



Stress levels of zoo animals are kept to a minimum with FLIR thermal imaging cameras

FLIR thermal imaging camera used to inspect health issues in animals at Artis Royal Zoo Amsterdam

Zoo keepers all over the world are faced with the problem of determining whether an animal should be treated or anesthetized or not. Many zoo animals are very sensitive to emotional stress and to the physical side-effects of anesthetics, so in some cases veterinary treatment can do more harm than good. To help them with this the keepers of the Artis Royal Zoo in Amsterdam, the Netherlands, can call upon the help of veterinarian assistant Daphne Valk and her FLIR P620 thermal imaging camera.

"It can provide important information that can help the vet to determine whether treatment is necessary", explains Valk. "This might not sound spectacular, but for keepers and veterinarians this is extremely important. You want to avoid treatment and handling unless it is really necessary, but in some situations waiting can be fatal. A thermal imaging camera can help determine whether treatment is necessary. And the great thing about thermal imaging technology is that it is a non-invasive method, so the stress level of the animal is kept to a minimum."

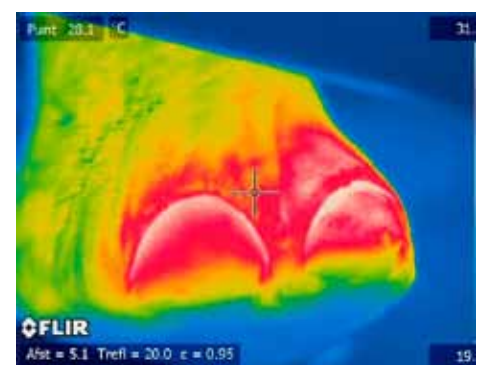
The thermal imaging camera used by Valk is the FLIR P620. This highly sensitive thermal imaging camera contains an uncooled microbolometer detector that produces thermal images at a resolution of 640 x 480 pixels and a thermal sensitivity of 40 mK. Experienced veterinary thermographers

can use the thermal images to find a multitude of health issues in animals by looking for anomalies in the thermal patterns. Generally speaking inflammations and injuries will show up as warmer and scar tissue and nerve damage will be visible as colder areas in the thermal image.

The FLIR P620 thermal imaging camera is accurate and completely safe for use with zoo animals.



The elephants at Artis are trained to show their feet to their keepers for a regular thermal imaging inspection.



It is normal for the cuticles to show up as warm, but the area around it is warm as well, indicating a possible infection.



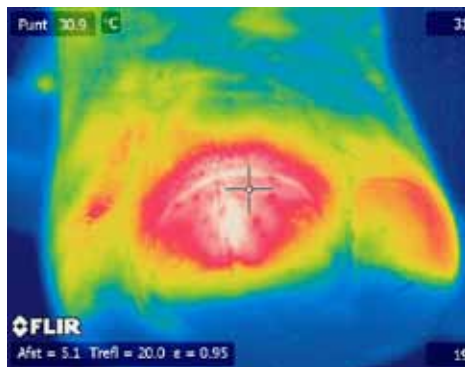


The highly accurate FLIR P620 is a great for veterinary inspections according to veterinarian assistant Daphne Valk.

FLIR P620 has proven its worth

In the short time the FLIR P620 thermal imaging camera has been in operation it has certainly proven its worth, according to Valk. "We started using it on elephants, like I had seen it demonstrated in the States, taking thermal images of elephant feet to see if they had infections or other abnormalities."

