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Review

Recommendations for the Creation of a Transit Rescue Shelter for Non-Traditional Pets

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Abstract

The keeping of non-traditional pets has markedly increased in recent years. These species are frequently maintained under inadequate or illegal conditions, raising substantial concerns regarding animal welfare. Authorities are regularly required to confiscate reptiles, arachnids, and other exotic taxa—often in poor health—and to accommodate them temporarily in transit facilities while long-term placement options are identified. Existing facilities are operating beyond capacity, creating an urgent need for the development of additional infrastructure. Given the potential risks associated with these animals, stringent safety measures are essential. Following an assessment of the hazards linked to housing primarily reptiles and arachnids—including risks related to venomous species, transmission of zoonotic pathogens, and the escape of potentially invasive organisms—the present paper provides a set of recommendations for the design and operation of transit housing facilities. The guidance focuses on infrastructure requirements, routine and emergency procedures, and daily management practices for both animals and facilities. Although these recommendations were developed within the specific regulatory framework of Southern Belgium, they may be applied more broadly, provided that local regulations are appropriately considered.

Keywords: non-traditional pets; biosecurity; housing; safety; procedure

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1. Introduction

An increasing number of individuals keep exotic animals, commonly referred to as non-traditional pets, including reptiles and arachnids. For example, the European Union ranks first worldwide in reptile imports [1]. The ownership of such animals is regulated, and, in Belgium, responsibility for this legislation lies with the regional governments.

In southern Belgium, the keeping of reptiles is regulated by a regional decree designed to ensure animal welfare and to oversee the marketing and possession of these species.

In 2017, the Walloon Council for Animal Welfare established a dedicated working group to develop a positive list of reptile species authorised for private ownership [2]. This initiative responded to the administrative complexity of environmental permit requirements, which had led many reptile owners to operate outside the legal framework. The

working group defined objective evaluation criteria to determine eligibility for inclusion on the positive list. These criteria encompassed: (i) ease of husbandry, including simple housing, reproducible environmental conditions, accessible food sources, manageable adult size, species vulnerability, sanitary considerations, and conservation status; (ii) absence of risk to human safety, recognising that dangerous species pose heightened handling risks, particularly for inexperienced keepers; and (iii) the availability of sufficient, accessible documentation on the species' biological needs and captive-care requirements. The resulting positive list was formalised through the Walloon Government Decree of 10 December 2020 [3] and implemented by the Ministerial Order of 25 February 2021 [4]. This regulatory framework governs the keeping and commercialisation of reptiles and establishes three categories of authorised species. Indeed, some species have specific housing requirements, in terms of surface area per animal, enclosure height, surface area and water depth (aquatic species), and additional provisions such as climbing structures, hiding places created with artificial plants, basking spots with a minimum daytime temperature, water temperature, need for daytime UVB light source, nighttime temperature, depth of substrate to allow burrowing, and the availability of hiding places made from flat stones [2]. These categories are: (i) reptiles that may be kept without additional conditions; (ii) reptiles whose keeping is subject to compliance with specific housing standards and the provision of a veterinary certificate; and (iii) reptiles requiring both compliance with enhanced housing standards and participation in an approved collective breeding and conservation programme, supported by veterinary certification and mandatory registration. The decree also restricts the species that may be sold or transferred within the Region [3]. Individuals who already kept reptiles prior to February 2021 were granted a six-month period to comply with the new requirements, including registration with the Directorate of Animal Quality and Welfare when applicable [5].

Only zoological parks, shelters, laboratories, and holders of a specific authorization are permitted to keep species not included on the approved list. Nevertheless, many individuals illegally possess exotic reptiles and amphibians that are not authorized for private ownership.

Each year, in Wallonia, numerous non-traditional pets are seized from private owners or recovered from the wild by official authorities (police, firefighters, etc.) following escape events. After seizure or capture, reptiles are initially transferred to specialized facilities (shelters, associations, rehabilitation centres, etc.) for temporary housing while a long-term solution is identified. According to the Walloon Animal Welfare Code, the management of abandoned, lost, or stray animals falls under the responsibility of the municipality. Municipalities maintain agreements with zoological parks to ensure the permanent care of these animals, and the designation of these facilities is publicly disclosed [6].

Once rehabilitated, when necessary, animals are most often transferred to permanent facilities such as zoological parks. Pairi Daiza, for instance, operates a dedicated shelter for abandoned reptiles and amphibians [7]. The number of reptiles taken in by Pairi Daiza in the recent years peaked in 2022 before decreasing progressively until 2024, i.e., 477 in 2020, 623 in 2021, 741 in 2022, 682 in 2023 and 529 in 2024 [7–10].

