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Infrared Thermography in Zoo and Wild Animals

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Infrared (IR) thermography is a noninvasive diagnostic screening tool that does not require handling or restraint of an animal.

Infrared Thermography in Zoo and Wild Animals

Physiologic or pathologic processes involving changes in surface temperature may be evaluated using this technique. This modern method give visual images with measurements of surface temperatures over a greater distance.

Infrared Thermography in Zoo and Wild Animals

The first medical application of “thermography” was by Hippocrates (ca. 460–375 BC), who used thin layers of mud for his temperature measurements, similar to modern thermography. An area of great heat emission caused an area of the mud to dry first, and thus a “hot spot” was detected.

Infrared Thermography in Zoo and Wild Animals

It was not until the mid–eighteenth century, however, that temperature scales were developed by Fahrenheit, Réaumur, and Celsius, and not until 1800 that Sir William Herschel discovered infrared rays distinguishable from visible light. The first detector was constructed in 1830.

In wildlife

In wildlife biology, IR thermography has been used since the mid-1940s for detecting and monitoring mammal and bird species. To some degree the method could even be used successfully in animal censuses (Counting).

In veterinary medicine this technique has been used on farm and companion animals since the late 1950.

Method

Infrared thermography makes use of the physical characteristic of bodies or materials to emit electromagnetic waves, and with the aid of a special detector, these rays are visible. Therefore, surface temperatures are measured over a greater distance.

The advantages of IR thermography

The advantages of IR thermography compared with other imaging techniques (e.g., ultrasonography, radiography, magnetic resonance imaging, endoscopy) are as follows:

1. Is completely noninvasive because no contact with the animal is necessary, and therefore no animal training, immobilization, or sedation is required.

The advantages of IR thermography

2. Offers an ideal, instantaneous (immediate)first screening method to help the veterinarian in decision making, monitoring, and determining whether other measures need to be taken.

The advantages of IR thermography

3. Give real-time visual imaging in gray or False color coding

4. Provides surface temperature imaging of a whole animal, or parts of the animal, as well as easy comparison with herd mates at the same time.

The advantages of IR thermography

5. Permits examination of motion and direction (e.g., inflammation, reproductive evaluation).
6. Allows easy monitoring of a condition short time (e.g., lameness, inflammation, pregnancy).

The advantages of IR thermography

7. Facilitates documentation and preservation of primary data.
8. Is portable and uses battery packs and thus is conducive (help) to zoo and wildlife field conditions.

Technique

Using an IR camera or scanner, the heat emitted by every material or object may be detected and made visible through conversion into temperature-associated shades of gray. The warmer areas are colored white or light gray, and the cooler areas are darker gray or black.


FLIR
117
127
109
125

Technique

The system may also use several scales of false color coding. This means that an image is created in which each temperature is assigned a specific color on a reference scale; the best scale for veterinary diagnostics is the rainbow color scale. The image created can be interpreted and used for diagnostic purposes in medical fields.

Technique

An IR system should be certified by the regional authorities. Only such systems guarantee that the measured temperatures are accurate and that it is legal to use the system; specific regulations exist because of the military use of this technology this technique should be used throughout veterinary medicine, especially in zoo and wild animal medicine, as an aid in primary diagnostics.

Technique

The images captured by the IR detector may be saved and stored on a hard disc or other storage media and viewed and evaluated later on the computer with specialized software.

Technique

Thermography is best used on animals, or parts of them, without long hair, such as elephants, rhinoceroses, hippopotami, giraffes, zebras/horses, and many larger antelopes. In longer-haired animals such as carnivores, camels with winter coats, and mountain animals, the interpretation of results is more difficult.

The Thermographer

The thermographer must be familiar with:

- Normal skin surface
- Internal anatomy
- Morphology of the animal under investigation.

