Preliminary Field Test Results of an Acoustic Deterrent with the Potential to Reduce Bat Mortality from Wind Turbines

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Screen shot of infrared video recording, Camas Creek. OR.

Summary

Documented bat mortality at wind energy facilities indicates a significant threat to many bat populations when extrapolated out to the number of proposed installations, particularly those crossing corridors used by migrating bats. Any means of deterring bats from approaching these turbines may prevent fatal impacts. We hypothesized that selected regimes of ultrasound could generate an uncomfortable or disorienting airspace that could deter bats from entering the dangerous airspace around turbines. We tested a prototype acoustic deterrent by monitoring foraging activity at eight different pond sites during July and August in CA and OR for two nights to establish baseline activity levels, and then after observing activity similar to baseline on a third night and then activating the ultrasonic sound regime. We measured activity in the same way each night by counting “visual passes” of bats entering and leaving the recorded view from a Sony DCR-TRV520 Nightshot video camera equipped with a high intensity infrared lamp. For the same one hour period each night the mean baseline activity was 419 ±153 passes, compared to 238 ±88 passes with the ultrasound regime active, $P<=0.025$. We conclude that ultrasonic broadcasts have promise as a tool for deterring bats from approaching turbines and warrant further investigation and trial implementation. Not surprisingly, bats seemed most affected closer to the ultrasound emitter, suggesting that increasing the amplitude of the sound regime may increase the effectiveness and range of this approach and facilitate scaling this approach up to that required for deterring bats from the airspace surrounding wind turbines.

Methods

The AT800 was designed to test the potential to deter bats by transmitting high quality regimes of ultrasonic sound. Because of this sound regime, it was not possible to use acoustic bat detectors to monitor bat activity when emitting ultrasound. Instead, activity was quantified using Sony Handycam 460x camcorders in their nightshot mode with Wildlife Engineering’s Model IRLamp6 infrared light.

Survey:

Each site was surveyed for a minimum of three nights for an hour after sunset. The first two nights have no experimental portion, a camera and Pettersson D240x bat detector were set up to collect data. On the third night, only the camera and AT800 were operated (the Pettersson is no longer capable of obtaining data due to the ultrasonic noise). All surveys were done during the summer foraging season (between July and September). All equipment from each survey was used consistently (the same camera, light arrangement, tripod height and location, etc).

Site Selection:

Sites were chosen in areas where there was the possibility of high bat activity. This was done either by looking at a topographic map and finding isolated water sources within a landscape or by following up with prior reconnaissance and survey locations. Once a body of water was chosen, the following were considerations to choose the specific location:

- Presence of still water
- Ability of the camera to clearly see the water surface and the area directly above (no vegetation within the view).

- Narrow channel or pathway, hopefully funneling bats within the view of the camera
- Open canopy regardless of habitat (forest, desert, etc)
- Distance to other sites (greater than 1200m)

Typically a local biologist or bat surveyor was able to recommend possible sites a priori to surveying.

Camera Setup:

The camera is set up prior to sunset. Sunset has been determined by using a Magellen GPS unit for each specific location. Using a large tripod with a “L bracket” for light placement the camera was placed such that the most width of the water body is within view without compromising a low zoom factor (i.e., allowing for bats in the distance to be seen and not confused with insects). Once the camera was placed, ideally two infrared lights were attached. One was placed using the slot on the L bracket, placed within 5-8” of the camera facing the water. The other was placed atop the camera using two rubber bands. Their battery packs were located on the ground with the cables loose.

Pettersson Setup:

The Pettersson detector was set near the camera on the control days (1,2). The detector was on standard settings for automatic recording and attached to an Iriver mp3 player (as per SonoBat.com PowerPoint presentation concerning IRiver Autorecording). It was turned on within a few minutes of the camera and headphones were placed over the camera to allow the calls to be recorded with the Hi8 medium in addition to the mp3 player.

Data Collected:

Three forms were used for the project. One was a location form that provides information on exact location (UTM), site place, duration, camera and detector locations, habitat, directions, and general notes. This Location form was intended to be filled out once and can be used to resurvey by any individual with the proper equipment and a map. The other was daily monitoring and includes sunset, time and temperature of the beginning and end of each survey, number or files collected, and notes for each individual night. Lastly, there was a data analysis form that is used as the videos are watched and surmises the number of bat passes the time of start to the nearest time divisible by 5 (2035), and from then on in five-minute increments to the end of the survey duration.

