

## Project Update: September 2019

Due to issues that arose with the import of the bat lures, they only arrived this week, at which point the bat netting can begin in earnest. So far, the major milestone has been the design and construction of the enclosures, a full description of which is provided below. Since this is the first time that an exclusion experiment is being conducted on bats in this type of landscape, there were no designs to base the enclosures off. Due to this, each part of the enclosure went through several different designs before we settled on the final version. This took time, and there were also several unexpected costs associated with it. We now have and have had since the 10th September 2019 six fully functioning pairs of enclosures. Small changes have been made since then, and the enclosures have been up at night and down during the day since the 10th, with the exception of the 16th and 17th September when a design change forced us to keep the nets down all day while we worked on them.

In all, I have had to use a lot of plastic to build the enclosures, both in the nets and the ropes. However, in keeping with the wishes of the foundation, I have already found uses for them after the project. The ropes and bamboo will go to builders to be used in building sheds and scaffolds in the village, and fishermen have already 'booked' my nets to fish with once my project has been completed. I also have a query related to the condition to pass on my equipment to NGOs and universities once my project had been completed.

I now have nearly 2 months left to catch bats, and as the rice grows, so will the pest population, which is what we predict will attract more bats. The Audiomoth recorders have been out for several nights now, on average about twice a week, and will continue to be used till the end of the season. This should hopefully give us the ability to view any temporal variation in the bat distribution. There has been a slight change to the methodology regarding how I would collect the final data from my exclusion study. While all the enclosures are the same dimensions, even slight changes in how different farmers sowed their crop would result in differences in crop densities. In an effort to standardise everything, calculation of the final yield is now going to be based on a set number of plants (which will be comprised of a major fraction of the crop), thereby getting a value for average yield per plant, as opposed to average yield per area.

### Description of enclosures

Each enclosure is a square with a side 9 m long, and a height of 4 m. The frame of the enclosure is made of bamboo, with thicker, heavier bamboo making up the stilts, and thinner, lighter bamboo making up the horizontal bars that form the roof. Each enclosure has a total of eight stilts and four horizontal bars. Each of the stilts is 2 ft longer than 4 m, with the extra 2 ft buried into the earth for stability. Since the enclosures are built in rice fields which are often inundated, the exact height of each stilt varies, but no more than 10 cm. The horizontal bars are made up of thinner bamboo, measuring over 9.5 m in length to allow for some bamboo to stick out at either end. At the top of each stilt is a wedge cut from the bamboo, with a small bamboo stick drilled in horizontally. This stick (Image 1) is used to secure the horizontal bars on top (Image 2).

The experimental enclosures are closed every evening, so that bats cannot enter to consume the pests within. This is achieved using cricket nets which descend down to form the 'walls', and slide across the top to form the 'roof'. Each wall has half a brick at each corner, and half in the middle to enable a smooth descent. To prevent gaps between each of the corners of the walls, the nets are joined together, forming one continuous net going all the way around the structure. A total of eight half-bricks are used to raise and lower the nets. Attached to each half-brick is a rope which is woven through the net on the way up, loops over the horizontal bamboo at the top, and descends back down on the other side. By weaving the rope through the net, when raised, the net crumples into a small bundle, making it a far small impediment to the free movement of birds during the day.

The 'roof' consists of two nets tied together lengthwise to form one 9 x 9 m net. At one end, this is attached to the horizontal frame, and at the other it is attached to another 10 m long bamboo pole. This pole, which I will refer to as the 'slider', has a tooth embedded in it at each end, and moves freely in one direction, allowing the net to be opened or closed. Three ropes at each end facilitate the safe opening and closing, with the ropes at one end having been woven through the nets to achieve the same effect as that of the walls. To ensure that there is no gap between the sides of the roof and the frame, three more thin ropes on each side are used to pull the net of the roof taut and close any gap.

To facilitate the efficient functioning of the various pulley systems in the enclosure, small (10 cm) bamboo sticks are drilled into the sides of each of the stilts at waist level. These are used to tie the ropes in the open or closed position to ensure that no gaps form when rain or wind buffet the structure. Taut nets also ensure that even if a bird or bat were to fly straight into the structure, they would simply bounce off instead of getting caught in it.

The nets used for the enclosure are 60 x 15 ft cricket nets. Each was cut in half to make one unit, which might later have been joined to another. The nets were chosen for years of use in playgrounds and schools over the country without reports of being a danger to birds or bats. I personally have seen this for over 10 years, where one was installed at the National Centre for Biological Sciences, which has a wildlife department that, when consulted, confirmed that there had never been a report of a bird or bat being caught in the nets. The mesh size is a 5 cm side, and the material is moderately stiff, unaccustomed to getting tangled. When two nets were joined together, flat plastic rope was used to tie nets together, at intervals of 5-8 cm. This meant that, even when stretched, there isn't a gap large enough for a bat to get through. While there are no gaps in the nets on the sides or top, the base of the walls are not fixed to anything. These nets end near the top of the rice plants, so that they don't cause damage to the crop. Since bats won't fly between the dense rice plants, it was deemed an appropriate height to end at. As the plants grow, the starting height of the nets will be further increased by chopping of small strips from the base.

The nets are raised every morning, starting just after dawn (currently around 04:30), and closed again before dusk. With shorter days, these timings are scheduled to change. With two people working together, the six enclosures take just over an hour to complete. Part of the experimental design was to have each pair at least 90 m apart and walking between the pairs adds to the overall processing time.

Each pair sits exactly 8 m apart. Both the control and experimental enclosures are identical, except that the control enclosures sometimes have slightly thinner bamboo, knowing that they would not have to take the stresses that came with the nets. The control treatment for Enclosure 1 is made slightly differently, with metal pipes being used at the corners to hold the bamboo in place. This had been the design for all the enclosures but proved impractical and was abandoned for the newer design after the construction of one enclosure. Since the dimensions are the same as the others, it was left erect, but not used as the experimental treatment due to the difficulty of installing the pulley systems on it.

Two time-lapsed videos are attached of the opening and closing of the nets. One additional thing that can't be seen in the video is the tightening of the roof by pulling ropes from the side. In the video, only one such rope on either side is pulled because the other two on either side had slipped in. That issue has now been resolved.