pistol directed at the brain from the top of the skull delivers virtually simultaneous unconsciousness and death. Provided it is done by a skilled individual, it is both rapid and stress-free. A captive bolt pistol is most appropriate for large specimens but can be used on small specimens. When used on small specimens, a soft material (e.g., padding) should be placed under the reptile to avoid damage to the bolt.
- Blunt trauma to the head, when performed effectively, can cause a virtually instant death. Blunt trauma is best applied by applying a blow against the immobile reptile, often to a metal rod positioned above the brain and never by swinging the animal against a solid object, which creates unnecessary distress and challenges the accuracy of the blow.
- Decapitation should not be performed on conscious reptiles, but can be used as a secondary method to ensure death after using another primary method of killing. Decapitation must be done with a quick, single cut, so it is most easily performed on smaller reptiles. With larger specimens, skilled individuals can decapitate specimens quickly using a sharp blade of sufficient size. Reptiles must have their brain pithed immediately after decapitation.

Bad practice: methods of killing that should not be used

- Exsanguination – Death as a result of severing major blood vessels is slow, distressful, and possibly painful in reptiles.
- Heating (e.g., hyperthermia) – excessive temperatures are distressful to reptiles and do not cause a timely death. Extreme temperatures (e.g., boiling) cause death more rapidly, but are extremely painful.
- Drowning – Because of their low metabolic rate, reptiles take a very long time to drown, which is extremely distressful.

- Suffocation – This includes burying reptiles underground, binding the head with rubber bands (compressing the nostrils and trachea), or any other means. As with drowning, suffocation results in extended suffering.
- Pithing the brain of conscious animals by inserting a sharp object up the nostril – Considerable pain occurs in the time it takes for the object to penetrate the tissue on the way to the brain.
- Harvesting tissues and organs from live reptiles – Reptile organs remain relatively functional for some time after death (e.g., the heart continues to beat for several hours after death), hence fresh tissues are readily attainable after humane killing.
- Decapitation should never be used as the primary means of killing conscious animals.
- The use of freezing temperatures as a humane method of killing reptiles is highly debated but may work in certain situations (Lillywhite et al, 2017). Cooling should be as rapid as possible, but the animal should never be put in direct contact with wet or dry ice. Within the context and scope of this document, this method is not recommended.

APPENDICES

Appendix I
Assessing and addressing the well-being of reptiles in trade

Assessing the well-being of reptiles in trade involves examination of the animals and their immediate environment. The type of inspection and treatment carried out will vary according to species and location along supply chains.

General animal inspection

- Are animals orientated correctly and are they able to right themselves if turned over? Problems in orientation can be a symptom of a wide range of injuries and ailments, ranging from physical trauma to viral infections and vitamin deficiencies. Unless obvious causes are identified (e.g., cooling to ~0°C or anaesthesia), correct diagnosis, treatment, and recovery under trade conditions is rare and humane killing is the preferred course of action. Check the condition of remaining animals, their environment, and supply chain history.
- Do the animals appear underweight? Are ribs, spines, or pelvis pronounced? If so, this indicates chronic starvation. The animals are unfit for sale and require urgent hydration followed by feeding. If the animal will not eat, it may require sustained force-feeding and possibly veterinary care (see chap. V).
- Are there any abnormal skin folds or are they exaggerated in appearance suggesting malnourishment or dehydration? If so, the animals are unfit for sale and require urgent hydration. After rehydrating an animal, it should be fed 24-48 hours later and then provided food and water on a regular basis thereafter until the symptoms disappear. If the animal refuses to feed after rehydration, it needs veterinary care to determine the underlying cause or should be humanely killed.
- Are there any signs (visual, tactile, or olfactory) of physical injuries? Broken bones, open wounds or abrasions? If so, the animals are unfit for sale and require veterinary care. In situations where veterinary care is not available, or the injury is deemed life threatening, the animal should be humanely killed to prevent further suffering. To prevent recurrence, review capture, handling, and transport methods within the supply chain.
- Are there any signs of ectoparasites such as ticks or mites? Reptiles with ectoparasites should be isolated from other reptiles and treated as soon as possible with an appropriate pesticide. Reptile-specific products are now widely available in Asia and online. This is not required if the specimens are wild-sourced and are soon to be humanely killed.
- Do the mouth and nostrils appear normal? Unusual gaping, respiratory wheezing, or increased saliva suggest respiratory tract or mouth infections. The animal should be isolated and provided with access to elevated temperatures (~35°C). If the symptoms persist, and veterinary care is available, the animal may be treated with appropriate antibiotics. The temperatures and humidity levels of the housing environment of the remaining population should be checked and adjustments made as necessary to avoid additional occurrences of these symptoms.
- Are animals unusually active or lethargic? Excessive activity can be indicative of poor environmental conditions, particularly being too hot. Check ambient temperatures and unusual local weather patterns. Stocking densities, reproductive behaviours, and noxious stimuli (e.g., volatile chemicals and sewer gases from faeces) may also agitate reptiles.