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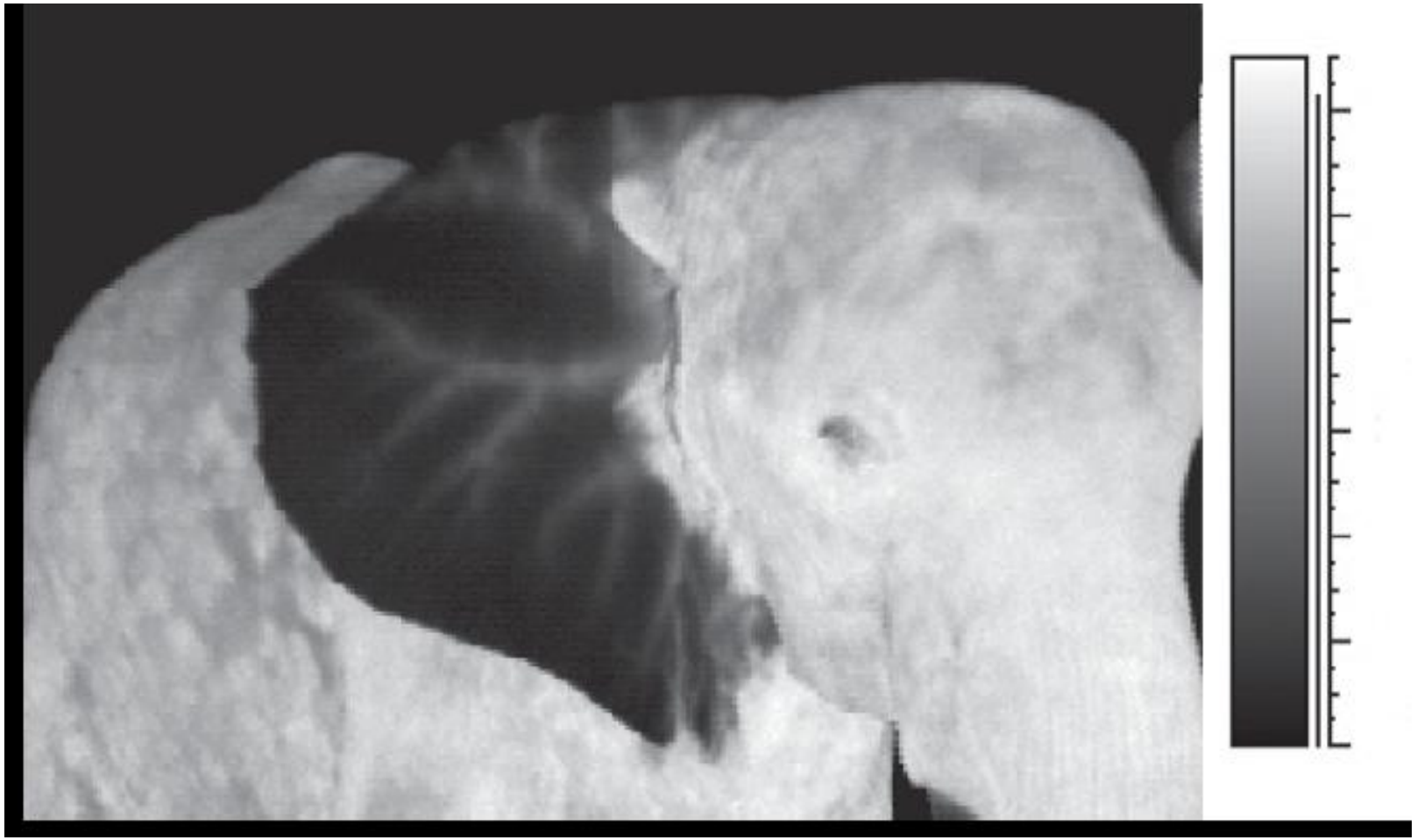
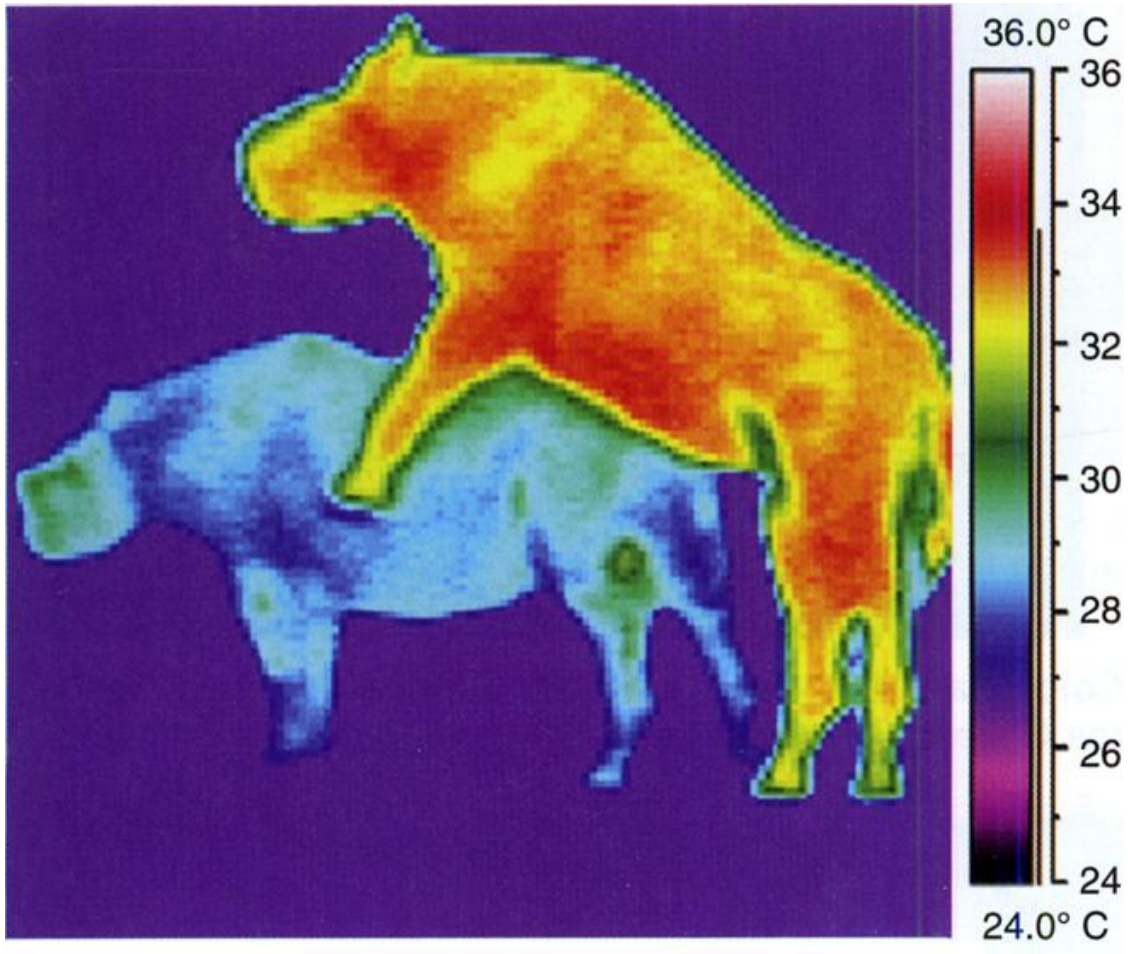
Interpretation

