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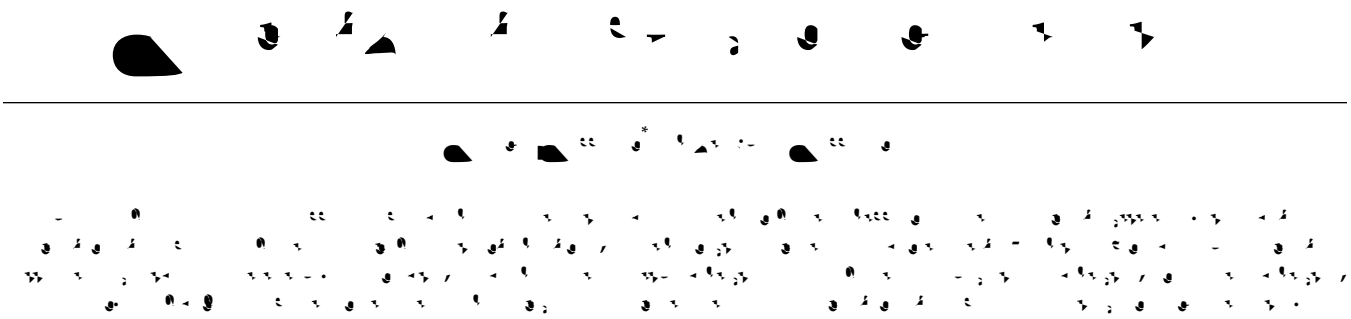

In our interactions with animals, we often assume that their hearing abilities are, if not identical to ours, at least quite similar. For example, we easily hear the vocalizations of cats and dogs, and they, in turn, are easily trained to come to the sound of our calls. However, comparative studies have shown that the auditory sensitivity of different species can vary widely, especially with regard to the ability to hear high- and low-frequency sounds. The purpose of this review is to illustrate the differences in the hearing sensitivities of mammals and birds, about which much is known, as well as of amphibians and reptiles, about which little is known. Not addressed are the hearing abilities of sh and invertebrates (for brief descriptions of the hearing of these 2 groups, as well as that of vertebrates in general, see references 3 and 7).

The Audiogram

The basic test of hearial9(kf49(kf49(kfl9(kf49(kf(e)1ogr)30(am)2a2(i)2(a2i)2(a2i)2d65(h)2()65(t)2(a)2(m)2(r)2(i)2(r)2(i)2(al9(kf49(t[(T)2(h)2(e)2

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Hearing in Mammals

Behavioral audiograms are available for those mammals commonly used in laboratories, as well as for many exotic species.[7–9] The hearing ranges of 9 species of common laboratory mammals are compared with those of humans in Figure 2, which shows both the 60- and 10-dB hearing ranges for each species. Three points can be drawn from this gure.

First, all of the mammals shown here have better high-frequency hearing than do humans, with the 60-dB upper limits ranging from the 34.5-kHz upper limit of the Japanese macaque to the 85.5-kHz upper limit of the domestic house mouse, whose upper limit is more than 2 octaves higher than the 17.6-kHz upper limit of humans. The main reason for this variation is that small mammals need to hear higher frequencies than do larger mammals in order to make use of the high-frequency sound-localization cues provided by the attenuating effect of the head and pinnae on sound. As a result, mammals with small heads generally have better high-frequency hearing than do mammals with large heads. Thus, only 2 groups of mammals do not hear as high as humans: those with larger heads, such as the Indian elephant, and those that do not localize sound and therefore are not under selective pressure to hear high frequencies, such as subterranean rodents.[8]

Second, almost all of the mammals shown (Figure 2) have poorer low-frequency hearing than do humans, with the 60-dB lower limits ranging from 28 Hz for the Japanese macaque (whose lower limit slightly exceeds that of humans [31 Hz]) to 2.3 kHz for the domestic mouse. Thus low-frequency hearing varies over a range of more than 6 octaves. Only the Indian elephant, with a 60-dB low-frequency limit of 17 Hz, is known to have signi cantly better low-frequency hearing than humans.

extensive use of vocalizations in locating mates.[21]Therefore, it is perhaps not surprising that the bullfrog, with a 60-dB hearing range of 100 Hz to 2.5 kHz, has better hearing than the turtle (Figure 2). However, the high-frequency hearing of bullfrogs is easily surpassed by that of birds and mammals.[7]

Conclusion

Although the hearing abilities of humans and laboratory animals overlap extensively, the differences make it necessary to consider what a particular species can hear before presuming that a sound is easily audible, or potentially annoying, to it. Because of our good low-frequency hearing, we humans are likely to overestimate the loudness of low-frequency sounds to other animals. For example, the sound of the air-handling system in an animal room may be noticeable to us but inaudible to the animals housed in it. In contrast, humans' complete inability to hear above 20 kHz means that we require special equipment to detect sounds that are easily audible to other animals, especially mice. However, the likelihood of high frequencies being a problem in the laboratory is reduced by the fact that they are highly directional and thus less likely to bend around objects to reach an animal in a cage. In addition, high frequencies are more easily attenuated by the mobile pinnae