NPS Natural Sounds & Night Skies Division Annual Synthesis of Studies on the Effects of Noise 2024

# Past Suggested Readings – Noise

## 2023

In a review of field studies examining the impacts of noise on wild fish, [Pieniazek et al. (2023)](https://pubs.aip.org/asa/jasa/article/154/5/2828/2920130) comprehensively summarize different data collection methods (e.g., camera, diver, tissue analysis, hydrophone), impact sources (e.g., noise from boats, air guns, tones, pile drives), future research directions, and emerging approaches. This work offers a helpful entry point for exploring the current state of research on noise impacts to wild fish.Meanwhile, [Kok et al. 2023](https://www.frontiersin.org/articles/10.3389/fevo.2023.1130075/full) provide a review of how chronic noise can affect wildlife communities in both terrestrial and aquatic ecosystems. Although community-level impacts of chronic noise exposure are not yet well-understood, the available studies indicate that noise has direct and indirect impacts, and effective mitigation will be difficult to accomplish without addressing knowledge gaps. Knowledge gaps persist due to the challenges involved in conducting the comprehensive long-term studies necessary to address community-level questions. The authors provide suggestions and a road map to address current knowledge gaps.Finally, [Kleist et al. 2023](https://www.frontiersin.org/articles/10.3389/fevo.2023.1149097/full) studied sites in 40 U.S. national parks to investigate whether birds respond differently to noise sources that could be clearly associated with the physical presence of a source (vehicle noise, human voice), vs. “disembodied” noise sources that a bird might not be able to easily associate to the physical source (aircraft overflight). The researchers observed an increased probability of detecting birds immediately after noise events, with effects persisting several hours afterward. The effects were strongest for aircraft noise, which might be particularly problematic since animals cannot easily move to avoid far-reaching aircraft noise the way they may be able to avoid vehicle noise or human vocal noise.

* Kleist, N. J., Fristrup, K. M., Buxton, R. T., McKenna, M. F., Job, J. R., Angeloni, L. M., … & Wittemyer, G. (2023). [Anthropogenic noise events perturb acoustic communication networks.](https://www.frontiersin.org/articles/10.3389/fevo.2023.1149097/full) Frontiers in Ecology and Evolution, 11, 1149097. **Open Access.**
* Kok, A., Berkhout, B. W., Carlson, N. V., Evans, N. P., Khan, N., Potvin, D. A., … & Wascher, C. A. (2023). [How chronic anthropogenic noise can affect wildlife communities.](https://www.frontiersin.org/articles/10.3389/fevo.2023.1130075/full) Frontiers in Ecology and Evolution, 11, 289. **Open Access.**
* Pieniazek, R. H., Beach, R. K., Dycha, G. M., Mickle, M. F., & Higgs, D. M. (2023). [Navigating noisy waters: A review of field studies examining anthropogenic noise effects on wild fish.](https://pubs.aip.org/asa/jasa/article/154/5/2828/2920130) The Journal of the Acoustical Society of America, 154(5), 2828-2842. **Open Access.**

## 2022

Compared with studies on impacts to wildlife and humans, the literature has paid minimal attention to the effects of noise on plants. This is the second year in a row that our search captured research studying noise impacts on plants. [Kafash et al. (2022)](https://www.sciencedirect.com/science/article/pii/S1439179122000081) subjected two urban plant species to 16 hours of road traffic noise for 15 days. Compared with control plants, noise-exposed plants had stunted growth and increased stress response mechanisms, indicating that traffic noise is an environmental stressor for plants. [Collins et al. (2022)](https://www.frontiersin.org/articles/10.3389/fevo.2022.891595/full) studied the impacts of acute and chronic traffic noise at entrances to wildlife crossing structures, finding that while coyotes demonstrated increased vigilance and running in response to chronic noise, mule deer responded positively to chronic traffic noise, possibly using crossing structures as a human shield against predators. These findings shed light on how acute and chronic noise impacts may affect predator-prey dynamics. [Willems et al. (2022)](https://www.sciencedirect.com/science/article/pii/S0048969721053006?via%3Dihub) investigated impacts of both noise and light on wildlife species richness, community turnover, and foraging activity. Impacts varied based on the scale of observation. Surprisingly, artificial light appeared to mitigate the negative impacts of noise on cumulative taxonomic richness, underscoring the nuanced consequences of sensory pollutants.

* Collins, A. C., Vickers, T. W., & Shilling, F. M. (2022). [Behavioral responses to anthropogenic noise at highways vary across temporal scales.](https://www.nps.gov/articles/%28https%3A/www.frontiersin.org/articles/10.3389/fevo.2022.891595/full%29) Frontiers in Ecology and Evolution, 1138. **Open Access.**
* Kafash, Z. H., Khoramnejadian, S., Ghotbi-Ravandi, A. A., & Dehghan, S. F. (2022). [Traffic noise induces oxidative stress and phytohormone imbalance in two urban plant species.](https://www.sciencedirect.com/science/article/pii/S1439179122000081) Basic and Applied Ecology, 60, 1-12. **Open Access.**
* Willems, J. S., Phillips, J. N., & Francis, C. D. (2022). [Artificial light at night and anthropogenic noise alter the foraging activity and structure of vertebrate communities.](https://www.sciencedirect.com/science/article/pii/S0048969721053006?via%3Dihub) Science of The Total Environment, 805, 150223. **Open Access.**

