Midpeninsula Regional Open Space District

Memorandum

DATE: November 10, 2021

MEMO TO: Board of Directors

THROUGH: Ana Ruiz, General Manager

FROM: Julie Andersen, Senior Resources Management Specialist

SUBJECT: Update on the Electric Bicycle (e-bike) Noise Study

SUMMARY

In support of the Midpeninsula Regional Open Space District (District's) E-bike Policy Evaluation Project, the Natural Resource Department was tasked with investigating potential noise impacts to wildlife (specifically birds and bats) from electric bikes (e-bikes). Wildlife Program staff contacted H.T. Harvey & Associates (H.T. Harvey), one of the District's on-call biological consultants, to assist as they have expertise in measuring sound and determining potential noise impacts to these species.

BACKGROUND

Most birds are active during the day, primarily hear in low frequencies (sound audible to humans), and are most sensitive to noise when incubating and raising young (nesting). Bats are active at night, primarily hear in high frequencies (sounds not audible to humans), and are acutely sensitive to human-generated noise. They use high frequency sounds to echolocate when hunting prey, to navigate within their surroundings, and to communicate. Different species of bats hear in different frequencies. Bats typically begin hunting at twilight and continue feeding periodically into the night. Human-generated noise within District Preserves occurs mainly during the day and generally does not disrupt foraging bats. However, bats that congregate in colonies to roost (rest or sleep) and to care for and rear young (maternity roosting) can be particularly sensitive to human-generated noise. Potential adverse effects to bats and birds from human-generated noise include roost or nest abandonment, disrupted foraging or feeding, and the interruption of communication between individuals.

In one example provided by H.T. Harvey, big brown bats that appeared tolerant to low-frequency, human-generated noise (chainsaws and graders), were observed abandoning their daytime roost when a high frequency instrument was used. The noise generated was inaudible to humans and the work crew was unaware of the disturbance they were creating for nearby roosting bats. This type of disturbance, especially to a maternity roost may reduce survivorship of some young bats and should be avoided.

DISCUSSION

Study Methods:

H.T. Harvey designed two noise recording sessions to determine the ambient (background environmental) noise level and the noise levels (at both high and low frequencies) generated by the operation of conventional and e-bikes. The study was performed in two representative habitats (redwood forest and grasslands).

Low frequency recordings occurred in May 2021 at Purisima Creek Redwoods Open Space Preserve. This Preserve contains habitat suitable for marbled murrelet, a bird species that requires the use of regulatory agency approved avoidance buffers during their nesting season to avoid impacts from human-generated noise. High frequency recordings occurred in June 2021 at Sierra Azul Open Space Preserve. This Preserve contains typical habitat for both foraging and roosting of pallid bat (*Antrozous pallidus),* which is a California state species of special concern.

Sound from three different types of e-bikes, representative of the types under consideration for access on District trails, and two different types of conventional mountain bikes were measured each day at each site. Each bike was recorded as it was: 1) pedaling slowly uphill (and in power assist mode for e-bikes), 2) pedaling fast uphill (and in power assist mode for e-bikes), 3) coasting, and 4) braking. These were determined to be the most likely modes of use by bicyclists on recreational trails.

Sounds were recorded at different distances from the bikes while they were in operation. The recordings were then sent to a sound laboratory for analysis to determine at what distance sound from both conventional mountain bikes and e-bikes would attenuate (or be reduced) to the ambient noise level. For the purposes of the study, the ambient noise level recorded at each site was 20 decibels (dB).

Decibels are a unit of measurement that describe the intensity, or volume, of noise. Frequency is another unit of measurement that describes the pitch of sounds. Decibel levels were recorded for each bike for each mode, and were calculated and separated into five groups representing the different frequencies in kilohertz (kHz) that are typically audible for bird and bat species that occur within District lands (See H.T. Harvey Table 1).

