Bats Along the Tuolumne River

An observational study of Chiroptera species richness along Tuolumne River

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ABSTRACT

The natural ecology of bats has not been studied in-depth until recent technology made it possible. Following the lead of an on-going survey of bat populations at Poopenaut Valley in Yosemite National Park, a Petterson D40x auto-triggering time expansion recorder was used along the Tuolumne River for 8 nights. The intention of this project was to identify which species are present or absent at each study site. During the day, vegetation and insect surveys were performed; along with an assessment of the overall water conditions at each site. Habitat quality was assessed at each site, and was then used to find correlations of bat species richness at the end of the research excursion. The Petterson detector was linked to an H2 Zoom recorder, then the recordings were run through SonoBat software to identify different species. Only two species were successfully identified through recording take along Tuolumne River, due to excess noise also recorded and technical difficulties. Although the results were not as successful as hoped, these results still suggest that bats are affected by the changes occurring in the Tuolumne River.

INTRODUCTION

Bats are not charismatic creatures, often painted out to be vermin or something you find in a haunted house- until recently. With advancing technology, these once considered small monsters are now being used to assess habitat heath (Cunto 2012). Although very elusive, the little knowledge about general bat ecology provides that bats survive on a diet of a variety of food types, including insects, fruit, and in a rare case, blood (Vaughn 2013). There are 17 species known to occur within Yosemite National Park, all are insectivores (Stock 2015), and majority of these species' foraging behaviors

are closely associated with bodies of water (Seidman 2001, Vaughn 2013). Bats serve as an indicator species due to the amount of insects required for their persistence. Bats are known to consume 30-50% of their body weight in insects per night (Esbérard 2008). Roosting behavior (Brigham 1997) and foraging behavior (Racey 1985, Jones 2004) of bats change between species, with seasonality, (Šuba 2012) and location (Swift 1983). Bats feed by using echolocation. They admit high to low frequency calls to approach prey, such as insects, in low light settings. These 'feeding buzzes' can be recorded in order to assess species richness along the river and within the watershed. General presence of specific species in an area can also be driven by disturbances, public land use (Wickramasinghe 2004), and fluctuations in abiotic factors (Naidoo 2012). The purpose of this study was to assess general species richness of bats along the Tuolumne River, inside and outside of national park boundaries.

A general assessment of the species present along the river was desired due to the environmental disturbances in recent years, specifically the Rim Fire in 2013, and the growing abundance of abiotic stressors, mainly the ongoing drought throughout California and fluctuating flows of the river. Within Tuolumne Meadows, dams and powerhouses do not control water levels. Acoustic detections within Yosemite National Park allowed for comparisons along the river to reaches with altered flows. Altering the level of the water, along with the temperature in the river below dams and powerhouses changes the distribution and abundance of insects (Bruno 2013). This is an important consideration when assessing bat species richness because a lack of insects in an area is thought to coincide with bat presence.

MATERIALS/METHODS

Materials:

- Petterson D40x detector
- Zoom H2 recorder
- 3.5mm stereo-stereo cable
- pole to mount 2-3m equipment off the ground
- rubber bands/zip ties
- plastic bags (for slight "weather proofing" of devices
- SonoBat software (to analyze data/identify species when returning)

Table 1 – Settings Used on H2 Recorder
Low-cut off filter: Off
Recording format: 44.1 Hz/16 bit
Automatic gain control: Off
File display: Default
Folder: 01
Monitor: Off
Plug-in power: On
Pre-record: Off
Autorecord: → On/off: On → Start level: -42 dB → Stop level: - 44 dB → Auto stop: 1 second
Mono mix: Off
Left/right: Default
Meternome: Default
Tuner: Default
Play Mode: Default
AB Repeat: Default
Light: 15 seconds
Contrast: 5
Battery: Alkaline
SD card: -
USB: Default
Date and Time: Current

Methods:

Using the Petterson detector along with the H2 recorder required preparing and testing before the start of this research trip. Table 1 is a general overview of the settings used in the field for recordings. The stereo-stereo cord needed to be altered in order to guarantee proper recordings. The end of one of the plug-ins needed to be clipped to allow the high frequencies to be recorded. Settings were set prior to departure, and the detector and recorder were taken out and tested in a local area where bats are known to occur. This helped ensure the devices were calibrated and working properly.

