

## **A brief summary of what we've learned from the Bats and Hummingbird Feeder monitoring project**

As many of you know, with the help of a small group of citizen-scientists, several bat biologists from the Arizona Department of Game and Fish, the US Fish and Wildlife Service, Bat Conservation International, the University of Arizona, and the city of Marana began to monitor visits to hummingbird feeders by two species of nectar-eating bats in 2007. These species include the lesser long-nosed bat (*Leptonycteris yerbabuena* = Lepto) and the Mexican long-tongued bat (*Choeronycteris mexicana* = Choero). This project is about to begin its eighth year, and we'd like to share with you some of our major findings. Since Lepto is much more common and widespread than Choero, most of our results will pertain to it. Our results are also most complete for the greater Tucson area, so we will emphasize that area here. We note, however, that we have received observations from many other areas and value them as much the Tucson area data. So we encourage our outlying observers to continue sending us their observations.

We have gleaned much of the following data from the year-end reports that you send us. Without those reports, it would be much more difficult to see the 'big picture' of what's happening each year. Weekly reports are very valuable, and we pay close attention to them. But they alone cannot really give us the 'big picture.' So we really encourage all of our observers to be diligent about sending in those year-end summaries!

We also capture bats in mist nets set in a few yards each year. We record the following data for each bat before we release it: sex, age (juvenile, yearling, or adult), weight, and forearm length (an indication of overall size). We haven't yet completely analyzed all of these data but do have a good picture of Lepto's population structure in our area from these and other data.

Below we ask and answer a series of questions about the population biology of *L. yerbabuena*.

### **What is the nectar bat season in the Tucson area?**

We have a very clear picture about this. Figure 1 shows a typical 'phenology curve' of first arrival and departure dates for 2013. The median dates of these events vary a few days each year but are centered on the last week in August and mid-October. We have not yet determined whether arrivals and departures are related to weather events, but it is likely that departure dates are associated with drops in temperature and the passage of cold fronts through our area. For example, fall and early winter in 2013 were quite mild, and bats continued to visit some feeders well into November. In contrast, fall 2012 was colder and most bats had left our area by November.

### **Has the distribution of Lepto in the Tucson area changed through time?**

The short answer here is Yes, it has changed. Prior to 2007, visits to feeders by both species were most common on the east side of Tucson and in the Catalina foothills where their best-known day roosts are located. Now Leptos (but not Choeros) occur throughout the greater Tucson area. It appears that Leptos are continuing to spread west and are now being reported at a few sites in the Tucson Mountains. Both species occur as far north as Saddlebrooke, but we'd love to have observations farther north to see how far north Leptos actually go.

Figure 2 is a sketch of changes in the distribution of Leptos between 2007 and 2013. From radio-tracking studies by the AZDGF in 2006-07, we know that bats are traveling 10-25 miles from their day roosts (mines and caves) located in the Rincons and Catalinas, to reach our backyard feeders. Long commutes to feeding areas are a well-documented aspect of Lepto's foraging behavior. It is likely that these bats are now using new roosts to forage in western and northwestern parts of the Tucson area.

### **How many bats are visiting people's feeders?**

Again, we have a very clear picture about this. Peak numbers of Leptos at feeders occur in mid-September when large numbers of Leptos (often well over 20) are visiting many feeders. As seen in Figure 3, a minority of sites are visited by just a few bats, and many sites are visited by many bats. These data indicate that a large population of Leptos is feeding in the Tucson area each night during the season.

We need more data on this, but it appears that sites with many or few bats are rather consistent from year to year. That is, sites with low numbers have low numbers year to year, and vice versa. But there are exceptions to this. For example, when Ted Fleming first put up feeders in his yard in 2008, only two (young) bats visited them nightly during the season. By 2012 and 2013, however, 20 or more bats were visiting his two feeders in mid-September.

Multiple-year final reports from our observers would be invaluable in documenting year-year changes (or lack thereof) in numbers of bats at particular sites. These data would help us determine whether the Lepto bat population in the Tucson area is stable, increasing, or decreasing.