Table 1. Phonic groups representing birds and bats

Frequency	**1kHz – 5kHz**	**18kHz – 26kHz**	**27kHz – 35kHz**	**36kHz – 44kHz**	**45kHz – 55kHz**
Phonic Groups	Birds	Bats			
Represented Species Examples	Generally, most birds	hoary bat (*Lasiurus cinereus*) Brazilian free-tailed bat (*Tadarida brasiliensis*) Townsend's big-eared bat (*Corynorhinus townsendii*)	pallid bat (*Antrozous pallidus*) big brown bat (*Eptesicus fuscus*) silver-haired bat (*Lasionycteris noctivagans*) Long-eared myotis (*Myotis evotis*) Fringed myotis (*Myotis thysanodes*)	long-legged myotis (*Myotis volans*) little brown bat (*Myotis lucifugus*) western red bat (*Lasiurus frantzii*)	California myotis (*Myotis californicus*) Yuma myotis (*Myotis yumanensis*)

Study Results:
Generally conventional bikes were quieter than e-bikes; at times the sound generated from conventional bikes was too quiet to be recorded. The consistently loudest noises resulted from pedaling slowly or quickly uphill with e-bikes, however, the single loudest noise was generated by braking hard on one of the e-bikes. Recorded sounds were loudest when recorded closest to the microphone, so this set of data was used to visually depict at what frequencies each bike generates noise in each mode (See Appendix A-1 to A-3 of the study). The highest sound pressures occurred between 8 kHz and 70 kHz, which would primarily affect bat species that hear in these ranges. Analysis of the data collected suggests that the amount of sound from e-bikes is far greater in the 40 kHz phonic group than in other phonic groups, suggesting that bats that hear in this range such as the long-legged myotis (*Myotis volans*), little brown myotis (*Myotis lucifugus*), and western red bat (*Lasiurus frantzii*) may be more prone to disturbance from e-bike traffic than other bat species. The human hearing range is typically between 20Hz and 20kHz and is most sensitive between 2 to 5 kHz, so people would not hear most sounds in the range that effect bats.

H.T. Harvey used the sound data collected to compute noise attenuation rates for the loudest bike (an e-bike) to provide recommended buffer distances from recreational trails and facilities to reduce potential noise impacts to bird and bat species. See H.T. Harvey Table 4 below:

Table 4. Computed distances for e-bike sound to attenuate to ambient levels of 20 dB for different frequency ranges

	1 kHz - 5 kHz	18 kHz - 26 kHz	27 kHz - 35 kHz	36 kHz - 44 kHz	45 kHz - 55 kHz
Distance to ambient (ft)	45	100	107	231	134*

*Drop in distance is due to how sound in this frequency travels and attenuates as well as at what level sounds are generated by e-bikes (loudest noises generated were in the 36kHz -44kHz levels)

The noise generated by e-bikes occurs in both low and high frequencies. Like humans, birds cannot hear high frequency sound and are not likely to be affected by e-bike high frequency noise. Instead, low frequency sound generated in the audible range (1kHz to 5kHz) may affect birds. Additionally, and specific to marbled murrelet, the District currently follows regulatory agency regulations that restrict noise-producing activities by creating dB limits and distance buffers based on ambient and action noise levels. These regulations define ambient noise levels at 50 dB or less which inherently makes H.T. Harvey's recommended buffers more conservative than agency standards. H.T. Harvey's study finds that e-bike noise attenuation will occur over a reasonably short distance (45 feet) and to an ambient level (20 dB).

Recommendations:
Buffer Distances: any trail that allows e-bikes should have:

- A minimum 45-foot distance from any known nesting bird site.
- A minimum 100-foot distance from any roost site of bats that hear in the 18kHz – 26kHz range, including Brazilian free-tailed bats (*Tadarida brasiliensis*), Townsend's big-eared bats (*Corynorhinus townsendii*), or hoary bats (*Lasiurus cinereus*).
- A minimum 107-foot distance from any roost site of bats that hear in the 27kHz – 35kHz range, including pallid bats, big brown bats (*Eptesicus fuscus*), silver-haired bats (*lasionycteris noctivagans*), long-eared myotis (*Myotis evotis*), and fringed myotis (*Myotis thysanodes*).
- A minimum 231-foot distance from any roost site of bats that hear in the 36kHz – 44kHz range, including long-legged myotis, little brown myotis, and western red bat.

- A minimum 134-foot distance from any roost site of bats that hear in the 45kHz – 55kHz range, including California myotis (*Myotis californicus*) and Yuma myotis (*Myotis yumanensis*).

For any trail that allows conventional and/or e-bikes:

- Maternity colonies of pallid bats and Townsend's big-eared bats are extremely sensitive, and Townsend's big-eared bats are known to abandon young because of disturbances. Therefore, for a maternity colony of either of these species, a minimum buffer of 200 feet to any trail allowing any bike traffic is recommended.