## 2021

Compared with studies on impacts to wildlife and humans, the literature has paid minimal attention to the effects of anthropogenic noise on plants, even though their lack of mobility may make plants particularly susceptible to chronic impacts. [**Solé et al. (2021)**](https://www.nature.com/articles/s42003-021-02165-3) investigated the impacts of anthropogenic noise on an aquatic plant, seagrass (*Posidonia oceanica*), finding alterations to nutritional processes and changes to the ability to sense gravity and sound vibrations. Because seagrass meadows are a widespread coastal ecosystem and provide many essential ecosystem services, these findings may have broad conservation implications.In a study relevant to parks, people, and birds, [**Levenhagen et al. (2021)**](https://www.ecologyandsociety.org/vol26/iss2/art32/) tested experimental quieting as a strategy to improve visitor experience and wildlife habitat quality at Grand Teton National Park. They found that visitors appreciated noise mitigation strategies – which produced better natural soundscape experiences – even if these strategies limited their personal access. Visitors perceived greater bird diversity when noise levels were lower due to mitigation signage. The abundance and composition of bird species, however, did not actually vary according to background noise levels. [**Gomes et al. (2021)**](https://academic.oup.com/bioscience/article-abstract/71/3/223/6104431) reviewed animal coping mechanisms for dealing with natural noise (like that from wind or snapping shrimp). This effort builds a more quantitative grasp on how natural noise characteristics have shaped animal communities. A deeper understanding of the mechanisms that shape how animals navigate natural noise may provide insights into how they will respond to increasing anthropogenic noise.

* Gomes, D. G., Francis, C. D., & Barber, J. R. (2021). [**Using the past to understand the present: coping with natural and anthropogenic noise.**](https://academic.oup.com/bioscience/article-abstract/71/3/223/6104431) BioScience, 71(3), 223-234.
* Levenhagen, M. J., McClure, C. J., & Barber, J. R. (2021). [**Does experimentally quieting traffic noise benefit people and birds?.**](https://www.ecologyandsociety.org/vol26/iss2/art32/) Ecology and Society. **Open Access.**
* Solé, M., Lenoir, M., Durfort, M., Fortuño, J. M., Van der Schaar, M., De Vreese, S., & André, M. (2021). [**Seagrass Posidonia is impaired by human-generated noise.**](https://www.nature.com/articles/s42003-021-02165-3) Communications Biology, 4(1), 1-11. **Open Access.**

## 2020

Regarding the impacts of anthropogenic noise on humans, [Van Renterghem et al.](https://www.sciencedirect.com/science/article/abs/pii/S016920461931093X) examined the effects of soundscape augmentation in a noise polluted park, showing the potential of augmented soundscapes to improve park experience and mask annoying road noise in urban green spaces. The rest of this year’s suggested reading relates to noise impacts on wildlife. [Sordello et al.](https://environmentalevidencejournal.biomedcentral.com/articles/10.1186/s13750-020-00202-y) provide a systematic meta-analysis of evidence of noise pollution impacts on biodiversity. Building on the work of Shannon et al. 2016, this effort is notable because it extends beyond journal articles to include gray literature. [Jerem & Mathews](https://conbio.onlinelibrary.wiley.com/doi/full/10.1111/cobi.13510) also provide a review of recent noise literature and note a shortage of long-term experimental studies. Both of these reviews have the utility of identifying current trends and knowledge gaps, and can help stakeholders and practitioners discover articles pertinent to their own work. Meanwhile, [Kunc & Schmidt](https://onlinelibrary.wiley.com/doi/full/10.1111/gcb.15428) provide a compelling meta-analysis on wildlife vocal activity modification in response to anthropogenic noise, analyzing over 100 effect sizes across 31 species; the variation in effects across species raises questions that may inform future noise studies examining multiple taxa. [Senzaki et al.](https://royalsocietypublishing.org/doi/abs/10.1098/rspb.2020.0176) experimentally investigated wildlife community-level noise responses, discovering that road noise not only negatively impacts the species richness and abundance of acoustically oriented organisms (birds, grasshoppers), but that these negative effects can extend to organisms without acoustic receptors (dragonflies) – even in quieter areas adjacent to noisier environments – demonstrating possible cascading impacts of noise.

* Jerem, P., & Mathews, F. (2020). [Trends and knowledge gaps in field research investigating effects of anthropogenic noise.](https://conbio.onlinelibrary.wiley.com/doi/full/10.1111/cobi.13510) [*Open Access*] Conservation Biology. 10.1111/cobi.13510
* Kunc, H. P., & Schmidt, R. (2021). [Species sensitivities to a global pollutant: A meta‐analysis on acoustic signals in response to anthropogenic noise.](https://onlinelibrary.wiley.com/doi/full/10.1111/gcb.15428) [*Open Access*] Global Change Biology, 27(3), 675-688. 10.1111/gcb.15428
* Senzaki, M., Kadoya, T., & Francis, C. D. (2020). [Direct and indirect effects of noise pollution alter biological communities in and near noise-exposed environments.](https://royalsocietypublishing.org/doi/abs/10.1098/rspb.2020.0176) Proceedings of the Royal Society B, 287(1923), 20200176. 10.1098/rspb.2020.0176
* Sordello, R., Ratel, O., De Lachapelle, F. F., Leger, C., Dambry, A., & Vanpeene, S. (2020). [Evidence of the impact of noise pollution on biodiversity: a systematic map.](https://environmentalevidencejournal.biomedcentral.com/articles/10.1186/s13750-020-00202-y) [*Open Access*] Environmental Evidence, 9(1), 1-27. DOI: 10.1186/s13750-020-00202-y
* Van Renterghem, T., Vanhecke, K., Filipan, K., Sun, K., De Pessemier, T., De Coensel, B., … & Botteldooren, D. (2020). [Interactive soundscape augmentation by natural sounds in a noise polluted urban park.](https://www.sciencedirect.com/science/article/abs/pii/S016920461931093X) Landscape and Urban Planning, 194, 103705. 10.1016/j.landurbplan.2019.103705