Until recently, animals seized or rescued in the district of Liège were temporarily housed in another district. With the objective of developing its own facility, the Liège municipality is planning to establish a new transit centre for seized animals. However, facilities intended to house such species must comply with stringent requirements. The aim of the present paper was to conduct a risk analysis and provide recommendations for the implementation a transit shelter for non-traditional pets seized by the authorities, with the objective of ensuring public safety, biosecurity and health for all stakeholders. These recommendations are consistent with the legislation currently in force in southern Belgium.

2. Risk Analysis

2.1. Animal Species of Concern

In the Belgian context, and based on past seizure records, the species involved are predominantly reptiles and invertebrates:

- Lizards: Iguana, gecko, chameleon, etc.
- Amphibians: Frogs, axolotl, poison dart frogs, etc.
- Snakes: Boas, pythons, etc.
- Several species of turtles.
- Caimans, alligators, and other crocodiles.
- Arthropods: Spiders, scorpions, myriapods, etc.

2.2. Specific Risks Associated with the Animal Species Concerned

Animals seized and/or found in public areas do not necessarily belong to the positive list of authorized species. Consequently, it is not unlikely that venomous or otherwise illegally kept animals may need to be handled. Two scenarios may occur [11]:

- Animals originate from breeding facilities (within Europe or elsewhere): in this case, monitoring and a certain degree of traceability from breeders to points of sale and owners are possible, providing some level of 'health assurance', despite potential carriage of common infectious pathogens. Indeed, animals are often bred at high densities and may have been subjected to selective pressure resulting from rational or irrational antimicrobial use (particularly antibiotics).
- Animals are taken directly from the wild and transported to other continents: in this case, no health guarantee exists, as their sanitary status is poorly known or entirely unknown. This represents a genuine health (and potentially zoonotic) and environmental risk, as natural environments are more conducive to animals carrying exotic infectious agents.

2.2.1. Venomous Species

Due to their venom, certain species such as snakes, spiders, and scorpions can inflict severe injuries to humans or even cause death. Nevertheless, most reptiles pose little to no risk [12]. Envenomation following a bite or stung results from the injection of a mixture of toxins, and some frog species also secrete potent toxins through their skin. Examples include:

- Snakes: Depending on the species, envenomation may have catastrophic consequences, ranging from immediate fatality to long-term sequelae such as amputation, or paralysis [13]. Several snake genera, as well as one genus of lizards (the beaded lizard and the Gila monster), produce venom capable of immobilizing prey but generally not posing significant medical risk to humans [12].
- Dendrobatids (colourful poison dart frogs): Their toxin ranks among the most potent known. However, individuals kept as pets—typically fed insect species different from those consumed in their natural habitat—generally do not pose a risk to humans, as the insects consumed in the wild contain specific chemical precursors required for toxin synthesis. Nevertheless, when frogs are taken directly from the wild, the risk is real: these animals secrete a powerful skin toxin that disrupts muscle contraction and causes locomotor impairment [14].
- Spiders: Only a small proportion of spider bites require antivenom treatment. However, bites from certain species can induce necrotic lesions, a condition referred to as necrotic arachnidism [15].

- Scorpions: The sting of some scorpion species constitutes a life-threatening medical emergency [16].

The availability and accessibility of appropriate antivenom in the event of an emergency may be uncertain. Venomous species should therefore be confined to a dedicated room with access restricted to limited authorized personnel.

2.2.2. Non-Venomous Species

Some non-venomous snakes and other reptiles may still pose a danger to humans, for example, through constriction (boas, pythons) or through severe bites (large lizards and crocodilians). However, most non-venomous species present minimal risk to humans [12].

Crocodilians can inflict serious bites, as can large lizards (e.g., monitor lizards), and one of the major associated risks is bacterial infection [17,18]. As in other reptile species, the oral cavity of snakes harbors a commensal bacterial flora (e.g., *Pasteurella* spp. [19], *Staphylococcus* spp. [20]). Secondary infections may develop following a bite [21]. Turtles are also capable of inflicting severe bites.

The urticating hairs of certain spiders can cause irritation, pruritus, or even trigger allergic reactions, which may occasionally be severe (including anaphylactic shock), as well as ocular lesions. These hairs may represent a greater risk to the handler than the bites themselves [22,23].

