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Dog Yard Noise

by Dan Kato

INTRODUCTION

As dog mushing has increased in popularity, some conflict has occurred between those who are bothered by dogs barking and those who are not. Kennels and dog yards that were originally established in rural areas are gaining new neighbors. Often these new neighbors have moved from the city, where background noise is generally higher yet they are bothered by dog noise. Dog owners are not the only ones producing noise. Communities are affected by many other sources of environmental noise, the major of these being road traffic, aircraft and industrial plants. Millions of people are exposed daily to these noises. But how are dog yards so different? Why are some people still bothered, even those living a half-mile (0.8 km) or more away? This article addresses some of the many questions that arise in such conflicts, including 1) what is noise annoyance, 2) how loud can my dogs be and 3) what should I do to keep my dog yard quiet?

THE PROBLEM OF NOISE ANNOYANCE

Community planners, engineers, acousticians and psycho-acousticians have wrestled with the problem of noise annoyance for some time. The question of what noise bothers a person is not as simple as what "sound level" bothers a person. Given that this is not just about sound level, what else can we measure, if anything, to be sure individuals are below a threshold value that "sets them off"?

There are many complex factors that contribute to annoyance, including the level or loudness of the sound, its character, its relative strength compared to the background noise, and its duration. Additional complicating, non-acoustic factors include the time of day at which sounds occur, previous conditioning of the listener and what the sound recipient is doing at the time. Measuring noise with the human ear, coupled to the human brain, is somewhat like measuring with an instrument that constantly needs calibration and which is working only part of the time.

SOUND LEVELS AND LOUDNESS: THE BASIC MEASURE

Without going into a lot of mathematics, it is worth explaining first what sound level is since it is the common quantity measured by most sound meters and is used in many noise regulations. The basic unit of sound is the decibel. The lower case "d" and the upper case "B" are the correct case usage. Historically, this comes from the basic unit being the "Bel," named for Alexander Graham Bell. The decibel is then one-tenth of a Bel.

Decibels are a physical measurement of acoustic pressure or the fluctuation in pressure above and below atmospheric pressure as a sound wave travels by. The word "level" implies that the scale is logarithmic, which changes the way sound levels add to one another. Briefly, sounds at the same level combine into one sound that is only 3 dB higher, no matter what the level. So, two sounds each of 50 dB add up to 53 dB. Likewise, two sounds of 60 dB combine to make 63 dB. Sounds that are not the same level combine to a level that is something less than 3 dB over the higher sound. For example, sounds that are 6 dB apart only add one dB to the higher level. As a result 60 dB and 54 dB combine to make 61 dB. If one sound is "10 dB" down from another sound, it is only adding 0.4 dB to the first sound and is sometimes ignored. So far this is all about physics and mathematics and has nothing to do with human beings or dogs.

Most of the time, however, you will see regulations written not with sound levels expressed in dB but rather dB(A). The "A" indicates that the sound has been "A-weighted" over frequency, with frequency being roughly equivalent to subjective pitch as in a musical note. This "A-weighted" sound level is an approximation to loudness or the subjective intensity of a sound. Loudness is a measure

of how much sound is being received at a given time irrespective of whether that sound is pleasing or annoying. Now we are allowing for the fact that humans do not hear sounds at different frequencies at the same "loudness." The use of the term "loudness" here is key.

The "A-weighting" concept was taken from psychoacoustic experiments originally performed by Fletcher and Munson[1] in 1933, where the same word "loudness" was used when soliciting a response from test subjects. In the Fletcher-Munson experiments, listeners were asked to adjust the sounds of different pitch until one sounded as "loud" as the other. This was done with many participants, resulting in a series of curves over frequency and level that quantified how an average individual responded to these parameters, specifically with regard to the question of loudness. Table 1 shows an example of these curves similar to those of Fletcher and Munson. Only one of these curves at the 40 dB level (at a frequency of 1000 cycles per second) was chosen as the basis for "A-weighting." This weighting network, with some modification, was then applied to instrumentation that measured sound pressure level. So, dB(A) is an approximation of how loud a sound is to an average human. It is only an approximation to loudness since it uses only one of the curves that Fletcher and Munson developed. When A-weighted sound meters were first developed, this simplifying assumption was needed, since technology at that time could not produce a true loudness meter. In recent years, with advancements in digital electronics, meters are now available that directly measure loudness. However, regulations have not yet caught up with the new measurement technology.

