Preliminary report on the use of a thermal imaging camera at Durrell Wildlife Conservation Trust

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Being involved in developing and promoting best practices for using visible light, ultraviolet and heat radiation for the husbandry of reptiles and amphibians in European zoos, we are constantly looking into and adjusting how lamp combinations should ideally be arranged to allow our captive species to thermoregulate in a most natural and efficient way. This is especially important for larger reptiles, e.g. tortoises, iguanas or monitor lizards. Here, basking under many radiation devices, especially infrared-C radiation-emitting ceramic heaters can lead to abnormally high and uneven skin temperatures while the body's core is typically not heated through. Unsuitable lamp arrangements or the use of few lamps can create basking sites, which are too small to allow all parts of the animals to heat evenly. In these cases appendages like limbs and tails or even areas of the body often remain relatively and unnaturally cool. Detrimental effects of poor lighting and heating can include stress, hormonal imbalances, burns, vitamin hypo- or hypervitaminosis, behavioural abnormalities and reproductive disorders. A very good summary of these effects were presented by A. Highfield, accessible under http://www.tortoisetrust.org/articles/baskinghealth.html.

To be able to study and test various combinations of lights and heat sources and their effect on and suitability for thermoregulation in reptiles, a thermal imaging camera is an invaluable tool. It allows us to evaluate in detail the methods and equipment needed to provide our animals with an effective and safe basking area. Trials with different measuring equipment proved high-resolution thermal imaging cameras (min. resolution 120 x 160) to be one of the most useful and telling ways of looking into the subject. Of course, this is not restricted for employment in an indoor zoo environment but should also be used outdoors: after all, we want to replicate the natural environment in our enclosures as best as possible and therefore need to be able to compare.

With this motivation in mind, we were able to purchase a professional thermal imaging camera in October 2016, generously funded by the British Chelonia Group.
We decided on the model IC080LV manufactured by Trotec, Germany, a camera that is in use and has been tested in other UK zoological institutions. Not only did this give us confidence in the product, it also allows for easier comparison of findings between institutions.

We were originally intending, after an initial learning period, to utilise the camera

Fig.1: Trotec IC080LV thermal imaging camera (images taken from www.trotec.com).

early on in structured research, substantial changes in departmental resources at that time unfortunately did not allow such a systematic project to be initiated.

However, we did make significant progress in understanding the outputs of our light and heating devices in various contexts. It is quite a revelation being able to see directly and instantly the effects a given lamp and lamp/heat combination has on the (external) body temperature of an animal. In the past, a thermometer's probe or IR emission readings only measured the temperature in one or several small points, e.g. under a lamp, from which one then had to estimate whether a basking area seemed suitable.

Extending basking zones and positioning suitable lights in a way to achieve larger, more evenly heated basking areas (including appropriate UV-B radiation) has been the primary focus in the past months. This was especially important for tortoises, larger iguana species and monitor lizards. Most important was to understand how to create a suitably heated area but to heat it in a way that the animals a) could bask long enough to be able to absorb suitable amounts of UV-B radiation and b), especially for tortoises, to achieve thorough heating-through of the whole body without overheating the topmost scutes of the carapace.

A few examples with commenting discussion of our lighting setups monitored and continuously improved in this way are pictured below. This is an ongoing process with steep and often time-consuming learning curves involved, especially for new keeper staff. This is offset by the much more accurate, useful, and less time-consuming monitoring and adjusting of enclosure temperatures via camera than by just using thermometers.

The camera has also been put to regular use in our mammal and veterinary departments. It proved useful to identify lameness-associated inflammation in lemurs and macaques without having to catch or restrain the animal and would benefit more large species, e.g. our gorillas in the same way should a situation occur.

An ongoing trial examines thermal properties of the wings of Livingston's fruit bats, one of the largest and most endangered bat species in the world. Especially applicable is the monitoring of heat loss through the surface of the huge wing membranes when members of this species are undergoing anaesthesia for medical examinations in our veterinary hospital. Monitoring of the core body temperature vs. the heat radiation from the huge membranes while on the examination table allows our veterinary team to intervene and warm the wings with heated towels if a significant heat loss is apparent. Keeping the bat's body temperature more stable in that way aids in their recovery from anaesthesia.

As the fruit bats had just received a large extension to their free-flying enclosure, the camera proved invaluable to detect areas of heat loss in the new building, facilitate the effectiveness of insulating cold points and helped identify the most effective placements of heaters and heat distributing fans.

The thermal imaging camera is now in very regular and standard use when setting-up new or monitoring established enclosures and it adds a significant benefit to the welfare of our animals, the knowledge and confidence of keeper staff and the quality of our advice given to colleagues in the zoo and private sector.

