

bri

BAT CONSERVATION INTERNATIONAL

Africa – April 2025

Collection of Biological Tissue Samples for Analysis

# Bat Field Sampling Methods





# BAT FIELD SAMPLING METHODS FOR TISSUE AND BIOLOGICAL SAMPLES

Collection of Tissues for Mercury, DNA, Parasite, Pathogens and Diet Analysis

April 2025


Biodiversity Research Institute

276 Canco Road

Portland, Maine, USA 04103

+1 (207) 839–7600

bri@briwildlife.org

www.briwildlife.org


Biodiversity Research Institute (BRI) is a 501(c)3 nonprofit organization located in Portland, Maine, USA. Founded in 1998, BRI is dedicated toward supporting global health through collaborative ecological research, assessment of ecosystem health, improving environmental awareness, and informing science-based decision making.

Bat Conservation International (BCI) is a 501(c)3 nonprofit organization located in Austin, Texas, USA. Founded in 1982, BCI is a globally recognized conservation organization dedicated to ending bat extinctions through the utilization of cutting-edge tools, technology, and training to create a real, measurable impact. Visit: www.batcon.org


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Cover photographs © Merlin Tuttle Foundation: Top: Egyptian slit-faced bat; Top row L to R: Damara woolly bat (***Kerivoula argentata***); Lappet-eared free-tailed bat (***Chaerephon major***); Dusky pipistelle (***Pipistrellus hesperidus***); Bottom row L to R: African yellow bat (***Scotophilus dinganii***); Egyptian fruit bat (***Rousettus aegyptiacus***); Rufous myotis (***Myotis bocagii***).

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# 1.0 Protocol Overview

These protocols guide the collecting and processing of bat tissue and biological samples across various studies. Blood and hair samples are used for measuring pollutants such as mercury and other heavy metals. The collection of DNA via wing punches is used for multiple genetic objectives such as species identification, diversity studies, and aging bats. Swabs allow for health assessments to monitor for diseases such as white-nose syndrome. The collection of ectoparasites enables the investigation of ectoparasite community ecology and genetics. Finally, the collection of guano informs the study of a bat's diet or genetic make-up.

This Standard Operating Procedure (SOP) is not a substitute for direct training by an experienced biologist; hands-on training must be received before conducting any of the procedures described below. This SOP outlines the standard of care in sample collection required by BRI staff and collaborators, ensuring uniform data collection across different research teams and collaborators.

# 2.0 Datasheets and Labeling Format

Accurate metadata must be collected to ensure that the samples can be analyzed in their proper context and to inform and improve subsequent trapping efforts at the same location or targeting specific bat species. Each biological sample needs both metadata for analysis and a unique identification (ID) code to track the collected samples. This ID must be written on all samples collected in the field.

The following SOP meets these needs while eliminating the requirement of continuous communication between collaborators or trapping teams working in the same area. Additionally, if a sample is found without documentation, the code allows for the identification of both the person who collected it and the date it was collected. Sample ID can then be linked to the metadata that is located at the top of the datasheet (Figure 1). At the end of each trapping night, take a photo of each datasheet (see last page or email BRI for PDF copy) to ensure that an electronic copy is recorded as a backup.

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**STAFF:**_____

**COUNTRY:**_____ **REGION:**_____ **SITE:**_____

**Traps:**_____ **X:**_____ **Y:**_____ **Elev (m):**_____

**Open Time:**_____ **Open Temp (C)/Wind:** ____/____ **Weather:** *Rain Clear Cloudy*

**Habitat types:** *Cave Forest Trail Scrub Grassland Pond Stream* Other:

**PAGE:**_____ **OF:**_____ **Close Time:**_____ **Close Temp(C)/Wind:** ____/____ **Weather:** *Rain Clear Cloudy*

**If not collected or unknown, leave blank.** **Net:** Letter Code & capture height (m) **Measurements:** Weight (g): *Total = bat and bag, bag = bag only* // Length Measurements (mm): *Forearm, TTL = Total Tail Length, Tail=Tail past Uropotagium, RHF= Right hindfoot, Ear Length, Trag= Tragus length, HS= Horseshoe width (horseshoe bats only)* **Categories:** Sex: *M = male; F = female* // Repro Status: *Non Reproductive = NON, Female: PR = pregnant, LA = lactating, PL = post-lactating, Male: TS = testes Age: J = Juvenile; A = Adult* **WS:** Wingscore 0-3 (see footer) **Photos**: Remember to take a photo of the data sheet before taking a photos of each bat **Sample Code**: Sample No. + Field Lead's 3 initials (e.g.001JMG) // Sample Types: *H = Hair, B = Blood, D = DNA, S = Swab P = Parasite, G = Guano, C = Call (echolocation)*