Subjectively, loudness does not add arithmetically when the decibel scale is used. Sounds have to increase roughly 10 dB before a human would say that the increased sound is "twice as loud" as the first. In terms of actual sound energy, however, 10 dB represents a ten-fold increase. Other scales for loudness do exist that are not logarithmic. One of these uses the units of "sones" to quantify loudness. The sone scale is not logarithmic, so twice as many "sones" sound twice as loud. However, so far these units of measure have only been used for product noise and you will not see them in community noise regulations.

So how loud are dogs? This of course depends on how close a person is to the dog yard, the breed of dog, how many there are and how excited they are during the measurements. Measurements done at Alaskan Husky dog yards with approximately twenty dogs range from 60 to 75 dB(A) at 100 ft. (30.5 m), as measured with a sound level meter set to "fast response." Measurements of this type are very difficult, since many dogs are barking together at varying sound levels. One must then rely on statistical parameters to characterize the sound. Some regulations, such as those from the Minnesota Pollution Control Agency address variation in environmental noise by limiting median sound levels and sound levels exceeded ten percent of the time. Measurement of these quantities requires a special sound meter or a clever way to measure the distribution of sound levels.

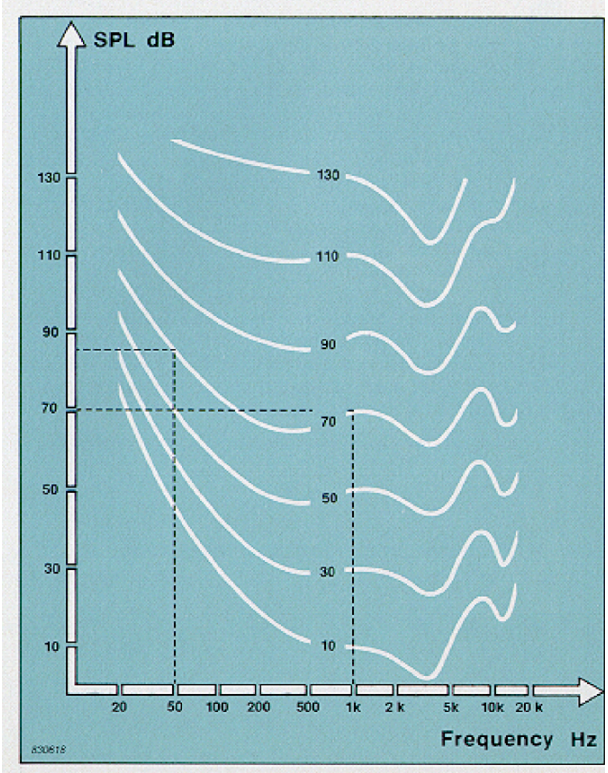

Table 1: Loudness curves. The number on each curve is the loudness level in "phons". The number on the left axis is the sound level in decibels.

OTHER PHYSICAL FACTORS OF ANNOYANCE

Loudness is not the only character of physical sound that contributes to annoyance. In addition to frequency, already discussed under loudness, there is tonality. Dog howls are examples of sounds that are somewhat tonal, as are automotive engines and police sirens. The impulsiveness of sounds also contributes to their annoyance. An impulsive noise consists of a rapid and extremely brief change in sound level. Gunshots and noise from hammering are examples of impulsive sounds. Dog barks do not fit clearly into a category of impulsive noise, but they may have somewhat of an impulsive nature. In general, impulsive noise having the same energy as a steady noise may be judged to be more annoying. Impulsive noise, however, also presents measurement issues, and most noise regulations do not address it adequately if they address it at all.

