Nectarivorous Bats: Vulnerable Island Populations

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Introduction

Nectarivorous bats are specialized mammals in many ways. Bats are the only group of true flying mammals. They are nocturnal, occupying a particular niche, and they rely on night-blooming plants for sustenance. In fact, they rely on very specific night-blooming plants, many of which have developed highly specialized relationships with nectar-consuming bats. One example of this specialization occurred in Venezuela, where researchers were able to measure the fact that bats actually visited flowers that had higher levels of nectar production and even sugar concentration of nectar (Nassar, Ramirez, & Linares, 1997). Another study found that the rate and amount of nectar secretion of flowers can affect whether or not or how often bats visit a particular plant (Horner, Fleming, & Sahlery, 1998).

Other researchers found that certain species flowers have evolved to possibly be more detectable for echolocating bats; their very shape ensures a higher likelihood of visitation and therefore pollination (Helverson, Holderied, & Helverson, 2003). Specifically in Mexico, species of columnar cacti have very strong pollination relationships with bats, with certain species (such as *Leptonycteris curasoe* and *Choeronycteris Mexicana*) being the most abundant (Valiente-Banuet, del CoroArizmendi, Rojas-Martínez, & Dominguez-Canseco, 1996). Therefore, it has been shown that in many cases relationships between nectarivorous and pollinating bats are highly specialized. Bats that consume nectar are by their very specialization much more susceptible to external forces that may affect their populations; because they have narrower and more numerous parameters for their nutritional and environmental needs, they are more vulnerable when changes in those environments occur (Arita & Santos-del-Prado, 1999; Couoh, de la Garza Flores-Rojas, Briones-Escobedo, Hernández-del Angel, E., Martínez-Gallardo, & Aguilera, 2006).

Nectar Bats as Island Populations

Animal populations found on islands are often more vulnerable than mainland animals, for a number of reasons. Nectar-consuming bats on islands have even more issues to contend with when it comes to threats to their diversity and population. In many ways, the bat populations of Baja and surrounding areas can be seen as representative of island biogeography and many of the issues and concerns that go along with it. Island biogeography basically explores the various species and populations found in island areas, as well as examining how those species arrived on the island, and how their populations change over time in diversity and in number (Harris, 1984). Because of its composition, Baja as a whole exhibits characteristics of both island and peninsular biogeography. Islands in general have less diversity in their bat populations, especially those that are far from the mainland (Meyer & Kalko, 2008a; Echenique-Díaz, Yokoyama, Takahashi, & Kawata, 2009). Many animal populations mimic island biogeography on peninsulas as well, especially birds and mammals (Seib, 1980).

Bats in general can be among the most difficult animals to study, both because they are nocturnal and volant. When studying nocturnal animals and flying mammals, one must take into account the particular difficulties associated with their study, such as limited visibility, tracking, and detection. There are a number of methods that may be used for study, such as mist nets and harps traps for capture, tracking through radiotelemmetry, visual tracking through light tags, and presence detection through acoustic surveys (Kunz, 1988). Even with these methods, there can be shortcomings in acquiring a completely accurate picture of the population status of bats. One of the ways to offset this is to complete numerous surveys in numerous sites, perhaps using varying methods of data acquisition.

The specifics of bat species on islands can vary widely, as their populations are dependent on a number of factors. In general, island species of bats often have lower levels of genetic diversity and a higher risk of loss in evolutionary adaptability (Echenique-Díaz et al., 2009). Larger bat species and individuals seem more resilient, however (Arias-Cóyotl, Stoner, & Casas, 2006; Cosson, Pons, & Masson, 1999; Horner et al., 1998). They are able to travel longer distances, and seem more resistant to external forces acting on the environment. Other factors impact bat populations as well. The foraging behavior of a particular population of bats may also be an influence; how far they travel, in what manner they feed, and how they get there may all influence survivability (Cosson et al., 1999; Horner et al., 1998, Frick, Hayes, & Heady, 2008b). Frick, Hayes, and Heady (2009) found that in their particular study, species' mobility did not have as strong an influence.

The size of a particular island is another influence on population. Larger islands may allow for bat populations to remain more stable (Chown, Gremmen, & Gaston, 1998; Cosson et al., 1999; Frick et al., 2009). Cosson et al. (1999) found that even when smaller islands had favorable conditions, the number of bats present was reduced. The distance between a particular set of islands can be another factor that can affect dispersal of individuals (Echenique-Díaz et al., 2009). In Frick's study (2007), area and habitat diversity affected populations significantly. Meyer and Kalko (2008b) found that both isolation effects and migration influenced bat populations there; they also looked at colonization ability. At the same time, large islands were more likely to be utilized by humans, which increases their possible exposure to detrimental effects (Chown et.al., 1998).

Human Influences

Human influence is at the root of most threats to bat (and all pollinator) interactions (Rathcke & Jules, 1993). There are a number of human practices that have contributed detrimentally to island ecology and bat populations. Habitat fragmentation is a growing threat to bats and pollinators (Kremen & Ricketts, 2000). In one study of bat populations in French Guiana, forest fragmentation was found to have a profound influence on bat populations, both in the number of types of bat species present (Cosson et al., 1999). Changes in these bat communities can be reflected throughout the ecosystem. Interestingly enough, it appears that insectivorous bats are more sensitive to habitat fragmentation that nectar-consuming bats (Frick, 2007; Frick et al., 2008). Additionally, many of the practices related to human farming and agriculture have negatively affected wildlife, such as the use of herbicides and pesticides, as well as land exploitation (Kearns, Inouye, & Waser, 1998). Humans introduce non-native species which can be disastrous for smaller ecosystems like those found on islands (Kearns et.al., 1998). Even human activities that are purporting to be helpful (such as so-called guided ecotourism) can be harmful in causing disturbances among bat populations (Echenique-Díaz et al., 2009).

Offsetting Human Impacts

Although habitat fragmentation and other factors can be negative influences on the abundance and diversity of bat populations, there are some alternatives that humans can offer to offset the harm. Replanting populations of native food sources for bats may be one solution, even among human habitations. In one study (Arias-Cóyotl et al., 2006; Kremen & Ricketts, 2000), it was found that pollinator bat species in central Mexico actually visited cultivated populations of night-flowering plants most often, compared to wild and managed populations. The reasons behind this were thought to be the fact that cultivated plants tended to be more concentrated in their offerings, thus allowing for less energy expenditure on the part of the bats when it came to foraging and feeding (Arias-Cóyotl et al., 2006).

Other solutions could include increasing legal protection of both bat species and the areas in which they reside (Kearns et.al., 1998). More regular surveys of the populations could provide more information about the changes that are being wrought by human activities (Echenique-Díaz et al., 2009; Frick, 2007). Greater awareness could allow for better planning and reactionary policies. Public education may be one of the most important tools that we have available for ensuring protection of these species (Kearns et al., 1998). Public education is an important tool in the conservation movement – it can involve giving presentations, distributing materials, doing demonstrations, or a variety of actions, as long as they are aimed toward connecting with human inhabitants. Engaging the local community can be key to getting them invested in the conservation and preservation of their local wildlife. This can require a significant investment in time, effort, and resources. However, researchers can no longer expect to work in a vacuum. They must work to connect with local communities; this is not an expenditure outside of research, but an integral part of it. Local support is crucial to the conservation effort, and researchers’ future endeavors with wildlife and research must ensure that education become a fundamental part of their program of study.

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