Project Update: June 2015

Project summary

Artificial roosts attract fruit-eating bats into deforested areas, representing a promising tool for accelerating seed input and forest regeneration. However, the method's applicability is not developed for large-scale use yet, and information on seedling establishment around roosts is lacking. Additionally, the beneficial ecosystem function of bats is still widely unknown and they are regarded as a pest. This hinders the use of bat roosts for nature conservation. We aim to identify the utility of bat roosts for reforestation and develop tools for informing about bats as agents of seed dispersal, thereby communicating an inexpensive technique for enhancing tropical forest recovery.

Introduction

Bats are important seed dispersers in the tropics. Their fruit consumption increases dispersal distance from parent plants, seed germination, and seed survival. They disperse keystone species, and help maintain forest diversity because of their diverse diet. In addition, bats aid in forest regeneration because many of their food plants are pioneer species, and bats deposit their seeds in highly disturbed areas where other frugivores rarely venture. Therefore, a healthy frugivore bat community is important for successful forest regeneration and the maintenance of diverse plant communities.

However, bats lose essential roost trees by deforestation. Also, bats are often regarded as pests and their roosts are destroyed, which affects bat distribution with concomitant effects on seed dispersal. Artificial bat roosts have been suggested as an effective tool for facilitating bat colonisation of deforested areas, thus supporting seed dispersal and potentially accelerating reforestation. However, while the significance of artificial roosts in attracting bats is recognised, their effect on forest succession has not been tested. Also, the utility of roosts for reforestation may be hampered due to superstition towards bats and the pivotal role of bats as agents of forest recovery is not appreciated by conservation and government agencies in their regeneration programmes.

The main objective of our project is to test, develop and propagate a novel method for increasing seed dispersal in degraded tropical habitats. In detail, we aim to validate artificial bat roosts as a method for augmenting seed dispersal and seedling establishment in deforested areas, improve the conception of bats as important agents of ecosystem services, and train local people and organisations to apply bat roosts and act as multipliers and contact points for bat issues. The proposed method could not only be employed as a singular means for boosting vegetation succession, but may also serve as an auxiliary technique in nature restoration projects, especially in such situations where restoration techniques that need constant maintenance are precluded or the floral connectivity of fragmented habitats shall be improved.

The main outcomes we expect from our project are five. First, we will install six bat roosts, thereby increasing seed disperser abundance and seed input. Second, we seek to improve the colonisation speed of artificial roosts by using acoustic lures. Third, we want to measure seedling establishment using seeds accumulated in artificial bat roosts. Fourth, we want to promote artificial roosts as a method for forest recovery projects among five nature

conservation organisations. Last, we will inform three communities and schools about the method to foster a greater appreciation of reforestation projects as well as bats as providers of ecosystem services.

Preliminary results

Goal 1: Install six bat roosts

In our previous project update, we showed that eight bat boxes had been constructed and securely placed in areas that were either devoid of native vegetation, such as pasturelands, and in or around forests in early stages of recovery. This was the first stage of our project and was successfully completed in 2014. Since their installation, we have monitored bat colonisation. None of the boxes that were placed in pastures have been used thus far by bats. Two of the boxes placed near secondary forests are being permanently used by the insectivorous sac-winged bat *Saccopteryx bilineata*, although few individuals (1 and 2 bats per box) are using these structures.

Figure 1. Photo showing traces of fruits consumed by bats using one of the bat boxes.

In our previous report we also mentioned that we had observed only one roost being used by fruit-eating bats, with substantial accumulation of guano on its base. However, we did not observe bats during the day, and plant material and guano stopped accumulating after our initial observation, which indicated that bats had used the roost for a short period of time. However, in May 2015 we observed a substantial new accumulation of plan materials at the base of the box (Figure 1), and observed two bats using the roost during the day (Figure 2). Upon close inspection, we identified the bats using the box as the short-tailed fruit bats of the genus *Carollia*. The accumulation of long stalks, as shown in Figure 1, suggests that the diet of the bats using this box is mainly composed of fruits of the genus *Piper*, which is an important pioneer plant species in the Neotropics.