Duration is another factor that is commonly employed and quantified in community noise. In Environmental Protection Agency documents and international standards on community noise (ISO 1996-1:2003), community noise is quantified in terms of average sound level over a twenty-four-hour period. They further add a 10 dB penalty for noise that occurs during the period from 10:00 PM to 7:00 AM and call this measure Day-Night Sound Level or DNL. The basic quantity on which this is constructed, however, is still dB(A) or loudness. With regard to this type of average measurement and associated annoyance criteria based on DNL levels, dog yards do very well. As most owners of Alaskan Huskies and other northern breeds know, they do not bark for long periods of time. The usual behavior is to bark just during the time it takes to hookup or feed and then

sometimes in unison for an after dinner howl, lasting but a few minutes. Fire sirens, roaming animals and other neighborhood dogs can also stimulate barking. Dog yards with northern breeds, however, are in sharp contrast to city boarding kennels, where the barking is more or less continuous because of the large number of different breeds in an unfamiliar environment. There is also the typical city-bred terrier that will bark for hours at anything in the neighborhood that catches his attention.

Finally, the degree of ambient or steady background noise is probably one of the most unappreciated aspects of community noise, where so-called "intrusive noises", like dog barks, are a concern. Intrusive sounds are sounds that capture the listener's attention and may be considered particularly distracting. Background noise that is pleasing, like wind in the trees, or even steady noise from freeways can often cover up or mask intermittent intrusive sounds. Thus, there are situations where even the overall louder sound is less annoying than one that is not as loud. I have observed some cases where the individuals complaining about noise from sled dog yards were new to the rural area. They were not accustomed to the very low rural ambient noise levels and as a result became more annoyed by the intrusive noises, some of which just happened to be dog barks. They were, however, equally annoyed by unnatural sounds from snowmobiles, ATVs and neighboring rock crushers in a gravel pit.

JUST BECAUSE IT'S A DOG

Beyond the physical characteristics of the sound itself, there are psychological factors that must be considered to understand and quantify noise annoyance. The message the sound sends can be a factor and depends on the receiver's attitude, past experience, perception of sound necessity and economic dependence on it. Another related non-physical factor is the receiver's activity during noise exposure. Are they sleeping, cutting the grass or watching television?

For some noise sources, there have been well-funded documented studies that demonstrate that the character of the sound and the message it sends contribute to its degree of annoyance. For example, aircraft noise has been found to be more annoying than road traffic noise, which is more annoying than railroad noise, even when they are at the same loudness. The international acoustic standard, ISO 1996, even allows for this by adding penalties of 3 to 6 dB for aircraft. However, to my knowledge there are no documented studies that compare the degree of annoyance from dog yards with that of other noises.

Attitude toward the mushing community can sometimes contribute to the dog yard noise issue. Some may have the notion, albeit unfounded, that training dogs to pull sleds is cruel. There may also be hidden factors and conflicts between neighbors, where the dog barks are just an excuse for legal action. Economic dependence plays a role in that some consider dogs barking as a degradation of the serene rural environment. Yet dog yard owners may realize an economic benefit and are willing to put up with a lot more barking. Moreover, dog barking, like wolf barking, howling and crickets and birds chirping, are considered by some to be part of the natural rural soundscape. Even beyond dog yard owners, the community itself may realize economic benefit in the form of adventure-tourists who come to experience a wilderness dog-mushing trip. These same tourists will be spending their money in local restaurants and stores and may return to be outfitted for a summer canoe trip. It is rare to find a musher that is annoyed by his or her own dogs.

What then is the annoyance penalty of a kennel? At this time, there is no reference or previous research that would suggest penalties or some other metric for kennel noise that correlates with human annoyance. Current community noise regulations do not adequately address the dog annoyance issue.

WHAT CAN BE DONE TO REDUCE DOG YARD NOISE AND ITS EFFECT ON THE NEIGHBORS

Even with the lack of an adequate sound annoyance metrics for dog barks, there are a number of things dog owners can do to reduce noise. A few comments are offered below.