But thermal imaging cameras can do more than just looking at elephant feet, as one case with an elephant tusk showed. "One of our elephants had an accident with one of his tusks, which caused part of the tusk to break off. The tusk stub featured a tare that continued to deep inside the jaw. The



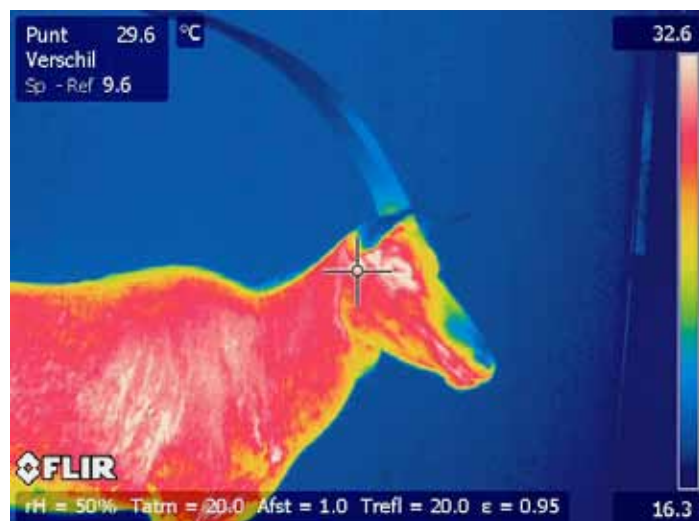
Thermal imaging can be used to accurately track the recuperation process of animals recovering from an inflammation or injury. This thermal image shows an elephant foot after treatment. The heat pattern is returning to normal, indicating that the treatment was successful.

bull showed unusual behavior, acting grumpy and eating less, so the keepers suspected an infection. But how were they to find out? I was called in with the thermal imaging camera and the keepers had the elephant open his mouth and move aside the trunk. We train them to do that on command for exactly this type of situation. The thermal image showed no signs of an infection. So in this case the use of thermal imaging prevented the unnecessary use of antibiotics."

But the thermal imaging camera is used more and more with other animals as well. "In one case a Scimitar Oryx had a swollen jaw. The keepers noticed the swelling but they were unsure about the cause. It could be that it was just some cud – food regurgitated by a ruminant to chew on it a second time – that was stuck there, but it could also be an inflammation. The thermal image showed no signs of inflammation, since the area showed up as having a regular temperature. Secure in the knowledge that it was probably just cud we took no further action and over time the swelling subsided. In this case the use of the thermal imaging camera saved the Scimitar Oryx from unnecessary sedation."

Providing crucial feedback

In another case the thermal imaging camera provided crucial feedback for the operating veterinarian. "We had a zebra with a limp and an inspection with the thermal imaging camera showed it had an infected hoof. When the vet started to remove the infected tissue I continued



This Scimitar Oryx has a swollen jaw. The thermal image shows that the swollen area is not significantly warmer, so no drugs were administered. Less than 2 days later the swelling was gone.

looking at it with the thermal imaging camera and urged the veterinarian to cut even deeper. I felt a little worried, for I didn't want to cause unnecessary damage to the zebra, but the thermal image turned out to be correct. In the end we found the infection and managed to remove it. If we wouldn't have had the thermal imaging feedback we would never have dared to go in that deep."

Thermal imaging succeeds where other methods fail

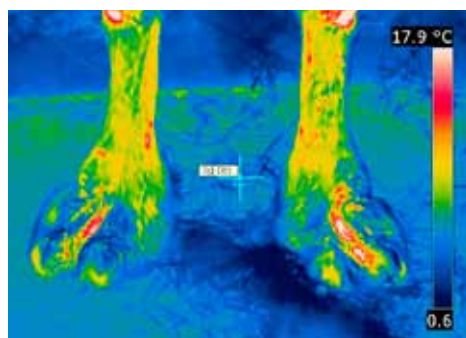
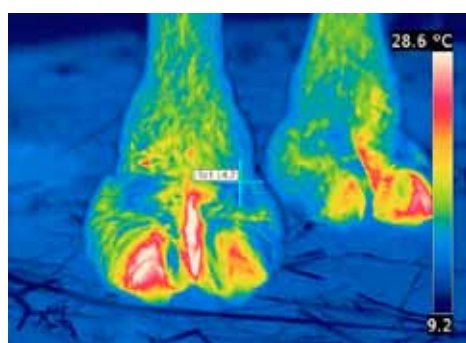
In some cases the thermal imaging camera provides solutions when all other diagnostic methods failed. "We had a camel that was limping and we just couldn't find out what was causing it. Physical inspections and X-rays didn't bring us any closer to finding the cause, so I took out my thermal imaging camera and I immediately spotted a warm

area in one of the toes. It turned out to be an infection, which can be easily treated with antibiotics. But you only use antibiotics on ruminants if you are absolutely sure you need to, because it can seriously damage the good bacteria in their digestive system."

