BAT GUANO IS USEFUL FOR MORE THAN DIET STUDIES

Daniel J. Judy: LPG Environmental and Permitting Services, 1174 Camp Avenue, Mount Dora, Florida 32757 USA

Dale W. Sparks: Environmental Solutions and Innovations, 781 Neeb Road, Cincinnati, Ohio 45233 USA

John O. Whitaker, Jr.: Center for North American Bat Research and Conservation, Department of Biology, Indiana State University, Terre Haute, Indiana 47809 USA

Sara J. Oyler-McCance: Rocky Mountain Center for Conservation Genetics and Systematics, United States Geological Survey, Fort Collins Science Center, & Department of Biological Sciences, University of Denver, Colorado 80208 USA

ABSTRACT. Researchers collect bat guano using a variety of techniques, and most samples are used for diet analysis. We provide recommendations for an easily-constructed guano collector that also samples a standard (1 m²) area. Recently, many conservationists have begun using fecal DNA in an effort to indentify the species of an unknown donor, or collect demographic data on rare or cryptic species. Most studies have targeted larger mammals such as carnivores that produce large scats; but more recently, researchers have begun to use bat guano to obtain DNA. This DNA can be analyzed using extraction techniques and a suite of highly polymorphic microsatellite loci to provide information about the identity of the species and of individual bats that are present. Other advances in analytical techniques suggest that future samples of bat guano can provide information about stress levels within a colony and even to obtain information about where prey insects were produced.

Keywords: DNA, guano, Indiana bat, microsatellites, Myotis sodalis, roosts

Guano is increasingly collected under the roosts of bats for use in a variety of studies. The most frequent purpose of collecting these samples is to examine the diet of bats within the roost (Whitaker 1988). Usually such samples are collected from free-ranging bats that are held until they defecate, or collected at standard intervals beneath roosts. In addition to providing information about diet, advances in modern molecular techniques now make it possible to identify the species (ERDC 2005; Kanuch et al. 2007; Puechmaille et al. 2007) or individual bat (Vege & McCracken 2001) that produced a sample using DNA and to monitor stress levels within a colony by monitoring by isolating glucocorticoid secretions in fresh guano (von der Ohe & Servheen 2002; Millsapugh & Washburn 2004). Our purpose is to provide an overview of the overlooked potential of guano and to encourage chiropteran biologists to make use of this resource.

METHODS

Techniques for handling guano.—Previous authors have used plywood (Whitaker & Clem 1992), plastic sheeting (Whitaker 1995), and window screening (Kurta & Whitaker 1998; Murray & Kurta 2002). In our experience bridal veil material (often sold as tulle) has several advantages over other materials because it is readily available (from any fabric or larger department store), inexpensive (usually less than $2.00 per m²), machine washable, easily collapsed for storage or movement, and allows rain and urine to pass through. We recommend that, when possible, guano be collected using quadrats of a standard size. This quadrat-based approach has the benefits of allowing researchers to accurately measure the density of fecal pellets and to design sub-sampling protocols when needed.

We have experimented with several varieties of quadrats including some made from PVC, a variety of lumber and even direct mounting of
the bridal veil to the substrate. The most
versatile of these quadrats was made by
converting the 2.5 × 122 cm guard squares
available from Forestry Suppliers (Jackson,
Mississippi). We constructed a frame of 1 m
per side by removing the vinyl. Mound
pointers are then mounted on the side and serve as legs. The frame is
joined together and legs attached using wing
nuts which allows the entire unit to be
disassembled and reassembled. At such loca-
tions we attached the fabric with pushpins or
a staple gun which allows the fabric to be easily
cut to prevent cross-contamination be-
tween sampling bouts.

One source of cross-contamination that is
cured by changing the fabric is the possibil-
ity that the sample includes older guano
that had been trapped in the roost but has since
become dislodged due to more recent move-
ments within the roost. To limit this problem, we
recommend presoaking fecal pellets and
removing older material, which has a faded
appearance. If molecular techniques are going
to be used, fresh fecal pellets should be placed in
microcentrifuge tubes (Lab Depot, Dawson-
ville, Georgia) using toothpicks to minimize the
potential for contamination. Each toothpick is
broken off in the vial with the fecal pellet to prevent
contact of epithelial cells that are contami-
nating to the toothpick. In the field, the
microcentrifuge tubes are stored on ice until
they are placed in an ultra-cold freezer to
await molecular analysis.

Advances in molecular techniques allow the
identification of individual bats through DNA
without handling or disturbing the bats. Fecal
samples are obtained under a roost, and DNA
is extracted from individual fecal pellets using the
Extractmaster Fecal DNA extraction kit
(Epicenter) following the manufacturer’s pro-
cedure with modifications described in Oyler-
McCance & St. John (2006). Using these DNA
samples, individuals can be identified using a
suite of highly polymorphic microsatellite loci
(Oyler-McCance & St. John 2006).

RESULTS

Species identification from guano.—Frequent
researchers simply want to identify the species of bat that is present. For example, researchers working with artificial roosts often quantify the effectiveness of the artificial roost based on the presence of guano or other sign

Kansu et al. 2007; Puechmaillie et al. 2007).

Similarly, guano is often found in sites where no
information to be obtained from guano. These
recent changes, however, also suggest that the
time has come to develop a more standardized
approach to collecting and processing guano
samples.

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LITERATURE CITED

Molecular advancements make it possible to use
refined identifications in the same
manner that wildlife biologists have tradition-
ally used other marking techniques such as
banding. To date, this approach has been
restricted to much larger species such as brown
bears (Ursus arctos) (Mowat & Strobeck 2000),
cyotos (Cynx carynus) (Kohn et al. 1999), and
mountain lions (Puma concolor) (Ernest et al.
2000). We contend that wide-spread applica-
tion of this approach will provide new insights
into the behavior and demographics of colonial
species of bats (Vege & McCracken 2001)
including the federally-endangered Indiana bat
(Eptesicus fuscus).

In addition, because some roosts are fre-
quently re-used both within and between
seasons (Kuria et al. 1996; Whitaker 1998), it is
possible to have old guano still in the roost.
Two other sources of contamination are the
result of bats visiting roosts that they are not
using. We suspect the most frequent of these
occur during a behavior known as rallying or
chaos (Gardner et al. 1991; Murray & Kurtz
2004), in which bats fly to and often briefly
touch a roost. Finally, we have obtained guano
from an unoccupied roost where we observed
no rallying behavior, indicating that the
guano was deposited by a bat that flew past the
roost. While we suspect this is a minor source
of contamination, it should not be
discounted.

Future avenues of guano.—Future researchers
will likely monitor stress by isolating glucose-
mediated secretions in fresh guano (von der Ohe &
Servheen 2002; Millsap & Washburn 2004).
This is important because adrenocortical activ-
ity can ultimately alter animal behavior,
increase disease susceptibility, and affect over-
all population performance (Millsap &
Washburn 2004). Advances in stable isotope
analysis may also allow researchers to identify
the origins of prey species such as cucumber
beetles and whether or not they are coming
corn, beans, or non-crop sources
(McKenzie 2004).

Traditionally, bat ecologists have viewed
guano sampling as a technique to understand
the behavior of bats. Recent advances in molecular
biology now allow guano to be used for many
other purposes including demographic pat-
terns. While we have discussed several limita-
tions to the use of guano, strict collection and
extraction protocols can allow a wealth of new
information to be obtained from guano. These
recent changes, however, also suggest that the
time has come to develop a more standardized
approach to collecting and processing guano
samples.
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