Noise Barriers, Walls, and Berms Walls can be an effective noise reducer but the typical 6 ft. (1.8 m) board fence will not do. The amount of reduction achieved depends on not only the wall height but also, the distance the noise source and noise receiver are from the wall. In general, either the noise source or receiver must be fairly close to the wall and the wall must be of substantial height and be well sealed. To achieve sound reductions of 10 dB or more, for example, a barrier should be at least 15 ft. (4.6 m) in height and dogs should be placed within 100 ft. (30.5 m) of the barrier. For best performance, the barrier should be roughly perpendicular to a line connecting the middle of the dog yard to the most sensitive noise area and should extend well beyond the last dogs at each end of the yard. The barrier can be of any construction material as long as it has weight of at least 4 lbs. per square ft. (19.5 kg per square m) and has minimal holes and cracks. Placing the wall on top of a natural berm or ridge can help to increase its effective height. It is prudent to retain an acoustical consultant to review a site plan before large amounts of money are spent on barriers or major construction projects. Figures 1 and 2 show and example of an effective dog yard noise barrier.

Figure 1: An effective dog yard noise barrier, view 1


Figure 2: An effective dog yard noise barrier, view 2

Setbacks to Exploit the Natural Attenuation of Sound Sound will naturally spread out from a source and attenuate with distance. Thus putting as much distance between the dogs and the neighbors is desirable, though not always practical. A general rule of thumb is that sound will reduce 6 dB every time the distance from the source is doubled. Therefore if a dog yard is producing 60 dB at 100 ft. (30.5 m) from its center, it will be approximately 54 dB at 200 ft. (61 m) Then at 400 ft. (121.9 m) it will be 48 dB. Setbacks from the neighbors of at least 400 ft. (121.9 m) are desirable although complaints from sensitive individuals one-half mile away or more are possible, particularly in areas of low background noise.

There is also the possibility of exploiting the excess attenuation of sound provided by trees, ground cover, air absorption and different weather conditions. Calculation of these factors, however, is complex and requires a lot of background data. It is not recommended that one depend on excess attenuation of sound to achieve large amounts of noise reduction. A single line of trees, for example, will not offer much help. However, a very dense forest through which sound must travel 300 ft. (91.4 m) or more can offer as much as 10 dB of reduction in dog noise.

Barns and Buildings Well-sealed barns for dogs can be much more effective than single-walled barriers. However, shelter of this type is normally not the preferred environment for northern dog breeds. A three-sided barn with the open side facing away from the neighbors could be a compromise and still allow dogs partial exposure to the outdoors. Locating dogs behind already existing buildings can offer some benefit.

Location and Noise Masking As previously discussed, fairly steady background noise of sufficient magnitude can mask or cover up the more annoying intrusive noises. Locating dog yards in an area that already has some background noise, such as near a freeway or busy road, can have some benefit. Also, locating yards near public land that will not experience development has obvious benefits.

Behavior Modification of Dogs This is one of the least explored areas but one that could have large benefits. Sometimes dogs need to bark for their own mental health, but there are ways to keep barking to a minimum. Some ideas are to limit feeding time to less sensitive times of the day, feeding dogs inside their houses (dogs conditioned for this would head for their houses when they know its feeding time, rather than staying out and barking), masking of or reduction of visual stimulus that sets them off possibly by using solid wall pens, and peer socialization of dogs. Shock collars that respond to the wearing dog's bark are reported to have some value but this author has no first hand experience with them.

CLOSING

This has been a brief overview of dog noise and the complex issues surrounding it. There is a need for better understanding of these issues. In particular, there needs to be a metric developed that will accurately and fairly gage the degree of annoyance from dog yard noise.

Reference

[1] H. Fletcher and W. H. Munson (1933), "Loudness, Its Definition, Measurement and Calculation," *Journal of the Acoustical Society of America*, Vol. 5, #2, October 1933, pp 82-108.

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