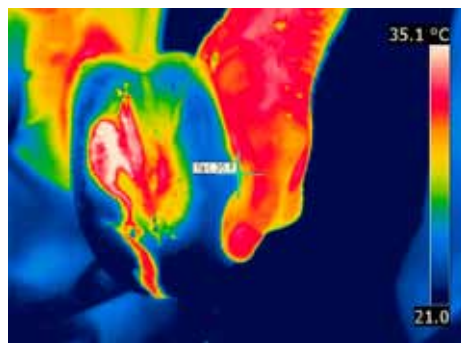
The news of the thermal imaging camera even spread to other zoos as well. "In one case I was called to investigate a toucan in another zoo. This toucan had a swelling next to its eye, but toucans are very sensitive to stress so investigating it in a conventional manner might do more harm than good. To make sure that the animal is not put under any unnecessary stress I was called in to investigate. The thermal image clearly showed that the swelling was warm, so I concluded that it was probably an infection and that further treatment was needed. The animal was anesthetized and further investigation showed that the initial assessment was correct."

Thermography on cold blooded animals: it is possible

An often made assumption is that veterinary thermography with cold-blooded animals is not feasible, but Valk had a case that proved this assumption to be wrong. "We had a green iguana with a swollen toe and we suspected it to be inflamed. But since



The top image shows the toe of a camel with a hot area indicating an infected toe. The lower thermal image shows the feet of that camel after two weeks of treatment with antibiotics.



This thermal image shows a zebra hoof. The warm fluid running down the hoof is pus discharge caused by an infection that was cut open by a veterinarian. The thermal imaging camera provided crucial feedback during the operation.

iguanas are very sensitive creatures you don't just administer antibiotics if it's not absolutely necessary. But using thermal imaging proved to be a challenge, since the iguana is kept in a warm room and its body temperature is almost the same as the room temperature. So I placed a cold stone underneath the iguana's claw, cooling down the claw slightly. The swollen toe turned out to be warmer than the rest of the claw, so we decided to administer the antibiotics."

Another useful application for the thermal imaging camera in the Artis zoo Valk has discovered is to determine whether animals have fought during the night. "This one time the keepers noticed strange behavior with our sea lions and they wondered whether they might have fought during the night, when no keepers were present to notice it. So we had them leave the basin in the morning, before the sun came up, to prevent influence from direct sunlight. I recorded some thermal images of each animal and we found that although there were no visible injuries there were many warmer areas visible in the thermal images. The fighting hadn't resulted in any visible wounds, but the invisible bruises were made visible by the thermal imaging camera. This was useful information for the keepers who could take into account in the way they treated the animals."

Finding wounds through the fur

Valk suspects that this application might turn out to be very useful if land dwelling animals with fur, such as the chimpanzees, will start fighting. "It is not always easy to prevent fighting between zoo animals. In



the past we've had situations when we suspected there had been a fight but we had no idea of how serious the injuries were, for it is difficult to see if an animal is hurt if the wounds are hidden by the fur. Luckily we have not had such a situation since we've acquired the FLIR P620 thermal imaging camera, so I have not tested this theory, but I suspect that differences between wounds and the surrounding skin and fur in both

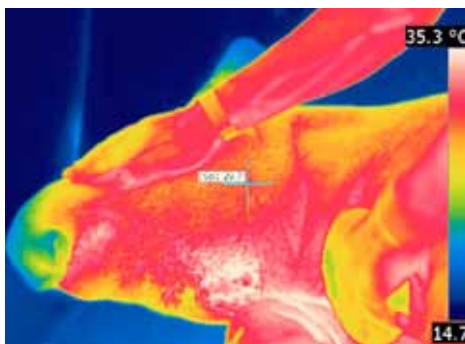


This thermal image shows the claw of a green iguana with a suspicious swelling. The swollen toe is much warmer than the other toes, indicating an infection.

temperature and in emissivity will make the wounds stand out clearly on the thermal image."

