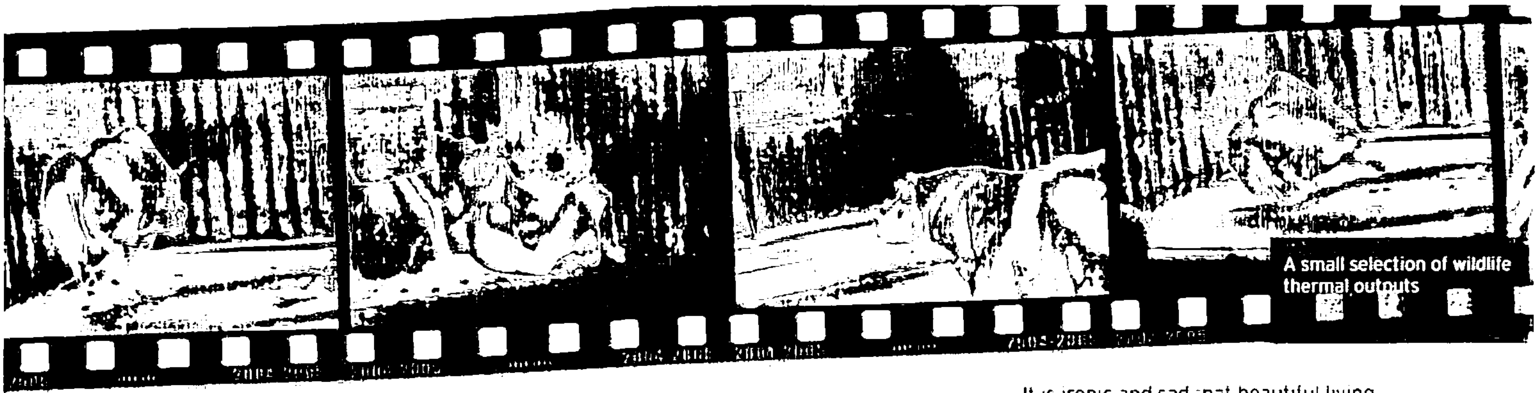

A small selection of wildlife thermal outputs

CHRIS LAVERS

Thermal imaging for wildlife evaluation

Climate change and rise in human population will increase pressures on natural habitats and species surviving in them alongside man. Monitoring wildlife in as near-natural an environment as possible may provide vital information to preserve current biodiversity.

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Until recently, it was only the military that possessed the ability to see in complete darkness or through the heavy dust and smoke of modern battlefield conditions. However, recent research has shown that military thermal imagery techniques provide effect 'swords into ploughshares' technology for wildlife management. In partnership with Paignton Zoological Park and the Buckfast Otter and Butterfly Sanctuary, Devon (UK), heat cameras demonstrated that endangered and vulnerable wildlife species (due directly to man's activities and also to climate change), may be evaluated in captivity at a distance without stress. Stress is now a key zoological factor to minimise. This remote observation technique can be used by veterinarians for non-invasive examinations and by conservationists in the field, who can use the technique to track elusive species, even in thick forest.

A zoo provides a good test centre to evaluate animals from varied habitats, but this technique is more urgently applicable to environmental management and evaluation in the wild. We extended previous comparative visible, Near Infra Red (NIR) and heat wildlife photography (just image intensity) to concentrate on calibrated temperature (radiometric) data. Heat cameras detect small radiated intensity differences from endangered animals protected in captivity day or night. We can view animal behaviour and numbers where it would be difficult otherwise to do so. Heat cameras cannot see through glass, and water absorbs heat so we cannot directly view in vivo marine species. However, removal of marine organisms from water for a short time may be supplemented by NIR imagery in shallow water or behind glass. Passive imaging is less suited for reptiles with little internal heat and not always good for small mammals coated with fur. Nonetheless, calibrated heat imaging is demonstrated over many species, especially large mammals like the black rhino, which radiate a considerable amount of heat (see Table 1) compared with most other species examined. Thermography also offers safety advantages to zoo staff and researchers in the wild and aids animal condition diagnosis.

Image 1 shows the heat distribution of a healthy black rhino, showing insulated sides: the surface is covered with strong muscle tissue and thick skin plates so temperatures are relatively even throughout. Insulation increases immediately from birth, so surface-measured temperatures can drop by as much as 5°C in only three months. Ears and horns appear cool. Horn is near ambient-background temperature as it is composed of dead chitin with no active blood supply.

It is ironic and sad that beautiful living animals are killed for a small amount of dead material, the chitin, which composes the rhino horn. Chitin is the same as hair protein (88% keratin), insoluble, and tough. Millions of compacted hair-like fibres are reinforced inside with calcium and melanin, and are resistant to wear and Ultra Violet (UV) breakdown. A 'pencil-like' horn is created by wear of the softer outside. The sensitivity of chitin to enhanced UV degradation due to thinning of the ozone layer, especially in South Africa, is as yet unknown.

Current night vision (night sights or image intensifiers) and thermal (heat) imaging systems are already quite capable of monitoring, counting and safely observing endangered rhino in the wild in detail, and can track suspected poachers even on the darkest of nights. In the near future it is likely that satellite-based systems could be used to observe rhino behaviour during the day, with the best optical satellites, in near-earth orbit, are capable of panchromatic 0.5m resolution across the visible spectrum. They may be detected at night with satellite thermal bands having poorer resolution (120m); alternatively a thermal imaging camera could be mounted on unmanned aerial vehicle, helicopter or even on a balloon platform if closer better resolution were needed.

Regardless of these particular developments, the battle to preserve some of our most iconic wildlife will continue to be aided substantially by developments in science and technology, and may very well come from the military as well as the civil sphere.

The table below shows a small selection of wildlife thermal outputs

Animal	Head T/°C	Body T/°C	Leg T/°C	Power
Rhino	30.5	25.5	23.5	3.7kW
Zebra	26.8	25.8	25	2.8kW
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[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
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