The Animal Communication Project

Hippos

Several land mammals besides elephants produce infrasound. But the hippopotamus may be the only one that calls and hears in stereo—one channel in air and a second underwater. Ornithologist William Barklow, of Framingham State College in Massachusetts, got a shock while observing a river full of hippopotamuses in 1987. Barklow normally studies loons, and he intended the Africa trip as a vacation. It turned out to introduce him to a new research direction. Barklow was sitting near the bank of a river when a hippo emerged from the water and stared silently for a few moments. Suddenly it let out a bellow that echoed off the river's banks and shook Barklow, both figuratively and literally. He could actually feel the sound. Hippos can achieve 115 decibels, well into the range of loud, close thunder. Several times during the afternoon he heard a hippo bellow and noticed a curious phenomenon. Distant hippos would surface and bellow back. Had they heard the sound underwater? Could they also vocalize under water?

Back home, Barklow became intrigued with hippos, and after finding nothing on hippo social communication in libraries, arranged a study trip to Tanzania to do his own exploratory work. He noticed males defending territories in the river, confirming observations of earlier researchers. He also found that a bellow produced by a male holding a territory often triggered a chorus from other hippos, the ensuing noise traveling along the river and inciting bellows from males at least a mile away. This wave of hippo calls travels up and down river, perhaps conveying information about where the individuals are at a given time. This information could help individuals know when they enter the territory of other hippos and avoid conflicts.

The hippo's head shape aids it in what Barklow calls amphibious communication. With its flat upper jaw, upward-pointing nostrils, and top-mounted ears, a hippo can keep its mouth, lower jaw and throat submerged. A bellow bursts forth from the nostrils, accompanied by twin geysers from its nostrils. The airborne sound obviously comes from the nostrils. Yet Barklow also recorded sounds with an underwater microphone. And he could watch as other hippos surfaced immediately after he heard both the above- and below-water sounds.

Back in his lab again, Barklow analyzed the recordings he had made. The results both intrigued and frustrated him. Computer analysis showed the sounds he'd recorded to be much more complex than he'd at first supposed. This hinted that hippos may have a complex communication system. And he found traces of overtones—like those seen in sonograms of elephant calls—indicating the presence of infrasound in the calls. Not expecting infrasound, Barklow hadn't brought equipment capable of recording such low frequencies.

Using infrasound makes sense for long-distance communication, both in air and in the water, where sound travels more than four times as fast. (The wavelength also increases more than four times, making the sound even better able to travel long distances.) But where did the underwater sound originate? Sound in air bounces off an air-water interface because of the difference in densities, just as sound in water bounces off the water-air interface. The likely path: through a large blob of blubber the hippo carries just under its jaw. This may act like the dolphin's fatty forehead melon to conduct and

channel the sound. The fat, nearly the same density as water, bridges the gap between the hippo's airway and the water.

That neat solution doesn't solve a second problem, however. How do the hippos hear underwater? Two problems arise with ears: flooding and that pesky water/air interface. The hippo solves the problem of flooding by folding its external ears back to seal off the canals, but this makes the ears even less sensitive to sound underwater. Sound vibrations in water do shake an animal's tissues, and bones can transmit the sound to the inner ear. But in general, this system is so inefficient and diffuse it's unlikely to support a complex underwater communication system like the one Barklow had observed. Barklow got a hint from dolphin researchers, who propose that the peculiar jaws of these marine mammals conducts sound clearly and efficiently to the middle ear. Could hippos hear in a similar way?

Studying hippo jaw and ear anatomy convinced Barklow that jaw hearing might work in hippos as well. If so, they might not only hear underwater sounds clearly, but might also hear the underwater sound before hearing the airborne sound. This could give a floating animal a way to determine the distance of an infrasonic bellow. Sound travels faster in water than air, and would reach the middle ear twice, once by way of the jaw and later through the ears—the greater the difference in arrival times, the farther the bellow must have traveled. To gather data on his provocative hippo hypothesis, Barklow had to return to Africa once more.

As part of the 800 pounds of equipment he lugged halfway across the world on his second research trip in 1992, Barklow brought an ingenious way of comparing underwater and airborne sounds, while at the same time monitoring the hippos' behavior. He used a stereo video camera connected to one underwater microphone and one normal microphone. He also took an underwater speaker to play back sounds to the hippos.

Barklow returned to Africa during a dry season. He found that low water had increased crowding. Crowding, in turn, increased social contacts. Adolescents "argued," sometimes coming to blows, young hippos played and the territorial males kept other males out.

Much of this activity took place underwater, and by recording above and below water, Barklow found that hippos carry on much of their communication underwater. Though the sounds were extremely loud—easily recorded by underwater microphones—they remained inaudible above the water-air interface. Hippos sometimes call underwater just as they do in air, spewing a double trail of bubbles. But they also apparently squeeze air back and forth between vocal cavities, creating a sort of croak not accompanied by air bubbles. These croaks correlated with video of calves playing underwater, though Barklow is not sure which animals made the sounds. In addition to the bellows, Barklow recorded underwater trains of clicks, similar to those used by killer whales for echolocation. Barklow always saw underwater social interactions correlated with these clicks, though, so he suggests they serve as communication rather than echolocation. Even stranger sounds, like a Bronx cheer, come from hippos fluttering the valves covering their nostrils. Barklow has no idea how these sounds function in hippo communication. The hippos oriented toward underwater calls and Barklow's underwater speaker when he played back calls, bolstering his supposition that they use their jaws for hearing and locating underwater sounds. Armed with 100 hours of videotape loaded with hippo grunts, bellows and clicks and some solid evidence of stereo hearing in hippos, Barklow continues to investigate this fascinating and unique communication system.

Next: Infrasound

Text-only Table of Contents | Top of Page | Search