### **What is the age structure and sex ratio of bats visiting feeders?**

Our netting data from nine sites scattered throughout the Tucson area indicate that most sites are dominated by young bats (juveniles and yearlings), not by adults (Figure 4). Sites dominated by adults are in the minority. Multiple-year observations at a few of these sites also support this generalization. This raises a fascinating question about Lepto's foraging behavior: how do young naïve bats discover feeders at particular sites? They apparently are not led to these sites by knowledgeable adults, as we might hypothesize. Instead, they appear to find new feeding sites on their own. This is not to say that each young bat is on its own to find feeders. On the contrary, these bats usually forage and feed in groups, which becomes obvious if you spend any time watching the bats in your yard. Waves of bats often come and go at feeders, indicating that these bats are foraging in coordinated fashion. It would be fascinating to discover how they do this. Are these groups roost-mates? If not, how do they form?

The sex ratio of Leptos at hummingbird feeder sites is strongly female-biased among both young bats and adults (Figure 5). This is not surprising for adults because it is well-known that yearling and adult females are by far the most common spring migrants to the Sonoran Desert from winter roosts in southwestern Mexico. Most, but obviously not all, adult males do not migrate north from their southern mating grounds. But the female bias among young bats is somewhat puzzling because we'd expect a 1:1 sex ratio among juveniles. We need to look into this further.

## **Conclusions**

Our multi-year study has been very successful in documenting the use of hummingbird feeders by two species of nectar-feeding bats. As a result, we now have a good understanding of the general population size and structure of the federally protected species *Leptonycteris yerbabuenae* in the greater Tucson area. A large part of this success is the result of the help we've had from an enthusiastic group of citizen-scientists, many of whom have contributed their observations over many years. Without your help, our knowledge about these fascinating bats as 'urban foragers' would be very incomplete. We plan to continue monitoring urban (and rural) populations of these bats in the future and hope that many of you will continue contributing your observations. With your help, our understanding of the abundance and distribution of these bats will continue to increase through the years. Multi-year studies such as ours are important for helping us to understand the effects of human activities and climate change on our native flora and fauna. We couldn't do this without the help of citizen-scientists. Many thanks to you all for your help!

Figure 1. Plot of dates of first arrivals and departures at 38-39 sites in 2013. Median dates are indicated along with the range of those dates for 2009-2013.