General environment inspection

- Do faecal masses appear and smell normal? Are they discoloured? Are there signs of diarrhoea or endoparasites such as intestinal worms? If so, replace or refresh bags and crates on a regular basis and clean and disinfect where necessary. Isolate responsible animals and separate for treatment.
- Are there signs of ectoparasites (i.e., ticks or mites) or blood? Ectoparasite faeces appear similar to small grains of sand. If so, replace or refresh bags and crates on a regular basis and clean, disinfect, and treat with an appropriate pesticide.
- Do temperature and humidity levels appear normal? Are there indications of recent unusual changes in environmental conditions? The use of good quality max/min thermometers, temperature guns, hygrometers, and associated recordkeeping is valuable.

Farms and short-term holdings

- Are there any unusual changes in food intake? Periods of abstention are normal in reptiles, particularly in relation to seasonal changes, shedding, and reproductive cycles, but considerable variation exists among species and life-stages. Good feeding records help to diagnose problems early. Common causes of atypical feeding activity in captive reptiles are suboptimal temperatures and environmental stresses.
- Have food choices changed? A change in food choices can signify a subtle, sub-symptomatic shift in well-being. Check feed freshness, meal size, and food temperature (e.g., frozen vs. thawed). Season, ambient temperatures, and life-stage should also be considered.
- Are animals clustering in or avoiding a particular part of the enclosure? Are they spending prolonged periods at the extremes of a thermal gradient? Reptiles often aggregate naturally for security and to buffer against thermal fluxes. Aggregations effectively increase the range of microhabitats available under captive conditions. However, noticeable avoidance behaviours are often an indication of an improper thermal gradient that needs to be adjusted so that the animals can use more of their enclosure. Other possible causes include environmental issues such as parasites, sewer gases, or draughty conditions.
- Has water intake changed or are the animals spending prolonged periods of time soaking? Increased soaking is often associated with ectoparasites. Some reptiles prefer fresh water and may be reluctant to drink unclean water, or they may strongly favour condensation or misting (e.g., fine droplets) over open surface water.
- Are shedding cycles and associated behaviour normal? Are sheds incomplete suggesting poor humidity or dehydration? Ectoparasites, excessive humidity, and skin conditions may increase the frequency of shedding cycles.
- Do animals show signs of abnormal movement, nervous twitches, or tremors? Nervous disorders are a potential side effect of selective in-breeding. They have also been recorded in cases of poisoning (e.g., rodenticides, pesticides, and herbicides). Check breeding records, the use of poisons near the animals, and the source of food animals, which might be contaminated.
- Do animals show signs of prolonged everted cloacal tissue? This is usually related to either abnormal feeding/defecation behaviour or reproduction (both male and females). Everted cloacal tissue can be manually inverted back into the cloaca, and, provided the problem does not reoccur, is rarely a long-term health issue. However, if other tissues (e.g., reproductive tract, intestine) are prolapsed through the cloaca, treatment is difficult and humane killing should be considered.