Management Considerations:
Guided by the District's mission, Natural Resources staff utilize best available science to determine best management practices when developing public access and managing recreational uses in the Preserves. This study provides recommended avoidance buffers for sensitive natural resources that are being reviewed and incorporated in the current e-bike evaluation work. Based on the location of known sensitive resources, there are no recommended changes to existing recreational trail uses, including conventional bike use. The evaluation of e-bike use will need to consider the sensitivity of bat populations for high frequency noise that is not audible to humans yet known to be generated by e-bike electric motors. See "Next Steps" below for information on how the Science Advisory Panel will consider these findings as part of their e-bike evaluation.

Seasonal trail closures and/or avoidance buffers are a current District practice utilized when warranted by the conditions (such as weather, noise, hazards etc.) and/or observable impacts to species. See situational evaluation section below for methodology and examples of when modifications to trail use may be warranted based on noise generated by recreational trail users. This information will continue to be used during future site planning for trails or other recreational facilities.

Situational Evaluation:
District staff will continue to evaluate sensitive resources like bird nests and bat maternity roosts on a situational basis and adjust protections based on species needs. Breeding birds have substantial variation in their behavior, sensitivity, and ability to acclimate to environmental stressors during the breeding season. The District implements nest protections for nests that are found incidentally or during surveys for project work. Seasonal nesting bird surveys would not be required just for trail use. Protections around bird nests should remain flexible to suit the ambient noise levels and activity in each particular location, using the distances described above as a suggested starting point if buffers are determined to be needed.

For example, nesting great-horned owls at Rancho San Antonio are acclimated to louder ambient noise levels and more frequent recreation activity. Each year perimeter flagging is placed around the tree that stands less than 25 feet from the paved trail, and the trail remains open while owls continue nesting successfully. Woodpeckers nesting at Bear Creek Redwoods during project work were monitored for disturbance and were determined to require no buffer at all; project work was therefore allowed to continue without negative impacts to the woodpeckers.

The majority of known bat maternity roosts in District preserves are located within buildings with low occupancy or use (e.g., barns), and in bat structures (e.g., bat boxes). Bats also nest in natural habitat, but such nesting sites are more dispersed and often go undocumented. Only two potential roost sites are known to be located in proximity to existing District bike trails – two bat boxes located on a spur access trail to the Skyline Ridge A-frame house. Temporary seasonal trail closures should be evaluated on an individual basis if new bat roost sites are identified

within proximity to bike trails. Bats may also have a higher disturbance tolerance and therefore smaller buffer size in more heavily visited areas (e.g., Skyline Field Office area).

Buffers would only be explored during the bird and bat breeding seasons, resulting in potential seasonal and temporary trail closures. Most bird nest sites that require temporary seasonal trail closures would be considered so sensitive (e.g., marbled murrelet) that the closure would apply for all forms of recreation and project work, and follow District resource protection practices.

Conclusion:
Both conventional bikes and e-bikes generate noise across both low and high frequencies depending on the model and the type of activity for which the bike is being used. Generally, conventional bikes are quieter than e-bikes and e-bikes generate noise in ranges that may be more impactful to bats.

An existing District best management practice is to avoid locating recreational trails and facilities in proximity to sensitive noise receptors (including known bird nests and bat roosts). However, both birds and/or bats may establish nests or roosts in proximity to a trail or other facility after it has been in place for some time. In these instances, during nesting and roosting seasons, when human generated noise is expected to exceed the ambient noise level, avoidance buffers can be considered to reduce potential impacts. Through this study, H.T. Harvey has provided recommended avoidance buffers that may be used to reduce impacts to both bird and bat species from bike and e-bike use on District trails.

NEXT STEPS

As part of the District's E-bike Policy Evaluation Project, the District's Scientific Advisory Panel (SAP) is reviewing the state of the science and practitioner knowledge on impacts and management of e-bike recreation on unpaved trails. This study has been provided to the SAP for review and to augment the existing literature on noise impacts from both conventional and e-bike use. It has also been shared with the SAP's Technical Advisory Committee, made up of researchers and practitioners for whom the information may be relevant. Since e-bikes have an electric motor, they produce sounds in the high frequency ranges. There appear to be few studies investigating e-bike noise impacts to wildlife and the few that exist often assume that e-bike impacts would be very similar to conventional bikes in terms of noise. This may be one of the first studies to look at potential impacts of high frequency sound emitted by e-bikes. H.T. Harvey will be presenting this study and findings at the Western Section of the Wildlife Society Conference in February of 2022. The study has been provided to the District e-bike team for review to inform the development of a potential e-bike policy. A copy of the final H.T. Harvey report and its appendices can be found on the District website.

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