[crickets]
[cymbal plays]
[chime]
[music plays]

[NARRATOR:] Caitlin O'Connell has spent over 20 years observing how elephants interact and communicate. Her research takes place in Etosha National Park, Namibia.

[O'CONNELL:] I've spent a lot of time trying to understand elephant communication, and particularly the physics of their communication.

[elephant trumpets]

[NARRATOR:] Elephants roam large territories, ranging from 15 to 1000 square kilometers.

[elephant trumpets]

To communicate, they produce a variety of calls containing a mix of high and low frequency sounds. The low frequency sounds, some below the human hearing range, travel farther.

[music plays]

Elephants seem to respond to these calls from as far as two kilometers away.

[elephant trumpets]

O'Connell suspects they are not just detecting them with their ears.

[music plays]

[NARRATOR:] Sound waves can travel in the air, but also propagate through the ground. O'Connell noticed that elephants behaved as if they were detecting vibrations with their trunks and feet.

[O'CONNELL:] It's pretty striking. They will be mid-stride walking, they will freeze, and then they'll start scanning the uncertain.

[NARRATOR:] O'Connell wanted to know if elephants can detect other elephant's calls through the ground. And if they can, are they able to interpret them? To answer this question, she designed an experiment. The team conducts the research from an observation tower near a watering hole, where groups of elephants spend time during the day.

[elephant sounds]

O'Connell plans to test the response to a call that elephants produce to warn others of nearby predators. First she plays the alarm call in the air with a speaker.

[music plays]
[elephants rumbling, trumpeting]

The elephants inmediately leave the watering hole as if the threat is nearby.

[music plays]

Next, O'Connell transmits the alarm call underground, with an instrument called a shaker, that will only transmit low frequency sounds.

[O'CONNELL:] This device is made for the home theater industry. It plays back the low frequencies from movies. We are just about to test the shaker.

[shaker rumbles]

OK, that's great.

How's the hole doing?

[NARRATOR:] They bury the shaker about 30 meters from the watering hole. The shaker should only produce vibrations in the ground and not in the air. To monitor the shaker's output they bury a geophone that measures underground vibrations closer to the watering hole, along with a microphone above ground.

[O'CONNELL:] The sensors are placed 10 meters away from the shaker, so that we know the level of the signal that the elephants are receiving at the water hole. And the microphone's going to confirm that there's no signal in the air coming from the shaker. While the elephants are here drinking we are going to shake the surface of the earth and see if they can detect this vibration in their feet.

[music plays]

[NARRATOR:] The team plays the anti-predator alarm call through the ground. Soon after delivery, the elephants freeze, suggesting they detect the ground vibrations.

[music plays]

They then bunch together, indicating that they feel threatened, and eventually leave the area.

[music plays]

After repeating the experiment multiple times, O'Connell establishes that the alarm call delivered underground causes the elephants to leave the watering hole sooner than they would without the call, although they spend even less time at the watering hole when the alarm call comes from the speaker.

[music plays]

[O'CONNELL:] So elephants are picking up this signal at long distances away, through their feet, through their trunk. They have this keen vibrotactile sense. Humans also have that capacity, but you don't think about detecting vibrations as a signal.

[music plays]

[NARRATOR:] But why did the elephants respond differently than when the signal was played through the air?

[music plays]

The shaker only played the low frequency sounds in the alarm call. The alarm call contains both high and low frequency sounds. Because low frequency sounds travel farther than higher frequencies, the elephants might have interpreted the absense of high frequency signals to mean that the call came from a long distance away. And they reacted with less urgency.

Ongoing research will allow O'Connell's team to analyze how elephants interpret different calls and how they use both acoustic and seismic signals to understand and navigate their environment.

[music plays]

[O'CONNELL:] Animals that evolved in an environment where all of their faculties are needed at all times, they are in constant touch with what's going on around them.

[music plays]