QUARANTINE AND DISEASE PREVENTION
Rachel E. Marschang
Laboklin GmbH & Co. KG, Bad Kissingen, Germany

Introduction

Quarantine and disease prevention are central issues in any reptile collection. A quarantine period allows animals new to a collection to acclimatize to the new surroundings. It is a period in which animals can be closely observed, given regular health checks, their medical history and provenance confirmed, treated for any infections or diseases, and monitored over a period of time. The goal of quarantine is to reduce the risk of introduction, transmission, and spread of pathogens and disease within a collection as well as between different parts of a collection, between a collection and outside collections, as well as transmission of pathogens and disease between a captive collection and wildlife. Infectious agents, including parasites, bacteria, fungi, and viruses, are important causes of morbidity and mortality. Treatment options for many infectious diseases of reptiles are inadequately described in many cases, and the variety of reptile species seen in practice and the variety of infectious agents associated with various species make hygiene and quarantine important aspects of any health plan. In addition, many infectious agents cause persistent infections in reptiles, and complete freedom from any given agent can be difficult or impossible to achieve. Preventing the introduction of disease into a collection is often the best method for keeping animals healthy over the long term.

As ectotherms, reptiles rely on their external environment in order to perform many of their bodily functions. The immune system is also reliant on adequate environmental temperatures. This is important for the diagnosis of infections as well as for developing treatment and quarantine plans. In addition, movement and holding in a quarantine area, as well as introduction into a new collection, are all stressful for an animal, and some species and some individuals will be more susceptible to stress than others. This will also affect the immune system and may make animals more susceptible to infection and to disease following infection.

Any quarantine plan should consider the physiology of the species involved as well as factors including age, source, and previous contacts with other animals. The husbandry requirements of the species will also influence quarantine procedures. It is important to remember that infectious agents may be present in an existing collection, and that newly introduced animals may be more susceptible to infections. It is therefore important to consider the health status of both newly incoming animals and of those already present in a collection.

General requirements
A quarantine is embedded in a preventive medicine program which includes identification of the animal, parasite monitoring and control, nutritional management, reproductive management, water quality management, pest management, routine testing for selected diseases and pathogens, health and disease surveillance, as well as investigation of illness or death in the collection.

In order to carry out an effective quarantine, it is important to have an appropriate place in which to keep animals during the quarantine period. This area must, of course, provide an appropriate environment for the species. This should include temperature gradients, lighting, including UVB light as necessary, provision of water, food, space to move, climb, and dig, and places to hide. On the other hand, hygiene is extremely important during quarantine, even more so than in normal husbandry, and in many cases, compromises will need to be made between optimal husbandry and high standards of hygiene. In general, all terrariums and fixtures as well as tools used with the animals or used to clean the area, should be dedicated to the quarantine area and should be either easily cleaned and disinfected or disposable. It is advantageous to use elements that are heat resistant, as numerous infectious agents are susceptible to heat, and some parasite stages are most easily inactivated by damp heat (e.g. amoeba and cryptosporidia cysts). In addition, the location of the quarantine area relative to other reptiles should be considered. Ectoparasites, e.g. mites, can move between terrariums and even farther and insufficient treatment or insufficient distance between the quarantine area and animals in the collection can lead to transmission. There are also several infectious agents that can be transmitted via aerosols, e.g. ferlaviruses and nidoviruses in snakes, therefore a shared air space can lead to transmission.

**Initial veterinary exam**

The first important aspect of a quarantine exam is a thorough history. Knowing whether an animal is wild-caught or captive bred, and whether it was purchased from a private owner, from a pet shop, or at a trade show will provide important information on what infectious agents it might have been exposed to as well as how stressed it may be and how adequate husbandry conditions may have been prior to purchase. In many cases, many aspects of previous husbandry will not be known for a newly purchased animal, and the history will focus on the circumstances surrounding the purchase of the animal. Ideally, quarantine procedures will begin with initial exams and testing before the animal is purchased or moved, but that is rarely the case for privately owned and purchased animals.

All animals should be given a complete physical exam at the beginning of quarantine. Animals should be clinically healthy before integration into an existing population, and the causes of any signs of disease should be determined and treated if possible. The health status of animals should also be monitored throughout the quarantine period, and any changes in health status should be followed by additional testing and treatment. A fecal exam for the detection of intestinal parasites should be included in the initial exam.
Laboratory diagnostics

Laboratory diagnostics are necessary for the general evaluation of the health of animals in quarantine as well as for the detection of specific infectious agents. Blood tests, including hematology and blood chemistry, can provide important evidence for the health status of animals, and can also provide evidence for possible infections. Testing for infectious agents should always include fecal exams for intestinal parasites (including protozoa and metazoa). In addition, direct detection of specific infectious agents that are common or of particular importance in the species (often via PCR), and, in some cases, serology are also important. For direct detection of infectious agents, it is important to note that many infectious agents can cause persistent infections in reptiles, and that clinically healthy animals may harbor these agents, but not actively shed them. This means that minimally invasive samples that can easily be collected from live animals may not be sufficient for detection. While repeat testing and increased length of quarantine can increase the chances of detecting infectious agents, there is no sure way to guarantee that all relevant agents can be diagnosed. Serological testing can provide evidence of previous infection, and can be helpful in some cases, e.g. to detect antibodies against herpesviruses in some species of terrestrial tortoises.

When deciding what infectious agents should be included in a quarantine screening protocol, it is also helpful to differentiate between agents that can be expected to cause severe disease in a species during the duration of the quarantine, and those that may not. Including testing for agents that may not cause manifest disease during quarantine but pose a threat to the infected animals or to the collection should be prioritized.

Duration

There is much discussion among reptile keepers and veterinarians about the length of quarantine that should be recommended. As a general rule, the longer the quarantine period, the less likely that an infectious agent will be introduced into a collection. In animals that brumate during the winter, it is generally recommended to include a brumation period in the quarantine, and to examine animals before and after brumation. Ideally, animals should always be examined at the beginning and at the end of quarantine and testing for infectious agents should be carried out at the beginning and end of quarantine. Any necessary treatment for infections or disease (e.g. for parasites) should be completed and the success determined before the animals are moved. A period of two to three months is generally considered an absolute minimum, but details will depend on the species involved.

Disinfection

During quarantine as well as in all other aspects of reptile husbandry, general hygiene and disinfection play an important role in the prevention of infection. Both chemical and physical methods are routinely
used for the inactivation of infectious agents. Biological inactivation of these agents can also play a role in infection dynamics in some cases, e.g. for animals kept in outdoor enclosures. Various types of infectious agents react differently to disinfectants. Vegetative bacteria and enveloped viruses are relatively susceptible to disinfection, while nonenveloped viruses, fungal spores, mycobacteria, bacterial spores, and parasite cysts are increasingly resistant to disinfection. Some chemical disinfectants can also be toxic for reptiles, making rinsing after disinfection especially important.