Refining the use of animals
in scientific research

Non-invasive methods

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Refining the use of animals in scientific research

Scientists are busy developing some really exciting high-tech methods to replace the use of many animals in scientific research, like organs-on-a-chip. But for those researchers who don't yet have an alternative, the principle of *refinement* is crucial. Non-invasive research methods are now available which can improve animal welfare.

refinement: *minimising potential suffering and improving animal welfare*

What problem are scientists trying to solve?

Observing behaviour and/or measuring a range of physiological parameters, such as concentrations of the hormone cortisol, allows scientists to assess whether animals are stressed or in pain as a result of experimental procedures. Unfortunately, gathering physiological data may require the handling and restraint of the animals, which can also cause stress.

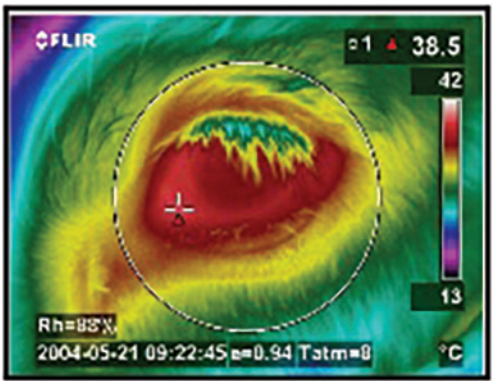
The solution

Infrared thermography to measure pain, stress and the early detection of disease

When an animal becomes stressed, hormonal and blood flow responses lead to a change in heat production and heat loss. This can be detected with infrared cameras, in the eye in particular. An infrared camera can be used to take pictures up to a metre away from the animal. While animals are still exposed to humans, this avoids or minimizes the need for handling and restraint.

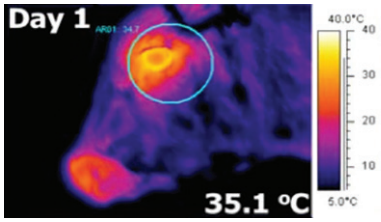
Infrared thermography can also pick up subtle changes in body temperature due to disease or inflammation enabling earlier detection and treatment than would be possible using normal clinical signs.

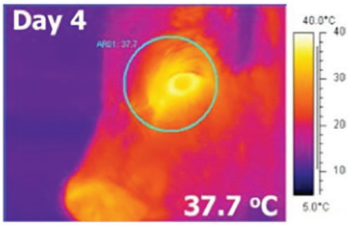
Zoo and wild animals can be assessed without the need for restraint and sedation. For example, seabirds affected by oil spills normally have to be handled and restrained to assess waterproofing of their feathers, which causes stress. Infrared thermography avoids this.

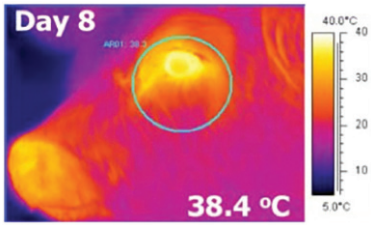


Thermal image of the eye of a dairy calf showing the range from warmer (red) to colder (blue/purple) areas. The cross indicates the area of maximum temperature within the eye (with permission from Stewart et al. 2008).

Infrared thermography images of a calf during the onset of bovine respiratory disease before the onset symptoms on day 9–10. Eye temperature changes can be detected before the onset of symptoms, and early treatment can prevent permanent damage to the lungs. (with permission by Church et al 2009).







Leg ailment in an elephant detected by an infrared thermography scan (bright area indicated by the arrow identifies area of concern) (with permission by Church et al 2009).

Advantages

- Don't need to catch and handle the animals.
- No puncture wound from a large needle.
- Reduces stress and pain.
- The same animals can be sampled many times.

Disadvantages

- Infrared images can be difficult to interpret and specific training is required.
- Results are highly dependent on working conditions, such as the surrounding temperature, airflow or humidity.

Infrared camera being used to measure eye temperature changes in dairy calves.

References

Infrared thermal imaging in studies of wild animals. Cilulko J, Janiszewski P, Bogdaszweski M and Szcygielska E (2013). *European Journal of Wildlife Research* 59, 17–23.

The non-invasive and automated detection of bovine respiratory disease onset in receiver calves using infrared thermography. Schaefer AL, Cook NJ, Bench C, Chabot JB, Colyn J, Liu T, Okine EK, Stewart M and Webster JR (2012). *Research in Veterinary Science* 93, 928–935.

Noninvasive assessment of autonomic activity for evaluation of pain in calves, using surgical castration as a model. Stewart M, Verkerk GA, Stafford KJ, Schaefer Al and Webster JR (2010). *Journal of Dairy Science* 93, 3602–3609.

Recent Applications of Infrared Thermography for Animal Welfare and Veterinary Research: Everything from Chicks to Elephants. Church JS, Cook NJ and Schaefer AL. (2009) InfraMation 2009 Proceedings. www.infraredsolutions.co.nz/wp-content/uploads/2013/09/Animal-Welfare-and-Veterinary-Research.pdf

Eye temperature and heart rate variability of calves disbudded with or without local anaesthetic. Stewart, M., Stafford, K. J., Dowling, S. K., Schaefer, A L., & Webster, J. R. (2008). Physiology & Behavior, 93(4–5), 789–97. www.doi.org/10.1016/j.physbeh.2007.11.044

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