Analysis:

Acoustics -

Calls were downloaded to a laptop each day and the files were briefly reviewed to document species diversity. Those calls were categorized into known (fits the key with at least one bold characteristic) and probable (calls that may not fit within the key but seem to be correct based on several characters – presence in the past, some key traits, habitat/location). Not all calls are classified to species and only good quality calls were used (complete with tail, has harmonics, etc).

Video -

A bat pass was defined as the occurrence of a bat flying onto and off the screen. No attempt was made to identify possible repeat passes as individuals could not be determined. There is no difference in the quantification of a pass if a bat flew on screen for a short or long duration.

Other notes:

The first few surveys used one light and the quality of bat passes is limited approximately 30 minutes after sunset. These were all done consistently, however, and this should not effect the experiment as long as each is site is not considered equal to the other sites. Two lights allows for bats to be seen further than the direct light’s beam.

Three days was chosen as a quantifiable number based on prior experience.

Field sites

Results are listed by site visited.

Field sites

Lakin Dam, 11, 12, 13, 23, 24, 25 July 2006, UTM 583157 4565023

Dense Salix/Alnus/Spirea/Sedge/Carex along water. Several 6m Salix in oxbow center. Surrounding area CWHR 5-6 PIPO forest, multistage with visible snags. Camera on viewing deck in northern most corner next to rail/water.

From I-5 take Hwy 89S towards McCloud. Go past McCloud into the McCloud Scenic River area and turn right on the 40N44 (McCloud River Loop). Follow the 40N44 past Upper falls and turn right where signs direct to Lakin Dam. Turn right at Lakin Dam turn and park near public walkway.

Oxbow upriver from Lakin Dam. Below is a gorge that is predominately riffles and falls with small scattered pools. Large rocks (lava) in gorge area. Oxbow is a long run, pond like, slow and deep water with dense vegetation. High number of bats. People at location all nights making it difficult to set up on time. Paired with Bigalow, set up after. First survey started later than usual due to Pettersson battery issue and swimmers.

Bigalow Bridge, 23, 24, 25 July 2006, UTM 583580 4564513

Riparian zone consisting of Salix/Alnus/and other. Similar to Lakin Dam. Camera on north east side of bridge, directly under at corner of degrading retaining wall. 2.4 m above water. Camera facing up stream to the north west.

From I-5 take Hwy 89S towards McCloud. Go past McCloud into the McCloud Scenic River area and turn right on the 40N44 (McCloud River Loop). Follow the 40N44 past Upper falls and turn right where signs direct to Lakin Dam. Pass right turn to Lakin Dam and continue down road approx 0.5 miles to the bridge. Bridge has gate.

Run downstream ~8 meter wide portion of stream. Paired and offset with Lakin Dam (trial 2). Bigalow 22-24 Jul, Lakin 23-25.

Trout Creek, 25, 26, 27 July 2006, UTM 592779 458862

Riparian zone (Salix, Alnus, etc) within the middle of mixed conifer (ABMA, PICO, PIPO). Some lava tubes upstream. Camera on old dam structure amongst Trout Creek Campground. On most south west corner to the east of a ABCo/PIPO cluster.

Take Hwy 89S past McCloud and take Forest Hwy 13N for 18 miles to the 42N09 (west). Drive 1 mile to the campground. Location on far end of campground down second left and second right. in between 2 campgrounds.

In campground, some structures (remnant buildings, etc). Creek undergoing restoration for red banded trout. In control area up stream.

Buck Mountain Pond, 4, 5, 6 August 2006, UTM 501762 4893899

Small riparian zone surrounding perennial creek (alnus, equisetum, skunk cabbage, etc). Nearby habitat mainly PSME in a grid of tree farms (clear cuts). Pond in second growth with a few snags and older characteristics. Camera on side of pond to the west of the mucky inlet. Camera in between several alders facing the majority of the pond.

Go to the town of Mohawk, Oregon. Make a left on Hill and a right on Donna next to the store. Drive about a 1/2 mile and make a left on McGowen Drive. Continue 8-9 miles, staying to the right at possible 'Y' intersections (the roads go to various tree farming/shotgun range activities). Head up a steep uphill overlooking the valley and under power lines. Make a sharp left after a quarry and a 90 degree right at the next intersection. The pond is to the left across from a small skid road and before the clear cut.