Figure 2. Photo showing two fruit-eating bats of the genus *Carollia* roosting on the inner side of a bat box.

Goal 2: Improve the colonisation speed of artificial roosts by using acoustic lures

For acoustic trials, we previously attempted to use social calls of fruit-eating bats of the genus *Carollia* that were facilitated to us by another colleague. These calls, which are used by males to attract females, did not work on previous attempts. As a result, we had to locate an adequate colony and make recordings of their vocal activity at the roost to use as potential lures. After finding a roost with sufficient individuals, we recorded vocalizations produced by colony members. This colony was found under a bridge and contains at least 30 bats of the genus *Carollia*. The recordings include many social calls and echolocation signals (Figure 3). We will start to broadcast these signals at

selected roosts and record any changes in roost use after these sessions.

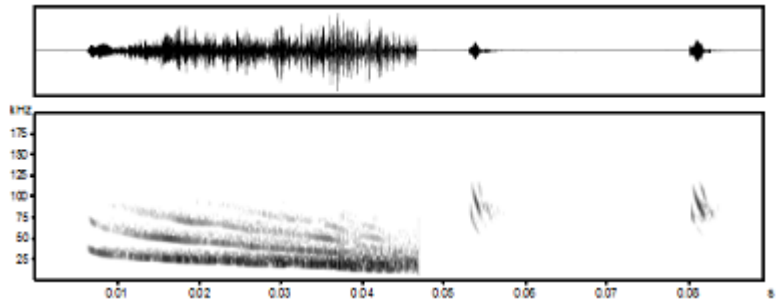

Figure 3. Waveform (upper panel) and sonogram (lower panel) of a social call (left) and two echolocation signals used by individuals within a colony of fruit-eating bats of the genus *Carollia*.

Goal 3: Determine seedling establishment

Only one of the constructed bat boxes had been previously used by fruit-eating bats, and there was not a constant input of seeds to use for this stage of the study. However, since the permanent arrival of two bats of the genus *Carollia* to one of the boxes, we have observed a steady accumulation of plant material, including seeds, which we plan to use for our seedling establishment experiment. This experiment will be conducted in an area used for cattle grazing (Figure 4), where one of our bat boxes is located.

Figure 4. Photograph of the Osa Peninsula (left) showing the site in red, property of the local NGO Osa Conservation, where the seedling establishment experiment will take place. The photograph on the right shows, circled in red, the area where Osa Conservation will coordinate several restoration projects lead by local and foreign scientists.

Goal 4: Promote artificial roosts as a method for forest recovery projects among five nature conservation organizations

As mentioned in our previous report, we have established a close collaboration with the local NGO called Osa Conservation. Since our last report, Osa Conservation has made alliances with other local and foreign scientists in the establishment of a large-scale restoration project, which includes our experiment of using artificial bat boxes to accelerate tropical forest recovery. Forming a close collaboration with an organisation that is strongly promoting a suite of techniques to aid forest restoration will certainly provide a good perspective about the usefulness of bat boxes for this purpose. If our experiments are successful, our project could be publicised not only locally through Osa Conservation and other conservation organisations, but internationally through other scientists involved in this restoration project.

Goal 5: Inform three communities and schools about the method, bat ecology and forest recovery

Now that one of the bat boxes has been successfully colonised, we will plan to involve local schoolchildren in our project by first visiting the school and explaining the biology of bats and how these mammals aid in forest recovery, but also taking the kids to visit one of the boxes. However, as there are only two fruit-eating bats using one of the roosts, and collecting seeds from this box is essential for starting our seedling establishment experiment, we will wait until after we collect seeds from this structure to bring school children in an attempt to avoid excessive noise and preventing the departure of these essential bats.

Next steps

Our most important next step is to collect sufficient seeds from the colonised roost to begin our seedling establishment experiment. Once this occurs, we can continue our other goals to perform the intended outreach activities with other local NGOs and schoolchildren. After these goals have been achieved, we intend to promote this method, if successful, to other organisations in the country.

Left: The base of the bat box showing accumulation of plant materials. Right: Bats of the genus *Carollia* using the bat box.