2.3. Risk of Transmitting Zoonotic Pathogens

Among vertebrate non-traditional pets of concern, turtles, snakes, and other lizards can act as reservoirs for a wide range of potentially zoonotic pathogens. Although many of these pathogens are not currently present in Belgium, illegal trade poses a risk of their introduction.

Table 1 presents a non-exhaustive list of potentially zoonotic pathogens that may be transmitted by reptiles. Among bacterial diseases, reptile-associated salmonellosis is considered the principal zoonosis of reptilian origin. Reptiles and amphibians may also act as reservoirs or hosts that enable the overwintering of certain viruses, particularly arboviruses. Numerous mosquito species—including *Aedes aegypti* and *Ae. albopictus*—are capable of feeding on reptiles, which are even preferred hosts for these vectors. Most reptile groups may test seropositive for various arboviruses [24].

Table 2 summarises a non-exhaustive list of reptile ectoparasites and their potential associations with pathogens.

Table 1. Non-exhaustive list of potentially zoonotic pathogens in the transmission of which reptiles could be involved.

Pathogens	Characteristics	References
Bacteria and bacterial diseases		
Salmonella spp.	Reptiles are asymptomatic carriers	[11,25–40]
	Cause reptile-associated salmonellosis, transmitted to humans via direct or indirect contact (contaminated environment)	
Non-tuberculous mycobacteria	Reptiles generally develop granulomatous lesions in several organs	[41]
	Systemic infections reported in lizards, snakes, turtles and crocodiles	[42–49]
- *Mycobacterium chelonae*	Recent cases reported in amphibians	[50]
	Reptiles (chameleons, lizards, iguanas, snakes, crocodiles, turtles) and amphibians	[29,41,50,51]
- *M. gordonae*	Turtles—in the wild	[52]
- *M. peregrinum*	Turtles	[41,50]
- *M.fortuitum*	Snakes and turtles, crocodiles	[41]
- *M. kansasii*	Turtles, snakes	[46,51]
- *M. haemophilum*	Turtles, snakes	[44,50,51]
- *M. avium*	Turtles	[50]
- *M. marinum*	Snakes, turtles, dragons	[33,44,50,51]
- *M. kumamotonerse*	Iguanas	[51]
- *M. ulcerans*	Lizards	[29,50]
- *M. szulgai*	Crocodiles	[53]
- *M. leprae*	Snakes	[50]
- *M. genavense*	Snakes bred in captivity	[54]
Chlamydia spp		[19,33,55,56]
- *C. pneumoniae*	Recent cases have been reported in reptiles and amphibians although no zoonotic infections documented to date	
- *C. abortus*	Isolated from turtles and snakes	
- *C. psittaci*	Isolated from turtles and crocodiles	
Aeromonas spp.	Asymptomatic carriage in reptiles	[5,33,37,40,57]
	Humans may become infected through exposure to contaminated water, by ingesting contaminated meat or following injuries inflicted by reptiles that have been in contact with or inhabit contaminated aquatic environments	
Enterobacteria (other than *Salmonella* spp.)		
- *Escherichia coli*	Amphibians may play a role in the epidemiology of human infections	[59]
- *Campylobacter* spp.	Asymptomatic carriage by reptiles	[37,40,60–62]
- *Clostridium difficile*		[63]
- *Klebsiella* spp.	Reported in dragons and turtles	[64,65]
- *Yersinia* spp.		[19,37]
- *Enterobacter cloacae*	Turtles (conjunctival infections)	[66]
- *Edwardsiella tarda*	Isolated from asymptomatic reptiles	[58]