- Regional hair length is an important factor for interpretation
- location of blood vessels
- Innervation of skin areas under investigation

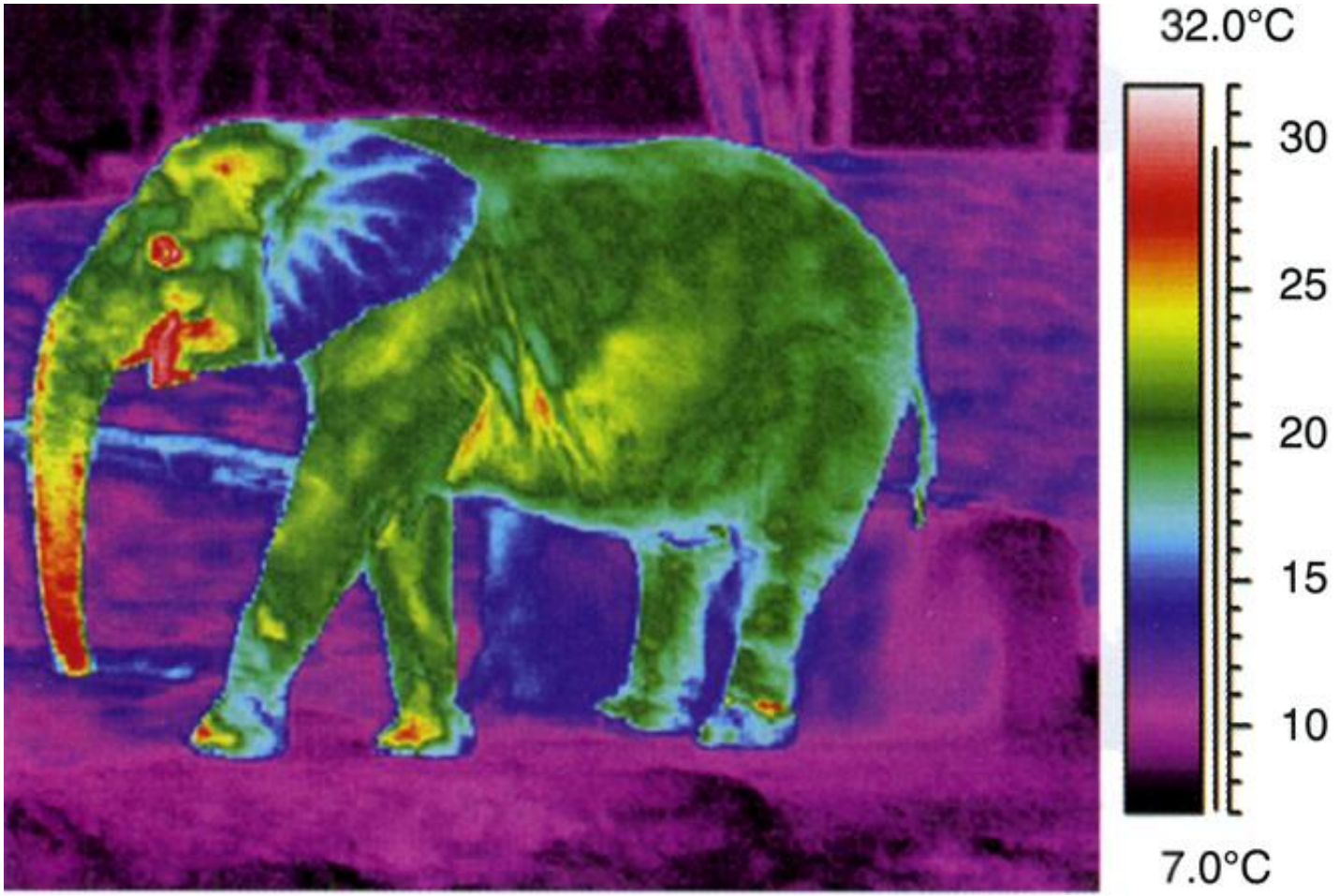
Normal thermogram of an elephant, with the ear showing less heat radiation than the body