- Are there any unusual swellings or lumps? Soft tissue tumours are not uncommon, particularly in older or wild-caught snakes. No cost-effective treatment is available, and animals should be humanely killed. Lower body swellings are often associated with impaction of faecal matter or retained eggs (egg binding). Soaking the animal in warm, clean, fresh water will occasionally resolve the issue. Attempting to gently palpate the mass out should be done with extreme caution as doing so often results in serious injury to the internal organs of the snake. Unresolvable cases should be humanely killed.
- Are there any abnormal scales, scabs, or blisters? Skin conditions often indicate poor environmental conditions ranging from enclosure design and unsafe heating systems to humidity and disease. Check the extent and prevalence in the greater population for further clues as to the cause.

Aquatic snakes

- Is the holding water relatively clean and odourless?
- Do animals appear dry (i.e., is there sufficient water for all the animals to submerge)?
- Do animals show signs of bacterial or fungal skin infections? Skin infections are often a sign of insufficient water changes. Antibiotics and fungicides are not advised, and preferred treatments include improved water quality through daily water changes and more precise water temperature management (~28°C for most tropical species).

Other

Dehydration is probably one of the most neglected aspects of welfare within the reptile trade. Dehydrated reptiles appear dull in colour with a lacklustre sheen and poor iridescence. They may have abnormal folds in their skin and show signs of incomplete shedding. Nevertheless, dehydration is difficult to assess and diagnose, and it is often overlooked simply because many reptiles can survive long periods without water. It is best to always provide reptiles with continuous or regular access to water, but, in situations where this is not possible, an accurate means of diagnosing dehydration may be carried out using a simple test: A sample (~1%) of a target reptile population/shipment is offered drinking water by means of a gentle spraying. If more than 50% of the sample are seen to be actively drinking, the entire population/shipment may be considered dehydrated and in urgent need of watering to prevent risks to their well-being. If between 1% and 50% are seen drinking, they may be considered thirsty and in need of watering at the first opportunity.

Appendix II
Handling snakes and monitor lizards

The way a reptile is handled can have a significant impact on both its short- and long-term well-being. Handling sets a precedent for the relationship between human and reptile, and even wild caught reptiles can adapt relatively quickly to captive environments if captured and handled in a stress-free manner. Similarly, farmed animals can become conditioned to handling to the point where they regard it as a routine and normal activity. Handling is essential throughout supply chains and is thus a critical component of welfare.

General

- Don't turn reptiles upside down (unless to examine righting response - see appx. I).
- Don't twist reptiles along their longitudinal axis.
- Don't dangle reptiles by the tip of the tail or head – support their body weight and length.
- Never pinch, squeeze, or compress any part of a reptile.
- Move slowly and deliberately.
- Ensure hands and equipment are clean.
- Avoid handling reptiles that are very hungry, breeding, or shedding.

Snakes

- Support the body weight at all times. Large constrictors may require two or more people (*Fig. 7*).
- Where possible, allow the snake to retain its resting configuration. Snakes may feel more vulnerable when stretched out (*Fig. 7*).
- Don't restrain the head with force unless absolutely necessary. If needing to restrain the head, never dangle the snake from its head as neck or spinal fractures may result.
- Never drop a snake from any height as soft tissue or skeletal damage can result.
- When lifting a snake, ensure it is fully disentangled from potential anchor points. The tail in many species is strongly prehensile and is prone to snagging on vegetation, cage furnishings, or even cage mates.
- Most venomous snake handling can be carried out without the need for excessive restraint. A common method is to use a hooked stick to control and guide the snake's head and upper body whilst the other hand holds the base of the tail (*Fig. 8*).
- Use snake 'bagging systems' wherever possible to further reduce stress during handling. Bagging systems are any form of device or contraption designed to simulate a natural retreat into the holding receptacle (*Fig. 8*). They are often perceived as a form of shelter and therefore provide a sense of security.
- Snakes should never be defanged, have their mouths sewn shut, or intentionally mutilated in any way.
- Prey scent and heat signatures are primary feeding cues for snakes. Use tongs, gloves, or feeding trays when feeding to avoid accidental bites.