Table 1. *Cont.*

Pathogens	Characteristics	References
Leptospira spp.	Reptiles—particularly turtles and crocodilians, which are more exposed due to their aquatic habitat—may play a role in the epidemiology of the disease without developing clinical signs.	[19]
	Humans can become infected through contact with water, soil or food contaminated by infected urine).	
	Many reptiles are seropositive but without showing clinical signs (rattlesnakes, turtles, lizards, crocodilians, etc.)	
Burkholderia pseudomallei	Isolated from a green iguana in Belgium and from another one in the Czech Republic	[67,68]
Coxiella burnetii	Isolated from three turtle species	[58,69]
Erysipelothrix rhusiopathiae	Isolated from snakes	[29,33,58]
Pseudomonas spp.	Part of oral flora of snakes	[20,57]
Streptococcus spp.	*S. agalactiae* reported in reptiles (crocodile, snakes, emerald tree monitor) and frogs	[70]
Dermatophilus congolensis	Isolated from crocodilians, among others	[29]
Arthropod-borne intracellular bacteria		
Anaplasma spp. *Ehrlichia* spp.	*Ixodes ricinus* sometimes feeds on reptiles	[71,72]
Borrelia spp.	Reptiles are natural reservoirs of Lyme disease and other borrelioses (including *B. lusitaniae*)	[73,74]
	Lyme disease probably associated with certain lizard species (natural reservoirs)	[74–76]
Rickettsia spp.	Reptiles play a direct role in the epidemiology of certain pathogens belonging to the order Rickettsiales and the family Rickettsiaceae	[77,78]
	- *R. helvetica* & *R. monacensis*: detected in *I. ricinus* and in the blood and tail of lacertid lizards	[79]
	- Other *species* isolated from reptile ticks (and sometimes mites): *R. aeschlimannii, R. amblyommatis, R. hoogstraalii, R. massiliae, R. raoultii, R. rhipicephali, R. tamurae, R. typhi*	[80]
Viruses and viral diseases		
West Nile fever (WNF)	Many reptile species are considered as potential reservoirs of west Nile virus	[81,82]
	Crocodilians can amplify the virus, infect a mosquito and excrete the virus in their feces, in addition to the development of clinical signs.	[83,84]
	Crocodiles can transmit the virus to their congeners without the intermediary of a mosquito vector	[85]
Equine encephalomyelitis (Eastern [EE], Western [WE] and Venezuelan [VE]) viruses	Many reptiles are considered as reservoirs of EEEv, WEEv and VEEv.	[1,81,82]
	VEE can replicate in reptiles	[81,86]
Chikungunya virus	Reptiles could amplify the virus	[81,82,87]
Crimean-Congo haemorrhagic fever virus	Isolated from turtles, primary hosts of *Hyalomma aegyptium* ticks	[88]
	The virus could circulate in a cryptic transmission cycle (in addition to the primary transmission cycle), that could play a role in the natural dynamics of the virus and its transmission to humans	
Endoparasites		
Pentastomids (exotic to Europe)	Parasitic arthropods that develop in the respiratory tract and cause pentastomiasis in humans. Although most infections occur through the ingestion of snake meat, individuals in contact with nasal secretions, saliva, or fecal matter from snakes are also at risk.	[89]
- *Armillifer* spp.	Snakes	[33,37,57]
- *Raillietiella hemidactyli*	Lizards (e.g., geckos), snakes and toads	[90]

Table 1. *Cont.*

Pathogens	Characteristics	References
Nematodes and cestodes	Reptiles are hosts of some potentially zoonotic nematodes; humans generally become infected after eating contaminated reptile/amphibian meat or water.	[89]
- *Spirometra* spp.	Cestode most frequently associated with reptiles and amphibians; causes sparganosis in humans	[89]
- *Angiostrongylus cantonensis*	Snakes and amphibians are intermediate hosts	[91–93]
- *Trichinella* spp.	Amphibians and reptiles are paratenic hosts	[94]
	T. zimbabwensis and *T. papuae* are found in large carnivorous reptiles (i.e., crocodiles and monitor lizards)	[95]
Protozoans		
Cryptosporidium spp.	High morbidity and mortality rates in reptiles (snakes, lizards, and turtles) and amphibians.	[89,96–98]
	Snakes: contaminated by ingestion of infected rodents.	[96,97,99,100]
	Excretion of oocysts demonstrated in lizards, snakes and turtles	[96,97,99,100]
Toxoplasma spp.	Cold-blooded animals would be intermediate hosts	[101]
Giardia spp.	Rarely described in reptiles	[98]
Leishmania spp.	Reptiles are potential reservoirs—presence of antibodies	[102]
	L. infantum isolated from geckos in Italy + amastigotes in the bone marrow ≥ animal not only exposed to the parasite but also infected	[103,104]
Blastocystis spp.	Isolated, among others, from turtles, snakes and iguanas	[105]
Enterocytozoon bieneusi	Identified from many reptiles and amphibians	[106]
Fungi		
Basidiobolus spp., *Conidiobolus* spp.	Frequent commensal ubiquitous saprophytes of the reptile digestive tract.	[37,40]
	Transmission to humans may occur through inhalation, ingestion or skin contact with fungal spores present on the skin or in the feces of contaminated reptiles; they may cause zygomycosis in humans	
Zoonotic pathogenic yeasts		
Candida albicans, Trichosporon spp., *Saccharomyces* spp., *Geotrichum* spp.	Some lizard species may act as environmental reservoirs and disseminators through their feces. They are thought to form part of the normal gastrointestinal microbiota of lizards	[107]

EEE = Eastern equine encephalomyelitis; VEE = Venezuelan equine encephalomyelitis; WEE = Western equine encephalomyelitis; WNF = west Nile fever.