During mating, male rhinoceroses may be much warmer than female rhinos.



Late pregnancy in an Asian elephant

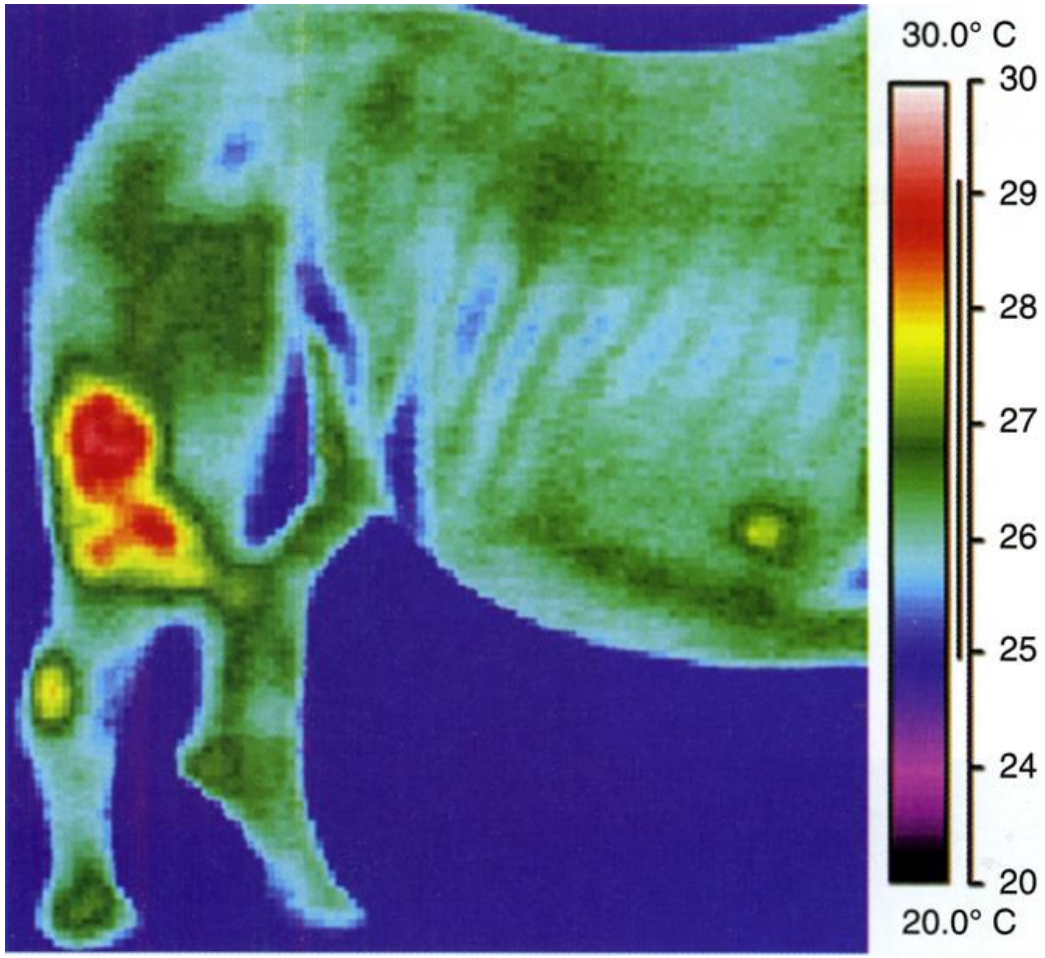


Late pregnancy in an Asian elephant.