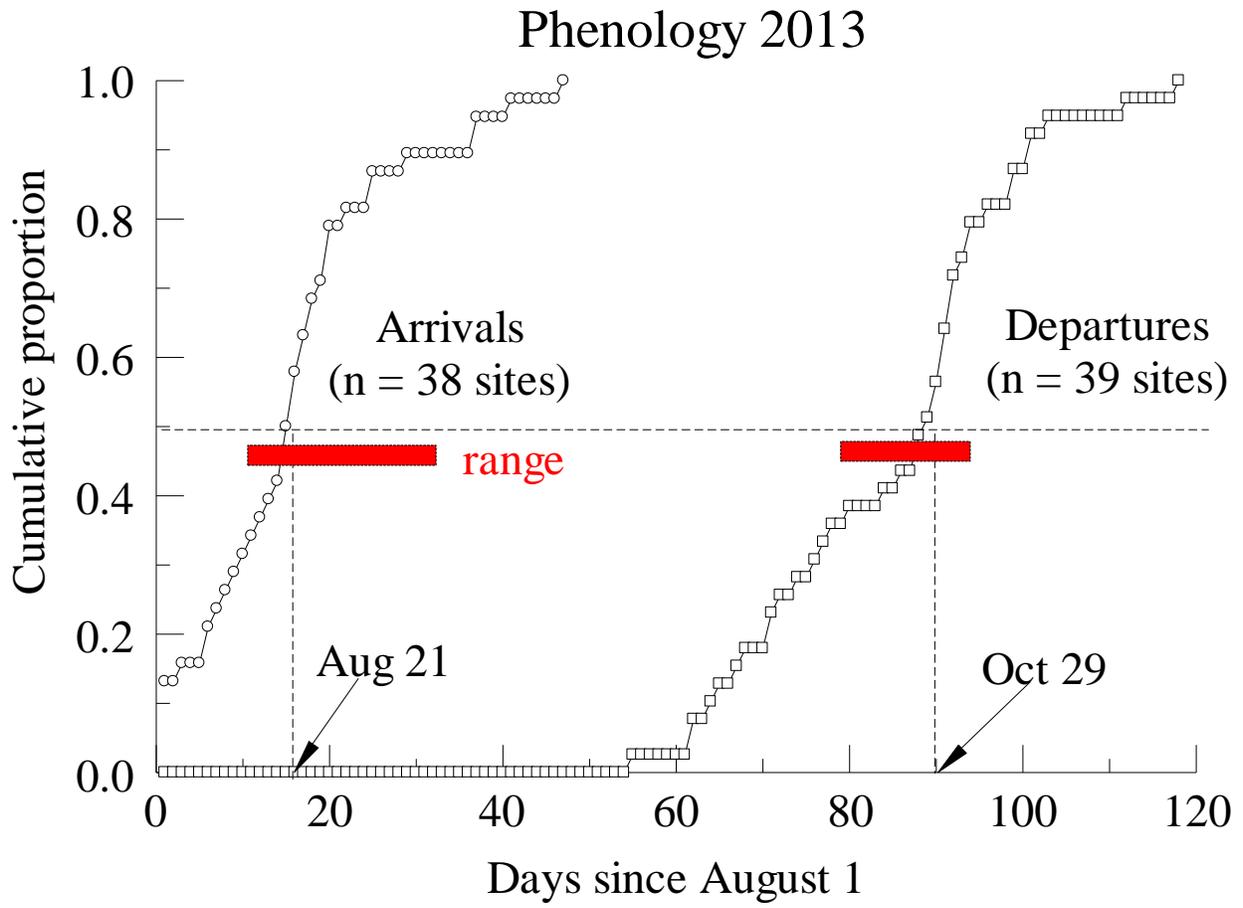


Figure 2. Sketch of the general areas reporting Lepto feeder visits in 2007 and 2013.