Table 2. Non-exhaustive list of reptile ectoparasites (arthropods and ticks).

Ectoparasites	Characteristics	References
Ticks		
- *Ixodes ricinus*	Lacertid lizards are the primary hosts for the immature stages of these ticks and may contribute to the epidemiology of certain tick-borne pathogens, including *Borrelia burgdorferi*, *Rickettsia* spp., and *Ehrlichia* spp.	[74,76]
- *Haemophysalis* spp.	Parasite of lizards and vipers	[80]
- *Hyalomma aegyptium*	Exotic ticks may be introduced into non-endemic regions through reptile trade; for example, the illegal importation of turtles infested with *Hyalomma aegyptium* has been documented in Italy	[33,108]
Sandflies	Certain *Leishmania* species have been detected in lizards, and the association between lizards and sandflies may contribute to the epidemiology of leishmaniasis.	[89,104]
Mites		
- *Ophionyssus natricis*	In addition to causing dermanyssic acariasis in snakes—which can also affect humans—it acts as a mechanical vector of *Aeromonas hydrophila*, particularly in snakes	[26,58,89,109–111]
- *Neotrombicula autumnalis*	Detected in lizards, in Italy; potential vector of *Borrelia* spp.	[79]
Mosquitoes	Reptiles can harbour arboviruses (see Table 1)	[112]

Reptiles serve as blood-meal sources for numerous hematophagous arthropods, including mites, ticks, sandflies, and mosquitoes, and may therefore act as potential reservoirs for a variety of arthropod-borne pathogens [89].

Reptiles are known reservoirs for several potentially zoonotic parasites [89]. Additional parasitic species have been isolated from reptiles and are considered potentially zoonotic, although no causal association with human disease has yet been demonstrated.

Reptiles and their environments may also serve as reservoirs for pathogenic or opportunistic fungi and yeasts [113]. Immunocompromised individuals are particularly susceptible to these pathogens.

2.4. Risk of Importing Exotic Diseases in Free Areas

The trade in exotic reptile and amphibian species carries the risk of introducing exotic ticks and potentially zoonotic pathogens into non-endemic areas, particularly when such trade occurs illegally. Introduced species may transport pathogens from endemic areas into previously disease-free regions [114]. The introduction of invasive species has likely contributed to the emergence of zoonotic diseases [115]. Numerous examples of pathogen introduction have been documented in amphibians and reptiles:

- In 2008, 585 turtles were illegally imported into Italy from North Africa; 221 were infested with ticks—specifically *Hyalomma aegyptium*, an exotic species capable of carrying *Rickettsia aeschlimannii* or *Borrelia turcica*, both zoonotic pathogens [80].
- The amphibian trade has facilitated the emergence and spread of chytridiomycosis (caused by *Batrachochytrium dendrobatidis*) following the introduction of infected bullfrogs into countries such as the United States and Venezuela [116–118].
- *Rickettsia* spp. has been detected in exotic ticks (*Amblyomma exornatum*) collected from a reptile farm in the United States [119].
- Tiger salamanders, widely used as fish bait, have disseminated iridoviruses across the United States [120].

2.5. Risk of Escape of Non-Native Species

The escape or release of exotic animals into the wild is one of the primary pathways through which non-native species become established in new environments, where they may negatively affect local ecosystems. The establishment of breeding populations can have detrimental impacts on native wildlife, human activities, and the environment, and represents a significant threat to biodiversity [33,121–125]. Numerous examples have been documented, including:

- Burmese pythons, native to Southeast Asia and popular in the pet trade in Florida: some individuals have escaped, and thousands now inhabit the Everglades wetlands, where they compete with native fauna and prey on endangered species [125].
- Cuban tree frogs (*Osteopilus septentrionalis*), native to Cuba, the Cayman Islands, and the Bahamas: they were accidentally introduced to Florida in the 1920s, likely via ship cargo, and their populations have continued to expand since then [126].

3. Recommendations for the Establishment of a Transit Shelter Based on Previous Risk Analysis

3.1. Location of the Facility

The premises intended to house these animals should be located away from areas with frequent human traffic for security reasons; such placement reduces the risk of intrusion by unauthorized people.

3.2. Infrastructure

3.2.1. General Recommendations

Access to the building should be secure and restricted to a limited number of authorized personnel. The implementation of electronically controlled entry (e.g., keycard access) is strongly recommended, as it enables traceability of all movements, which may be essential for biosecurity and for the monitoring of potential exposure to zoonotic pathogens.

