

Information Crossfile

Synopses of selected publications relevant to natural resource management

ARTICLE

Hearing perception

IN ACCORDANCE WITH THE NATIONAL PARK SERVICE

Organic Act and Chapter 8 of NPS *Management Policies 2006*, the fundamental purpose of all national park units includes providing for the enjoyment of park resources such as the soundscape. Hearing is fundamental to visitor perception of the soundscape and cannot easily be divorced from condition assessment of that resource. Most current soundscape metrics have their basis in human hearing, ranging from audibility functions to weightings that approximate hearing sensitivity. Therefore, it is helpful for park managers to have a fundamental understanding of the hearing process.

Hearing is a complex process that involves various aspects of physics, physiology, and neural processing (including psychology). Physics comes into play when incoming sound waves are modified, that is, filtered, by the shape and position of the listener's head, ears, and shoulders. This spatial filtering presents cues that neural processing in the brain can utilize to detect the approximate location, distance, and movement of sound sources. The physiology of the entire ear system affects how well sounds can be heard and at what frequencies they may be masked (rendered inaudible by another sound).

Human auditory perception is a multimodal process (Bulkin and Groh 2009). Sound carries information about the source, and this information can be judged in various ways. Response judgments may include interpretations of meaning (potential danger, speech communication), pleasantness (soothing ocean wave sounds), and undesirability (annoying noise), for example. Perception of sound sources is not limited to the sense of hearing. Visual-auditory interactions play a prominent role in perception. The image intrinsic to sound sources affects the evaluation of sounds. The converse is also true: A sound can affect the perceived quality of an image or a visual landscape (Carles et al. 1999). For example, studies show that the pleasantness and beauty of outdoor settings are impacted by multiple interconnected senses. For an outdoor location to be judged as "tranquil," a certain visual and sound quality level is usually required.

It is well-known that a listener's expectation and experience play significant roles in the perception of sound. Auditory attention elasticity—the ability to switch attention between environmental sounds—depends on the context and mind state of the listener, the individual's activity, and the loudness of environments that precede the moment of auditory perception (De Coensel and Botteldooren 2008). For example, if a listener is habituated to

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The masking of sounds by noise, or conversely, the audibility of sounds, is an important perceptual factor when communication is involved. However, because masking is mainly dependent on physiological aspects of hearing and there is a fairly abrupt transition region between audibility and inaudibility, it cannot fully describe human perceptual response. Auditory attention focusing has been proposed as another means for modeling soundscape perception (De Coensel and Botteldooren 2008). Auditory attention focusing comprises both top-down (directed) focusing, in which higher-level cognition guides attention toward expected sound sources, and bottom-up focusing, in which attention is triggered by the noticing of sound events.

Studies also indicate that natural sounds offer potential benefits for cognitive functioning and directed attention abilities. Unlike urban environments, with stimulation that dramatically captures attention, natural sounds modestly grab attention in a bottom-up fashion, allowing top-down directed attention abilities a chance to replenish (Berman et al. 2008). This provides further support for park management efforts to preserve the natural soundscape and the opportunity for visitors to experience those sounds.

References

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