Each night just before or during sunset, the detector and recorder were linked to one another, attached to PVC pipe and set near the Tuolumne River. The Petterson detector and recorder were placed 2-3 meters off the ground, and in areas with the least canopy coverage. Bats were visually seen, but only identified as members of the Myotis genus. When the devices were placed near more stagnant water, they were mounted within one meter of the water's edge. When devices were deployed near faster reaches of the river, a greater distance was required to reduce excessive noise. Figures 1a and 1b show some of the mounting positions used in Tuolumne Meadows in Yosemite National Park and in Stanislaus National Park. The first two nights the detector was set up served as a trial run, in which setting errors and connections needed to be perfected. Once the technical difficulties were corrected, bat-feeding buzzes were successfully recorded. Batteries were a concern due to the need for both devices to operate throughout the entire night.

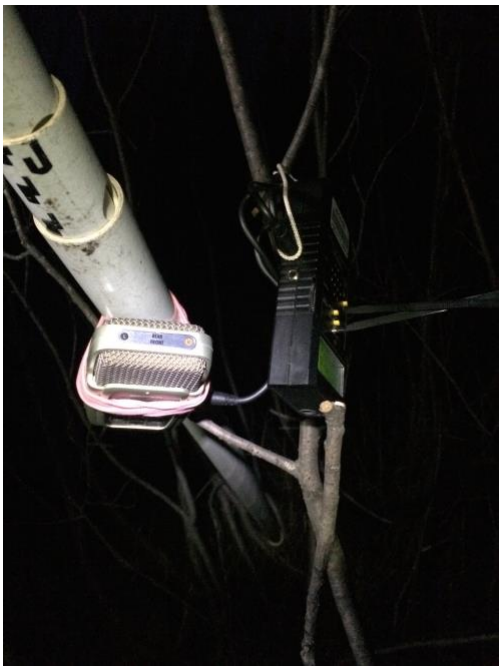

Figure 1a above, Figure 1b below

RESULTS

After processing 623 recordings, only 25 passes could be used to identify bats to species. Recording feeding buzzes was difficult in some areas due to other environmental noise in the area. Only low frequency calls were

obtained, due to technical difficulties with the Petterson detector. Due to the high frequency calls that bats use, the detector must be adjusted to "slow down" the call, so that it can be translated by SonoBat software. By not having the frequency adjusted properly some nights, the recordings taken were only of low frequency bats, such as the Western Mastiff bat (*Eumops perotis*) and spotted bat (*Euderma maculatum*). Both species are of special concern in California, and they were also found near houses and downstream from Kirkwood Powerhouse. Figure 2a and Figure 2b are two of the recordings obtained along Tuolumne River and processed through SonoBat. Species richness was not able to be calculated due to a lack of diversity recorded.

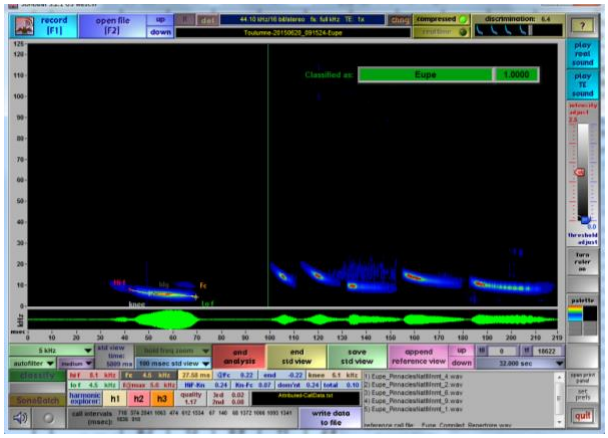

Figure 2a – E. perotis recording

DISCUSSION

Bats are affected indirectly by altered flows and environmental disturbances within watersheds. Along the river within the boundaries of a national park, which do not have altered flows, it is expected that there would be a higher number and diversity of bats. This was not proven true partly due to high elevations and cold temperatures within Yosemite National Park, and also due to inconsistencies in the equipment deployed. It was unfortunate that the equipment was not functioning properly. The technology being used for this project is still under improvements, as is the software used to identify to species. Although the results of this study did not yield a large amount of data, it did show that