| **DATE:** YYYYMMMDD | | | SPP | Net | Recap | Weight (g) | | Forearm | TTL | Tail | RHF | Ear Length | Tragus | HS | Sex | Repro | AGE | WS | Photos? | SAMPLE CODE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BAG | TIME | BAND ID# | GGSS | # / ht.m | | Total | Bag | (mm) | (mm) | (mm) | (mm) | (mm) | (mm) | (mm) | | Status | | # | | |
| 1 | | Band # or Capture # | | | | | | | | | | | | | M F | PR LA NON PL TD | A J | | | # # # # # # # # H B W S P G C |
| 2 | | Band # or Capture # | | | | | | | | | | | | | M F | PR LA NON PL TD | A J | | | # # # # # # # # H B W S P G C |
| 3 | | Band # or Capture # | | | | | | | | | | | | | M F | PR LA NON PL TD | A J | | | # # # # # # # # H B W S P G C |
| 4 | | Band # or Capture # | | | | | | | | | | | | | M F | PR LA NON PL TD | A J | | | # # # # # # # # H B W S P G C |
| 5 | | Band # or Capture # | | | | | | | | | | | | | M F | PR LA NON PL TD | A J | | | # # # # # # # # H B W S P G C |

**Figure 1.** Metadata section of the bat datasheet. See Appendix D for a version to print.

## 2.1 Required Metadata

**Staff:** The first name, middle initial, and last name of each person present. The individual or individuals collecting the samples write their initials in brackets after their names.

**Species:** The first four letters of the code represent the Genus and Species of the sample, typically using two letters from each. For example, SCDI stands for ***Scotophilus dinganii***, the African Yellow Bat. Include a "?" for uncertain identifications or **SPP** if only the genus is known to tag them for review. If the species is unknown, use the code **UNKN** until a definitive identification is made. In cases where two species share the same four-letter code, expand BOTH species to a three-letter code for both Genus AND Species. If it is a subspecies, write a dash (-) between the Species and subspecies.

There are a couple of species with only two letters for the species name. If you are working in a location where you are constantly using three letters for Genus and Species, include the hashtag symbol (#) as the third digit.

**Date:** The date is formatted using four digits for the year, a three-letter abbreviation for the month, and two digits for the day (e.g., 2025APR10). This structure prevents confusion between the day and month while maintaining a consistent length, crucial for efficient data management and analysis in electronic databases. For labels (see below) the month is further reduced to two letters to save space.

**Location:** The location code consists of a minimum of five letters. The first two letters represent the country's Alpha-2 code (Table 5; Table 6), followed by a three-letter code for the state or county. For example, **KEKJD** stands for Kenya, Kajiado.

> **IMPORTANT:** Country codes are listed in the Appendix, however, you will need to look up state, district, and county codes before traveling to the trapping site. For trapping locations in large countries that have states or provinces (e.g., US, Canada), write the country code followed by a dash, then the state code (e.g., US-ME or CA-QC).
>
> Additional letters can be included to specify the area or site if more detailed location information is necessary. These are likely to be researcher-generated. If possible, check with local researchers to see if they already have codes for various sites. Include the decimal latitude and longitude coordinates on the datasheet.

**Habitat and trapping data:** The trapping effort metadata should include:

- Method (nets, harp, or hoop)
- Quantity (height and length recorded for each)
- Trapping time (start and finish recorded in military time)
- Weather conditions (temperature in degrees Celsius and Beaufort Wind Scale, Table 1)

Habitat type should be noted to inform analysis and future trapping efforts. Each net and harp trap should be lettered, A, B, C, etc. If you are trapping with both, assign H1, H2, etc., to the harp traps.

For each trap site, in the field notes include:

1. Draw a basic top-down map of the area within 20-30 meters of the net or harp trap.
2. Record the net length, height, and coordinates in decimal degrees.
3. Notes on the general habitat type, water sources, or other features that may impact trapping success
4. Take photos of each trap setup. When writing up a trapping summary of the above data, include these photos in it and attach them to photocopies of the datasheets.