A secondary anteroom should be incorporated immediately after the primary entrance (see Section 3.2.2).

The building should be divided into several separate rooms, each dedicated to a specific level of risk. At minimum, three distinct rooms should be planned, i.e., (i) quarantine, (ii) non-venomous animals, and (iii) venomous animals.

The door of each room should be fitted with mosquito netting, and all doors should include security-grade windows to allow observation from outside.

A dedicated care area is strongly recommended within each room to avoid moving animals elsewhere for routine procedures, thereby reducing the risk of escape.

The ventilation system should be adapted to the needs of the species housed, and mosquito netting should be installed on every air vent, including those in rooms not currently housing animals.

Before any animals are introduced, the entire building should be thoroughly inspected to identify cracks or holes that could serve as potential hiding places. All breaches and crevices should be repaired. Walls should be painted white to facilitate rapid detection of escaped animal, and light-coloured flooring is similarly. Walls and floors should be constructed from materials that are easy to clean and resistant to commonly used disinfectants.

Furnishings should be kept to an absolute minimum to avoid providing hiding places for animals that might escape.

3.2.2. Creation of an Anteroom

A buffer zone or anteroom should be established between the main entrance of the shelter and the animal-housing premises. This measure provides an additional safeguard against animal escape. Doors should be fitted with security glass, and the installation of an interlocking system as an added precaution.

The anteroom should be equipped with a sink fitted with an eye-washing station.

Essential personal protective equipment (PPE)—including gloves, protective goggles and masks when handling arachnids—should be available, along with a coat rack, a dispenser of hydroalcoholic hand sanitizer, and a foot bath or foot mat. Whenever possible, items should be stored in tightly sealed cabinets to avoid creating potential hiding places.

An emergency kit containing Aspivenin® (Aspivenin™, Dômes Pharma FR Division Officine, Lempdes, France) and a container for biologically contaminated waste should also be present.

Several documents and notices should be displayed in the area, including standard operating and emergency instructions (e.g., contact list for animal escape and capture, emergency phone numbers, initial first aid in case of a bite, and the procedure to follow in the event of an escape), as well as floor plan of the facility.

The following records must be available (e.g., stored in the anteroom), as required by Belgian legislation:

- Animal register: the person responsible for animal care must ensure that it is kept up to date and that no animal is missing during checks.
- Separate register for venomous animals
- Record of people entries and exits, enabling full traceability
- All animal names must be recorded using in Latin nomenclature (species and subspecies).

3.2.3. Storage Room

An additional room may be used as a storage area for litter and feed. These materials should be kept in a space enclosed by a screen or mosquito netting. The storage room may also be equipped with a freezer and a refrigerator for storing animal feed (e.g., carcasses of rabbits, mice and poultry, as well as fruits, insects, etc.).

All equipment in the storage room should be arranged to avoid—or at least minimize—potential hiding places for any escaped animal.

3.2.4. Housing Rooms

Animal-housing rooms should be equipped with a safety-glass door fitted with mosquito netting. These rooms should not contain windows. As noted above, all air vents must be fitted with securely fastened, fine-mesh screen (mosquito-net type).

Custom-built stacking enclosures should be constructed from materials that are easy to clean and disinfect. Reptile-specific enclosures must provide adequate privacy to ensure a sense of security, allow for an appropriate thermal gradient, and permit efficient cleaning and disinfection. For biosecurity reasons, animals should be housed individually. Each animal must be provided with an enclosure of appropriate size, suitable heating and lighting, digital thermometers and thermostats for temperature control, and a safe substrate [127]. Environmental enrichment is also strongly recommended as it promotes mental stimulation, foraging, and exercise, all of which contribute to overall health and welfare [128]. Alongside biosecurity considerations, hiding opportunities, visual isolation, and minimized handling are also good practices to recommend [129].

As previously mentioned, animal care should be performed within the housing room: no animal should be removed from its designated area. Each room should therefore contain the necessary care equipment, stored in a locked, sealed cabinet, as well as a work surface. Installing a sink for hand hygiene and for cleaning animals and equipment is strongly encouraged, along with dispensers of paper towels and hand sanitizer.

For additional surveillance, the installation of a closed-circuit television system may be considered.

3.2.5. Quarantine Room

The quarantine area should be located as far as possible from other animals [127], ideally in a separate building. If this is not feasible, a room situated at the opposite end of the facility is considered sufficient [127].

New arrivals should be placed in this room, as their condition and health status are often unknown.