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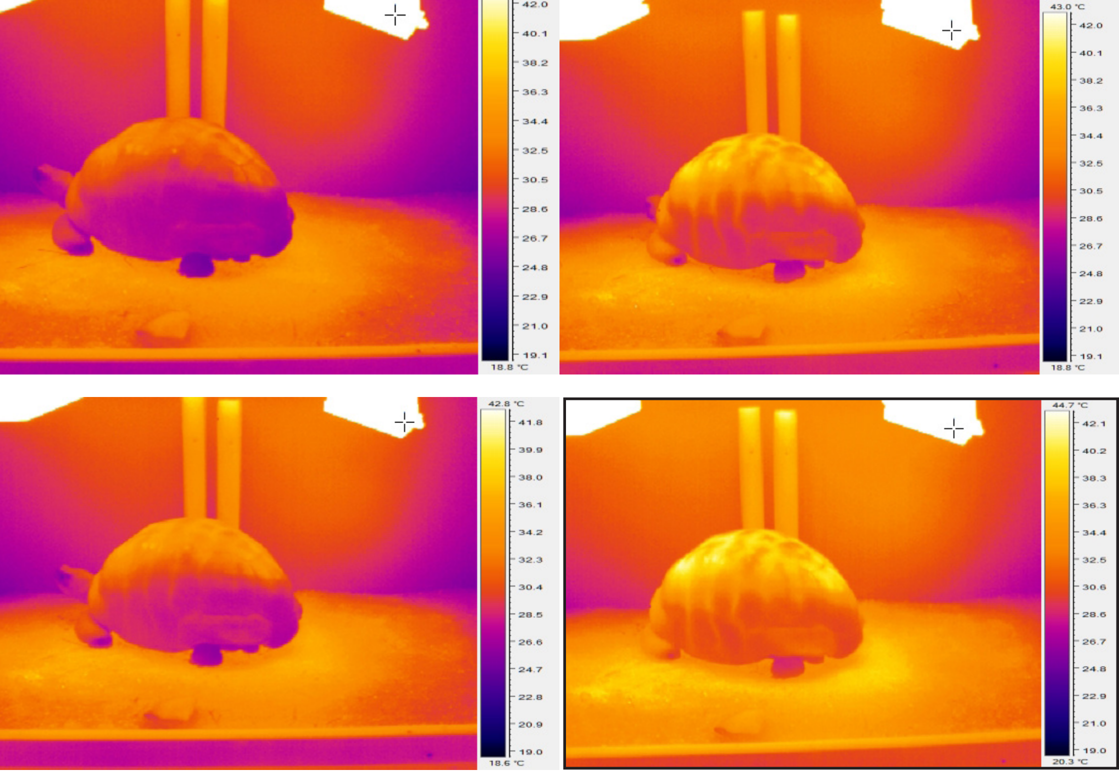

Fig. 2-5 (clockwise): heating of a basking adult radiated tortoise within ~15min. under two 120W halogen floods and six Arcadia T5 D3+ Reptile Lamp 54W on loam/sand substrate. The positioning of the lamps prevents too high temperatures on the carapace's top while the sides also receive some heat radiation. For reference, the hottest area in Fig. 4 is around 40˚C, while the left back foot in that picture remains at 29˚C. This means that some lower areas still lag behind in warming, which is still not ideal; but we avoid excessive heating on higher parts of the carapace. More lamps are now in place to try to overcome this.

Fig. 6-8: basking area for juvenile ploughshare tortoises under two 150W Lucky Reptile Bright Sun ULTRA Desert flood and three Arcadia T5 D3 Reptile Lamp 54W. The slightly offset and angled positioning of the lamps create a large, uniform basking zone. Maximum temperatures reach around 45˚C. NB: care needs to be taken not to angle any UV-B emitting light source too much: for safety of the animals' eyes, UV radiation should always come straight from the top, not the side.

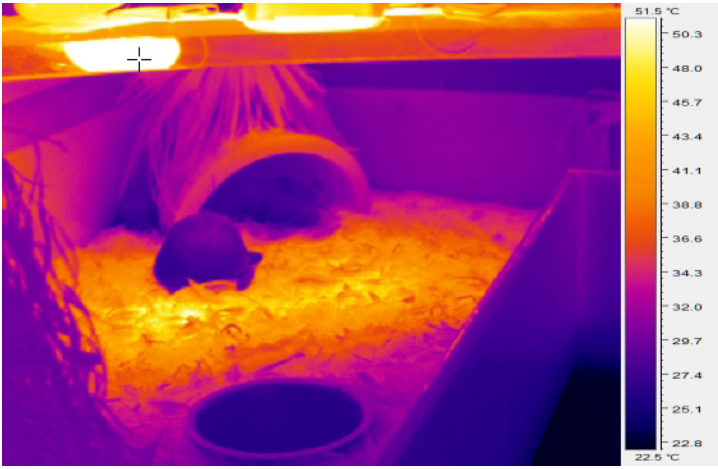

Fig. 9+10: basking semi-adult Komodo dragon under a dimmable 1500W quartz-halogen heater and six Arcadia T5 D3+ Reptile Lamp 54W. Distancing the heater far from the basking zone and adjusting its output allows for a fairly even heating of an area larger than the monitor, while it benefits from the above positioned UV-B lamps. In the picture, the animal reaches between 36˚C and 39˚C. We experimented with several substrates in the basking site and settled for bark chips as we found most other materials becoming too hot for the animal to remain there for long enough to achieve an even (external) body temperature.