Another new application Valk is planning to test as soon as the situation arises is confirming the obligatory tuberculosis check. "If an animal is moved to another zoo we have to make sure that the animal is not infected with tuberculosis, so each animal has to undergo a tuberculin skin test. To do that we shave off a part of the fur to reveal the skin, we then inject them with tuberculin antigens and after three days we check whether the antigens have caused a swelling. If there is a swelling of a certain size in the location where the antigens were administered then the animal is suspected of having tuberculosis and it cannot be transported."

But this process can be very difficult with some animals. "Many zoo animals cannot be kept separated for three days in a row, so we have to let them join the rest of the group or herd. But that makes it very difficult to determine whether there is enough cause to capture and sedate the animal again in order to determine the size



The thermal image of this Tapir shows that the abscess below the jaw is warmer than the surrounding tissue, which warrants further investigation.

of the swelling. An important characteristic of this reaction to the antigen is also an increase in temperature, similar to an inflammation, so I hope to be able to use the thermal imaging camera to determine from a distance whether there is a swelling or not, so we can avoid putting the animals through unnecessary stress and sedation."

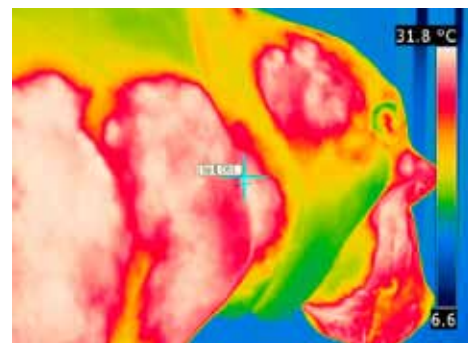
FLIR thermal imaging camera: a good investment

All in all Valk is very pleased with the decision to acquire the FLIR P620 thermal imaging camera. "It really has been a good investment. It has helped to find health issues in while preventing unnecessary surgery and minimizing stress. But I would like to stress that with veterinary thermography it is of vital importance to keep critically assessing the validity of the results. Not every anomaly in the thermal pattern is an infection or a bruise. You have to understand the circumstances that influence the thermal camera readings, like raindrops, mud, sunshine, sweat, thick fur or a breeze coming in from an opened window. All of these external influences – also called artifacts – can create thermal anomalies that have nothing to do with the health of the animal."

Valk therefore tries to eliminate these artifacts as much as possible. "We only inspect the animals within their enclosure in the morning before they head outside with all the doors and windows shut tight, to minimize the effect of sunlight and air convection on the thermal pattern. If the animal is dirty we use a hose to clean the animal and then wait for a couple of hours until the animal is dry. And we also use standardized viewing angles to enable comparison between results from different inspections."

Individual differences

But even when these precautions are taken, Valk is very careful to draw any conclusions. "Not only do you have to know about the physics of thermography, you also have to know a lot about the animal you are dealing with. And I don't mean just the anatomy of that species; I'm talking about the particulars of that



Thermal imaging helps to determine the skin temperature of this hippopotamus with a very serious rash from a safe distance.

individual animal. Sometimes an animal is warm or cold in certain places that might seem to indicate a health issue, while it is just part of the normal pattern for that animal. I have been working with some of our animals for years and I still don't have the feeling that I know exactly what the normal thermal patterns are for our individual animals."

Certification

Valk therefore hopes that in the near future a certification for veterinary thermographers will be developed and enforced by the European Union. "Currently anyone can pick up a camera and call himself a thermography consultant, but it takes more than a thermal imaging camera alone."

FLIR cooperates with the Infrared Training Center (ITC) to provide training courses and reliable thermography certificates in three different levels. "I applaud the efforts taken by FLIR to promote reliable training and certification and I hope that in the future a certification system for veterinarians will be given an official status."

For more information about thermal imaging cameras or about this application, please contact:

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