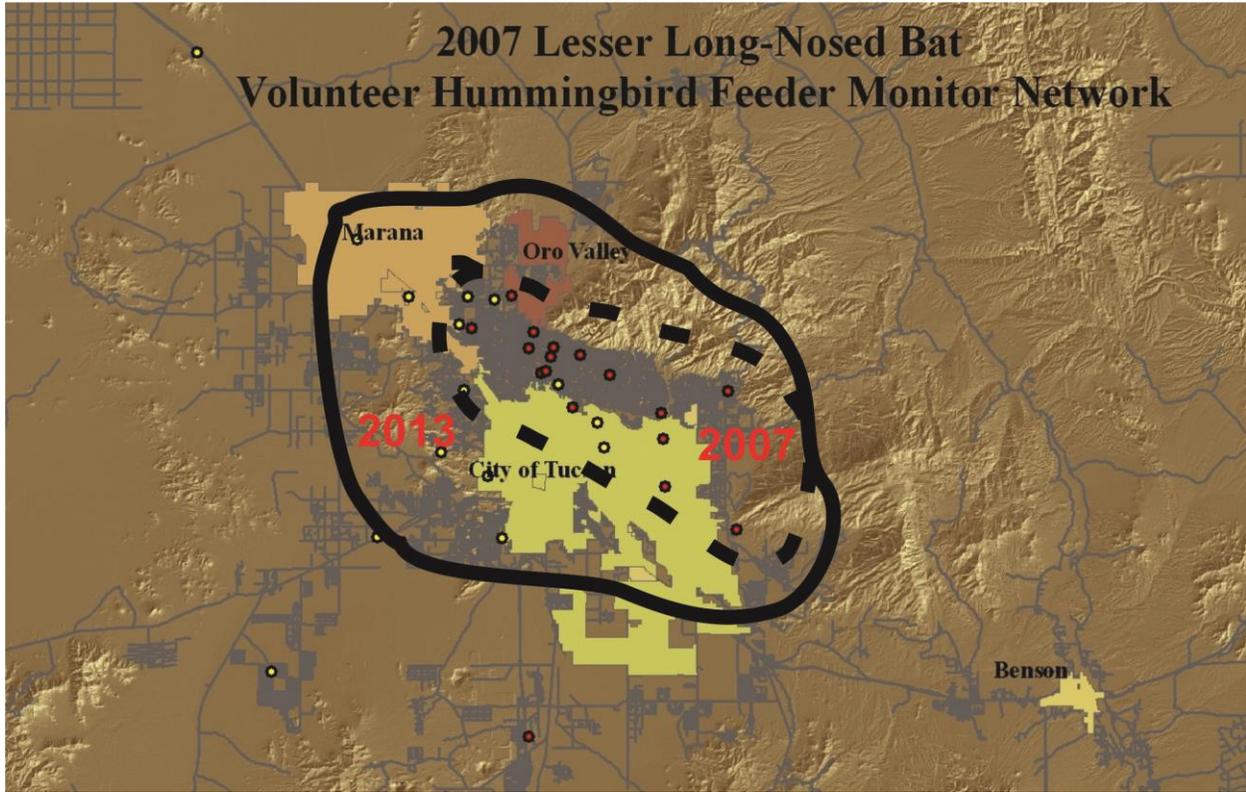


Figure 3. Plot of number of bats at peak visitation dates in 2013.

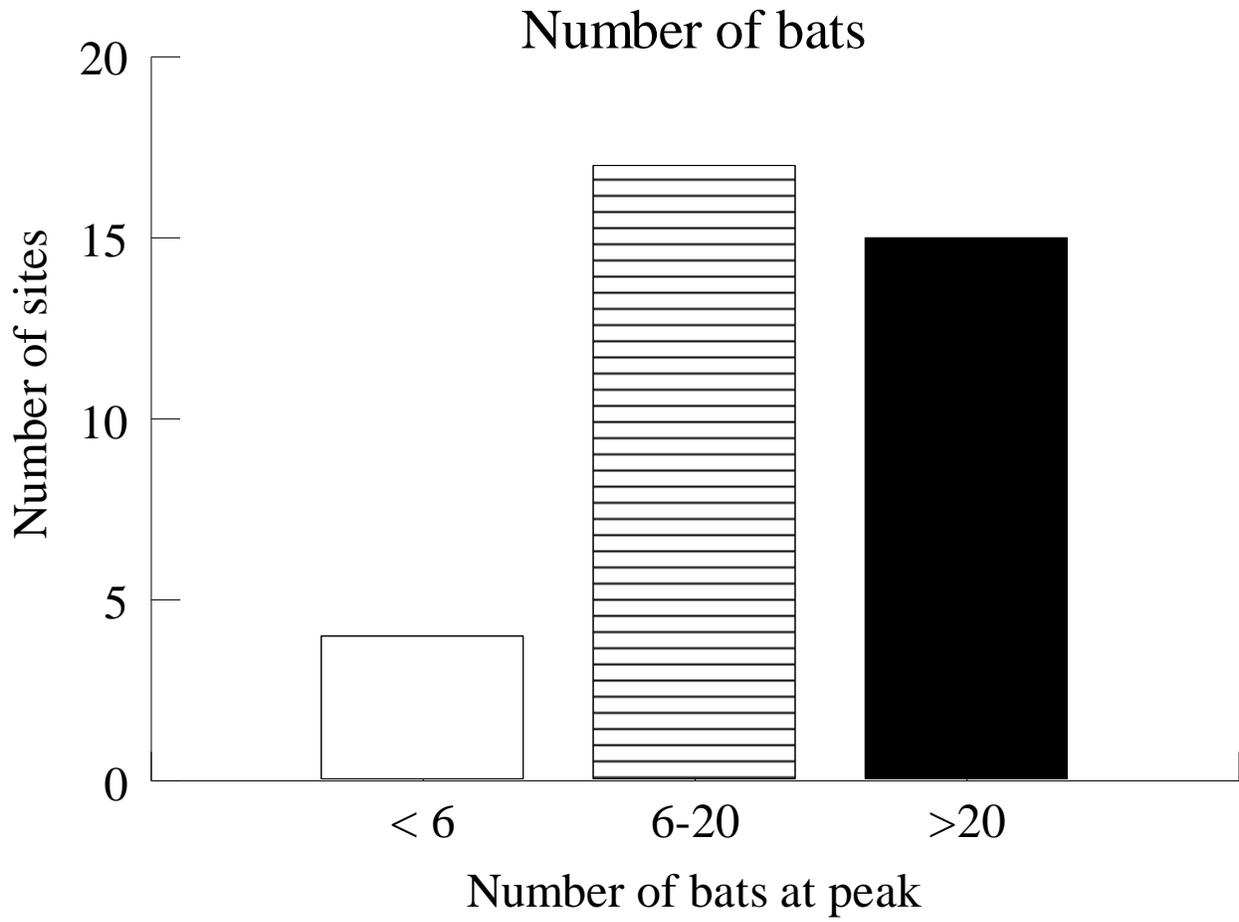


Figure 4. Plot of the proportion of juveniles and yearlings at sites in 2010-2013 based on netting data. Adults are most common at sites with low proportions.