Monitor lizards

- Support the body weight at all times by placing one hand under or around the neck and the other around the pelvis or base of the tail (*Fig. 6*).
- If the animal is struggling excessively, allow the body to dangle from the base of the tail with the front legs resting on the ground until it has calmed down. Never support the entire weight of a monitor by the distal half of the tail.
- Monitor lizards often thrash their tail as a defence mechanism. Precautions should be

taken to prevent the tail tip from striking sharp edges, which can cause injury.

- Welding gloves or similar protective hand-wear can provide protection from bites and sharp claws and thereby help to minimise the stress of handling for both the reptile and the handler. However, they do reduce sensitivity and the handlers' ability to judge restraint pressures so should only be used on large, robust specimens.

Reptile bites

Reptile bites are a common hazard in the reptile trade. Snakes bite for one of two reasons – fear or food. Most fear-related bites comprise a rapid strike and release action. Consequences to the handler vary, but these bites are mostly harmless to the snakes. Food-related bites and some defensive bites, where the snake holds on, are more serious. In most cases, the snake seems to sense a mistake has been made and lets go, but occasionally it will retain its hold. Unless performed correctly, forcefully dislodging a biting snake can result in significant injury to the reptile (e.g., broken teeth or jaws) or the handler (e.g., torn flesh). As snake teeth tend to be recurved backwards, a biting snake is best removed by pushing its top and bottom jaws forward while gently prying the jaws open. In constricting snakes, coils may have to be unravelled prior to disengaging the bite. If this doesn't work, the head can be doused with alcohol or vinegar to encourage the animal to let go. Be sure to avoid pouring the liquid down the animal's throat or trachea, and rinse the head thoroughly in clean water afterwards to ensure irritation is minimised. Monitor lizards have very powerful jaws and short, strong, recurved teeth. They tend to bite-and-hold in a vice-like grip. Similar protocols to snake bites should be followed, although the force required to pry the jaws open may be significantly greater.

Fig. 6 Humane handling of monitor lizards. The animal is caught and removed from its enclosure by the base of the tail. It is then secured around the neck and pelvis before being picked up. These animals resumed normal foraging behaviour shortly after they were returned to their enclosure

a

b

c

Fig. 7

The way reptiles are handled has important implications for well-being and welfare. Gently lifting in the resting configuration (a) followed by unrestrained but well-supported handling (b) causes the least amount of stress. Manhandling and physical restraint may be unavoidable at times (c), but bear in mind that this is stressful to the animal and may negatively impact well-being and market value.

Fig. 8 Tools such as bagging systems and hooked sticks enable venomous species to be handled safely and with minimal risk of stress or injury to the snake or the handler

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Appendix IV - Definitions

- **Closed-cycle farming:** The production of reptiles within a controlled captive environment independent of introduction of specimens from the wild.
- **Euthanasia:** Derived from the Greek terms eu meaning good and thanatos meaning death. The term is usually used to describe ending the life of an individual animal in a way that minimizes or eliminates pain and distress. A good death is tantamount to the humane termination of an animal's life.
- **Humane/Humanely:** To show compassion towards animals by minimising pain and distress
- **Humane killing:** Actions undertaken to euthanize an animal that results in rapid loss of consciousness and death of the animal that avoids or minimises pain and distress.
- **Science Based Animal Welfare (SBAW):** A scientific perspective that provides methodologies for evidence-based assessments of an animal's welfare. This is typically in contrast to emotive responses based on unmeasured or subjective opinions.
- **Supply chains:** the sequence of processes involved in the acquisition and distribution of the reptile or derived product. In this document they typically comprise the various commercial entities that exist from source (e.g. wild-caught) through to the point where animals are killed (e.g. restaurant).
- **Stress:** A response that activates behavioural, physiological and/or psychological coping mechanisms.
- **Unconsciousness:** Loss of individual awareness. Occurs when the brain's ability to integrate information is blocked or disrupted.

WELFARE PRINCIPLES FOR SNAKES AND MONITOR LIZARDS IN THE SOUTHEAST ASIAN SKIN TRADE

A guide for stakeholders

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SARCA Southeast Asian Reptile Conservation Alliance

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Swiss Confederation

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Federal Food Safety and Veterinary Office FSVO