The abdomen bulged, and heat radiation increased both from that area and from the mammary glands.

The heat radiation during late pregnancy was so great that the feet and trunk functioned as facultative thermal windows.

Lameness in a black rhinoceros. The right knee/thigh area showed an intense increase in radiation.



Sources of artifacts

- Clipped hair may increase temperature readings.
- Alcoholic ointments or other surface heat–producing materials also create artifacts in the form of increased heat emission.

Sources of artifacts

On the other hand:

- Cold water
- Dirt
- Mud

may create an altered heat emission that shows lower temperatures.

Strong physical activity

Strong physical activity of the animal will create local heat production at first, but heat emission from the whole-animal surface may occur later, depending on the type of animal and the type and duration of the activity.

High ambient temperature

High ambient temperature poses difficulties when looking for smaller temperature differences. Under high ambient temperatures the difference between the animal core and surface temperature decreases. This makes the use of IR thermography more challenging(difficult) in field investigations than in zoo settings.

High ambient temperature

A good way to address this problem is using the technique in a stable or, for wildlife at night, near a water hole. The sun itself also creates significant artifacts, and therefore cloudy days are preferred.

Best place

Again, the best place for an investigation of a zoo animal is the stable, or the investigations should take place on a cloudy day, after sunset, or before sunrise, if absolute temperatures are required. Otherwise, the investigator should try to lure the animal into a shady part of the enclosure.

An experienced thermographer

An experienced thermographer can cope(deal) with many artifacts or will do a follow-up investigation a few hours or days later.

Artifacts may also result from sources of heat in the housing environment of zoo animals, such as heaters on walls , floor heating, or even heating from ceilings.

Familiar

Thermoregulation: the Basics for Medical Thermography

Before veterinarians can make good use of IR thermography in zoo and wildlife medicine, they must become familiar with the thermoregulatory patterns of each species.

specific challenges (difficulties) for thermography: color patterns; hair length; thickness of the dermis; location of glands; size of ears, horns, or antlers; location of potential thermal windows on the body itself; and the anatomy of the legs. Thermal windows are areas of increased heat emission; some are facultative and some obligatory

Elephants

Because of the lack of hair, elephants (and most rhino species) display a relatively even surface temperature under normal conditions, with only the ears, horns, or tusks showing lesser heat radiation than the body and legs.

Mammals

Mammals with short hair and thin legs (e.g., giraffes, antelopes, zebras) display cooler legs than bodies under normal thermoregulatory conditions and in the shade.

Animals body surface

Animals with thick hair may display little radiation through the body surface, which may make the use of IR thermography almost impossible. However, some uses may still be possible, such as the diagnosis of inflammatory processes on the legs.

Mammals

The inside of mammalian legs shows a slightly greater heat radiation than the outside because of the more superficial location of blood vessels. When doing

Mammals

In mammals the eyes are always obligatory thermal windows, as are the mouth, heart region, and the rectal and vaginal openings, as well as the penis during urination or erection.

Signs

Experienced trainers and veterinarians are able to identify potentially lame animals up to 2 weeks before the animal actually shows clinical signs.

General indicators of altered thermoregulation can be physiologic or pathologic, as follows:

1. Exposure to strong sun
2. High ambient temperatures with simultaneous(at the same time) high humidity
3. Physical activity

4. Stress (psychologic)
5. Pregnancy
6. Abrasions
7. Inflammation

Fetus

Depending on the ambient temperature and relative humidity, this metabolic heat, as well as the heat of the placenta and the body heat of the growing fetus, is channeled to the outside of the mother's skin by conductance, especially when the fetus is pressed against the mother's body wall.

Pregnancy Diagnosis

During pregnancy the female animal shows increased metabolism that allows for the growth of the fetus.

When energy of one form is converted into another form, some energy is always lost in the form of heat.

Diagnosing Inflammation

Heat production in inflammatory processes is one of the cardinal symptoms of inflammation. IR thermography picks up this heat if the process is located close to the body surface.

The diagnosis of an inflammatory process in a leg or ear is a good way to gain experience with this method.

Thank You