Trying both infrared lights as there is no paired survey nearby. Pond small enough to almost be captured in one frame.

Twin Springs, 16, 17, 18 August 2006, UTM 730377 4670815

Mixed hardwood conifer (aspen, ponderosa pine, red fir) some willows, numerous cattails around pond. Camera at southern end of the pond near road and close to the cattails on the east. As close to the water as the camera can get without being in a bog.

From Lakeview, Oregon take Hwy 140E towards Adel. Turn right past the snopark onto Walker Road. Go south to the dead end, then west to the end, then south across a bridge and over Camas Creek. Follow Camas Creek to Ranger Meadows and the 5-way junction. Turn left and follow the 3910-27 and make the first right after the Forest Service Twin Springs campground.

The meadow to the south has wide "flyway" possibilities. Camera in between willow and aspen such that if bats are traveling from the south they will come over the camera.

Camas Creek, 22, 23,24 August 2006, UTM 725402 4672857

Mixed conifer forest, willow shrubs near the water, dry and rocky, grass around pond. Camera placed at southeast end of pond over the berm from the road near willow shrubs.

From Lakeview, Oregon take Center Street about 7 miles to a hair pin turn with a burn on the left. Pond is behind the berm.

Pond created by man-made berm on north side of the pond. Camas Creek flows from the south.

Stuart Fork, 26, 27, 28 August 2006, UTM 506881 4524629

Klamath mixed conifer (PSME, CADE, PIPO, QUKE) plus big leafed maple, dogwood, umbrella plant, etc. Healthy looking riparian zone near creek. Below the parking area for Bridgecamp corral/Stuart Fork Trinity Alps trailhead. On the small rocky outcropping on creek between 2 riffles.

Take Hwy 3 north from Weaverville about 20 miles. Turn left on Trinity Alps Road (past the resort) to the end of the road at Stuart Fork Trailhead. Go below Bridgecamp's corral to the river at the widest, flattest, and most calm part in the vicinity.

Three snags exist below camera. Possible roosts, many bats seen emerging two nights prior (8/24) foraging and skimming.

Results

For the same one hour period each night the mean baseline activity was 419 ±153 passes, compared to 238 ±88 passes with the ultrasound regime active, P<=0.025.

t-Test: Paired Two Sample for Means

	control	treatment
Mean **passes per hour**	418.9	238.1
Observations	8	8
P(T<=t) one-tail	**0.025** *	
t Critical one-tail	1.895	
P(T<=t) two-tail	0.049 *	
t Critical two-tail	2.365	

Overall, bat activity was reduced by approximately half in the presence of the ultrasonic broadcast.

Discussion and conclusions

This preliminary investigation was undertaken to determine whether ultrasound could potentially be used to deter bats from entering an airspace. We conclude that ultrasonic broadcasts have promise as a tool for deterring bats from approaching turbines and warrant further investigation and trial implementation. Not surprisingly, bats seemed most affected closer to the ultrasound emitter, suggesting that increasing the amplitude of the sound regime may increase the effectiveness and range of this approach and facilitate scaling this approach up to that required for deterring bats from the airspace surrounding wind turbines. Additionally, the protocol of this preliminary investigation only tested an experimental effect on the first night of ultrasound treatment. It is likely that many of the bats counted passing into the ultrasound regime may learn to avoid the affected airspace and not return on subsequent nights. Thus, the ultrasonic deterrent effect may be more pronounced on subsequent nights. Alternatively, it is possible that bats may learn to accommodate the sound regime and reoccupy it, although this would be contrary to physiological expectations.

Next Steps

Our laboratory and initial field tests indicate that further development and testing of acoustic deterrents is warranted. We will continue developing new prototypes and plan to test them at a wind facility in late summer and fall 2007. Intensive fatality searches will be performed at the test facility. Randomly selected turbines will be fit with acoustic deterrents (~5-6) and bat fatality will be compared with a sample of turbines that do not have these devices attached. Pending adequate funding, we also plan to use thermal imaging cameras to monitor bat activity and interactions with turbines that have acoustic deterrents to better understand responses of bats to these devices.