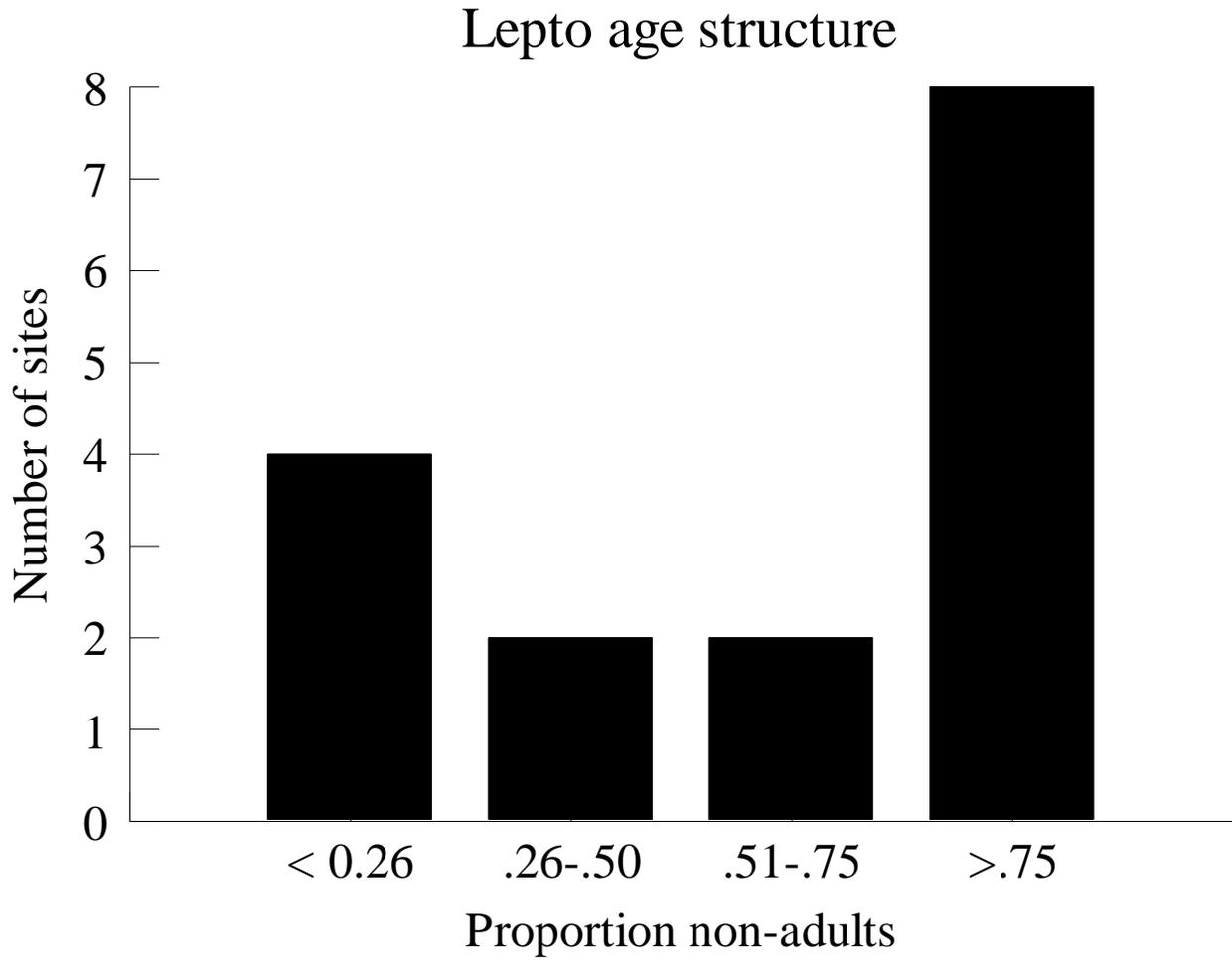


Figure 5. Plot of the sex structure of Leptos in 2010-2013 based on netting data.