A 'single' safety-glass door is adequate for the quarantine room.

During quarantine, animals should be monitored for any signs of illness [127] but handled as little as possible to reduce the risk of contamination and to minimize stress, allowing them to acclimate. The quarantine period should last at least 30 days and may be extended if the animal originates from a questionable source or from a location where it may have been exposed to numerous other animals. The substrate should allow easy detection of mites and abnormal faeces. Monitoring should include assessment of general appearance and behaviour, defecation and urination, internal and external parasites, respiratory signs such as wheezing or gasping, abnormal movements or postures, and feeding behaviour. Body weight should be recorded weekly using a reliable scale. For snakes, quarantine should not end until they have successfully consumed at least four meals [127].

The use of PPE dedicated to the quarantine area, combined with strict cleaning procedure (including transport in sealed bags until laundering) is strongly recommended. This includes a respiratory mask, examination gloves, and a protective gown, as well as protective goggles and specialized gloves when handling arachnids. A white protective gown or lab coat is preferable, as it facilitates the detection of any escaped animal.

As mentioned above, animals placed in quarantine should receive all necessary care within the quarantine room, thereby reducing opportunities for escape.

A completely separate set of tools and supplies must be dedicated to quarantined animals, including cleaning materials, feeding tongs, spray bottles, paper towels, food supplement, and similar items. All equipment should be kept to a minimum and must be easy to clean and disinfect. Dedicated items such as feeding dishes, water containers, and cleaning tools should be used exclusively for quarantined animals to prevent inadvertent pathogen transmission.

All waste and uneaten food should be disposed of in containers designated for biologically contaminated material.

Animals housed in the quarantine area should be attended to only after all 'established' animals have been cared for. Within the quarantine area, apparently healthy individuals should be handled before those showing signs of disease, following the principle of onward progression.

It is strongly recommended that any animal still exhibiting signs of illness at the end of the quarantine period remain in quarantine until full recovery.

3.2.6. Room for Non-Venomous Animals

A single safety-glass door is sufficient for access to non-venomous animal rooms.

3.2.7. Room for Venomous Animals

For access to venomous animals, a double-safety-glass door is strongly recommended, along with additional access-control measures. Only the minimum number of responsible personnel should be authorized to enter the room.

The door should always remain locked and must be equipped with an internal panic button or bar to allow rapid evacuation in case of emergency.

A dedicated animal register should be available, and each enclosure must display the following information: precise species identification (Latin name), the specific risks associated with bites or stings, emergency measures to be taken, and availability of antivenom within the region.

3.3. Procedures

From a biosecurity perspective, personnel behaviour plays a critical role; for example, wearing jewellery or a watch should be avoided. Rings may pose a problem in the event of a bite if oedema develops.

Several procedures should be documented and displayed within the facility, including:

- Protocols for new arrivals, which may take the form of a decision tree beginning with the determination of whether the animal is venomous.
- Cleaning and disinfection procedures.
- Emergency procedures, including a cascade of contact numbers when required (e.g., in the event of an escape).
- A list of designated personnel responsible for animal capture.
- Initial first-aid measures to be taken in the event of a bite.

3.4. Animal Arrival and Daily Management

Upon its arrival in the shelter, examination of the animal by a specialized veterinarian is essential to identify potentially contagious animals that require isolation.

The daily management of the shelter should be entrusted to a primary care and feeding manager who has experience with non-traditional pets. At least one alternate person with similar expertise should be designated to assume responsibility in their absence. The number of staff involved in the daily management and care of animals should be kept to a minimum, which is particularly critical for the handling of venomous species.

In addition, several individuals should be trained in the capture of non-traditional pets. These people should be easily contactable through a cascade contact list.

No person should enter the facility alone; at minimum, they should record entry time and expected exit time. This ensures that, if they do not leave within the anticipated timeframe, an alert can be raised.

Regarding nutrition, it is essential to ensure that reptiles receive appropriate nutritional supplementation during their stay, as deficiencies may compromise immune function and increase susceptibility to infection.

Feed should be stored under appropriate conditions. A refrigerator must be installed within the facility, for example in the anteroom or in a designated storage room (as proposed above).

Cleaning and disinfection: Maintaining a clean and sanitized enclosure is a fundamental component of biosecurity. Regular cleaning and disinfection of the habitat, substrate, and all equipment are essential to prevent the accumulation of pathogens and the transmission of infectious diseases [130]. All enclosure surfaces should first be cleaned to remove visible debris and organic material, using a cleaning solution that is safe for reptiles. The enclosure should then be disinfected with an appropriate product, following the manufacturer's instructions regarding contact time and dilution. Commonly used disinfectants for reptile husbandry include quaternary ammonium compounds and accelerated hydrogen peroxide. The disinfectant must be thoroughly rinsed off before the animals are returned to their enclosure, as chemical residues may be harmful.