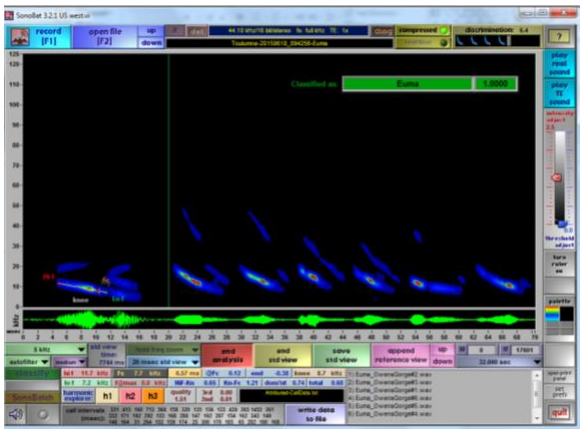

Figure 2b – E. maculatum recording

there are endangered species in close proximity to the powerhouses along Tuolumne River. *E. perotis* and *E. maculatum* are both thought to be declining due to anthropogenic factors, but maybe by slowing the water at Early Intake, humans are inadvertently providing foraging grounds for the declining species.

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LITERATURE CITED

http://jmammal.oxfordjournals.org/content/78/4/1231.abstract
Brigham, R. Mark, et al. "Roosting behavior and roost-site preferences of forest-dwelling California bats (Myotis californicus)." *Journal of Mammalogy* 78.4 (1997): 1231-1239.

Bruno, Maria Cristina, et al. "Multiple drift responses of benthic invertebrates to interacting hydropeaking and thermopeaking waves." *Ecohydrology* 6.4 (2013): 511-522.

Cunto, Gabriela Coutinho, and Enrico Bernard. "Neotropical bats as indicators of environmental disturbance: What is the emerging message?." *Acta Chiropterologica* 14.1 (2012): 143-151.

http://books.google.com/books?hl=en&lr=&id=P_Wn3wfd0SQC&oi=fnd&pg=PA219&dq=chiroptera+management+&ots=GCiRI1sbXs&sig=THeiVnbhuQFmPV5e4Aac2KVPWGM#v=onepage&q&f=false
Esbérard, Carlos, and Luciana Hardt Gomes. "Order Chiroptera (Bats)." *Biology, Medicine, and Surgery of South American Wild Animals* (2008): 219-224.

NAIDoo, SAMANThA, R. L. Mackey, and M. CoRRIE SChoEMAN. "Foraging ecology of insectivorous bats (Chiroptera) at a polluted and an unpolluted river in an urban landscape." *Durban Museum Novitates* 33.7 (2012).

Jones, G. A. R. E. T. H., et al. "Designing bat activity surveys using time expansion and direct sampling of ultrasound." *Bat Echolocation Research: Tools, Techniques, and Analysis, RM Brigham, EKV Kalko, G. Jones, S. Parsons, and HJGA Limpens, eds. Austin, TX: Bat Conservation International* (2004): 83-89.

Racey, P. A., and S. M. Swift. "Feeding ecology of Pipistrellus pipistrellus (Chiroptera: Vespertilionidae) during pregnancy and lactation. I. Foraging behaviour." *The Journal of Animal Ecology* (1985): 205-215.

http://utrep.blogspot.com/2011/06/nps-bat-research-in-poopenaut-valley.html?m=1
Sears, William. "NPS Bat Research in Poopenaut Valley" *The Upper Tuolumne River Ecosystem Program.* June 13th, 2011.

http://www.asmjournals.org/doi/abs/10.1644/1545-1542(2001)082%3C0738%3ABAAISI%3E2.0.CO%3B2
Seidman, Victoria M., and Cynthia J. Zabel. "Bat activity along intermittent streams in northwestern California." *Journal of Mammalogy* 82.3 (2001): 738-747.

https://drive.google.com/a/ucdavis.edu/file/d/0ByXbtqrXtQ1LZ3JvVW5wNHFTQXM/view
Stock, Greg. "Looking Downstream: Final 2014 Update" Physical and Ecological Responses to River Flow downstream of Hetch Hetchy Reservoir, Yosemite National Park. January 6th, 2015.

Šuba, Jurgis, Gunars Petersons, and Jens Rydell. "Fly-and-forage strategy in the bat Pipistrellus nathusii during autumn migration." *Acta Chiropterologica* 14.2 (2012): 379-385

Swift, S. M., and P. A. Racey. "Resource partitioning in two species of vespertilionid bats (Chiroptera) occupying the same roost." *Journal of Zoology* 200.2 (1983): 249-259.

Vaughan, Terry A., James M. Ryan, and Nicholas J. Czaplewski. *Mammalogy*. Jones & Bartlett Publishers, 2013.

Wickramasinghe, Liat P., et al. "Abundance and species richness of nocturnal insects on organic and conventional farms: effects of agricultural intensification on bat foraging." *Conservation Biology* 18.5 (2004): 1283-1292.