Equipment such as water dishes, heating elements, and other accessories (enrichment items, etc.) must also be cleaned and disinfected regularly to limit the proliferation of pathogen.

Substrates—including newspaper, paper towels, or specialized reptile bedding—should be replaced frequently to maintain a hygienic environment.

Appropriate waste disposal: Soiled substrate, faecal material, and other waste must be disposed of in a manner that prevents the spread of potential pathogens. The use of

appropriate PPE, such as gloves and face masks, is strongly recommended when handling waste to minimize exposure risks.

Monitoring of animals and their environment: Different taxa may show different signs of stress, illness, or behavioural changes, and specifying observation criteria for each group—including feeding behaviour, activity levels, and species-specific clinical signs is of prime importance. In order to increase the practical applicability of the guidelines, it is recommended that specific records be written using these criteria according to taxa that are keep. For example, reptiles should be observed daily for any signs of illness, including changes in appetite, lethargy, respiratory distress, or skin abnormalities. A veterinarian experienced with non-traditional pets should be consulted promptly if clinical signs are detected, as early intervention is critical for successful treatment.

Environmental parameters—such as temperature, humidity, and lighting—must also be monitored daily to ensure optimal health and welfare.

Regular inspection of infrastructures: All facilities should be inspected routinely to prevent escapes. Walls and floors must be checked for cracks and holes, air vents for structural integrity, and mosquito nets for tears. Any defects should be repaired immediately upon detection.

3.5. Emergency Procedures

3.5.1. In the Event of Animal Escape

In the event of an escape, the animal would be required to pass through several physical barriers; after leaving the terrarium, it would still need to cross at least two doors and a screen door. No other exit routes are possible, as all air vents are secured with fixed mesh comparable to mosquito netting.

If an escape is suspected, all non-essential personnel must immediately evacuate the area. The responsible person must ensure that all doors are securely closed and notify site security as well as staff trained in the capture of non-traditional pets (as previously mentioned, informational posters should be available and clearly visible in each room).

If an animal escapes within the 'quarantine' or 'non-venomous' premises, the responsible person on site may attempt to locate and capture the animal, with or without assistance from other trained personnel, depending on the circumstances.

In the event of an escape in the 'venomous' room, the individual present must leave the premises immediately after ensuring that all terrariums, screens, and doors are securely closed. In the anteroom, the person should remove as much clothing as possible and verify once more that the animal is not on his/her person before exiting the facility. That person must then wait outside for the designated expert to coordinate the capture, but is also responsible for informing colleagues about the identity of the escaped animal, the risks associated with its capture and the precautionary measures required.

It is also strongly recommended to anticipate potential incidents during capture attempts by ensuring that antivenom is available within the country (ideally nearby). As a precaution, emergency services should also be notified.

3.5.2. In the Event of Envenomation

A clear procedure outlining the measures to be taken should be available in both the venomous room and the anteroom. These measures include remaining calm, immobilizing the bite site, contacting emergency services and antivenom providers (e.g., in Belgium: ZNA Antwerp reference hospital, Alphabiotoxone Laboratory, and relevant local hospital contacts), and using an Aspivenin® device (Aspivenin™, Dômes Pharma FR Division Officine, Lempdes, France), even though its effectiveness remains debated. Clothing should be removed from the affected area before oedema develops.

4. Conclusions

The appropriate housing of non-conventional pets, such as reptiles, amphibians, and arachnids, is of critical importance, even for short-term accommodation. Several risks must be considered and assessed when planning the development of facilities dedicated to housing these species. The risk of establishing invasive exotic populations must be mitigated through infrastructure and procedures that effectively prevent animal escape. A suitable quarantine system, combined with strict biosecurity measures, should minimize the risk of introducing and disseminating exotic pathogens, whether zoonotic or not. Proper training of personnel by experienced professionals, the implementation of biosecurity protocols—such as the use of appropriate PPE—and strict compliance with existing regulations and emergency procedures should reduce risks to human health and safety, including those related to zoonotic pathogens, venomous incidents, and physical hazards.

The risk analysis and resulting recommendations are tailored to the context and legislation currently in force in Southern Belgium, but they may be readily applied to other settings, provided that local regulatory frameworks are taken into account.

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