Table 1: Beaufort Wind Scale

| Force | Description | Miles per hr | | | m/sec | | | Discription on land |
|---|---|---|---|---|---|---|---|---|
| 0 | Calm | 0.0 | - | 1.0 | 0.0 | - | 0.2 | Calm; smoke rises vertically. |
| 1 | Light Air | 2.0 | - | 3.0 | 0.3 | - | 1.5 | Direction of wind shown by smoke drift, but not by wind vanes. |
| 2 | Light Breeze | 4.0 | - | 7.0 | 1.6 | - | 3.3 | Wind felt on face; leaves rustle; ordinary vanes moved by wind. |
| 3 | Gentle Breeze | 8.0 | - | 12.0 | 3.4 | - | 5.4 | Leaves and small twigs in constant motion; wind extends light flag. |
| 4 | Moderate Breeze | 13.0 | - | 18.0 | 5.5 | - | 7.9 | Raises dust and loose paper; small branches are moved. |
| 5 | Fresh Breeze | 19.0 | - | 24.0 | 8.0 | - | 10.7 | Small trees in leaf begin to sway; crested wavelets form on inland waters. |
| 6 | Strong Breeze | 25.0 | - | 31.0 | 10.8 | - | 13.8 | Large branches in motion; whistling heard in telegraph wires; umbrellas used with difficulty. |
| 7 | Near Gale | 32.0 | - | 38.0 | 13.9 | - | 17.1 | Whole trees in motion; inconvenience felt when walking against the wind. |

Additional notes: Any extra information that cannot be written directly on the datasheet should be recorded in a separate field notes document. This can be either a separate sheet or the field journal of the individual running the trapping site. This field notes document should include:

1. Information describing the trapping area.
2. Any important notes on what happened during the trapping night (e.g., closed early because of rain)
3. Additional information on individual bats (e.g., Post lactating female caught with a juvenile at the same time, possible mother and pup. Bat attached transmitter to and tracked for 2 hrs, roost found)
4. Recommendations for future work at the site.

For each bat with additional notes, include the page and bat number (e.g.. page 2, bat 3) so the record can be easily reconciled with the captured data. Similarly, write "notes" on the datasheet under the capture time to indicate that additional notes exist. For transmitted bats, write the frequency in brackets under the capture time.

## 2.2 Sample ID Code

The mammal program uses a **SAMPLE CODE** system based on the identity of the field lead. An example code is **H048JMG2025AP08**. This includes the sample type, sample collection number, the collector's initials, and the full date of capture.

### Sample type:

Common sample types collected by BRI for bats are Hair, Blood, Wing, Swab, Parasites, Guano, and Call (echolocation). Some individuals will have multiple types of samples taken from them. For instance, a bat with hair, blood, and guano samples would have three samples in the system, all with the same Sample Collector Code AFTER the first letter (e.g., **H048JMG2025AP08**, **B048JMG2025AP08**, and **G048JMG2025AP08**).

If samples are ever split between collaborators (e.g., two people retrieve one DNA sample each), or if two different species of parasites are taken from a single bat, then label the sample container with an additional number at the start of the code (e.g., **1H048JMG2025AP08**, **2H048JMG2025AP08**, etc.). Note these duplicates on the datasheet and in the BRI database.

### Sample Collection Number and Collector Initials:

The **Sample Collection Number** is always three digits, starting at 001, and increases by 1 for each new individual sampled, NOT each new individual caught. If several samples are taken from the same individual during the same processing session, they all have the SAME Sample Collection Number.

The Sample Collection Number resets at the start of each new collection period (day), but not necessarily at midnight. If you are trapping from 18:00 to 02:00, all individual samples are considered caught on the same day. If you catch from 04:00-09:00 and then again from 18:00-21:00, all those samples are deemed caught on the same day.

The three **Collector Initials** are of the most senior person or the person in charge of running the processing station that night. Use the First, Middle, and Last names to minimize the possibility of two or more people having the same initials. For individuals with only two names use the second letter of either first or last name. If you have more than three names, pick one to drop. Registering your initials with the data manager when you start working or collaborating with BRI is also advised to ensure no replication between years and to help ID any found samples.

All samples collected during the trapping session should have the same initials, regardless of who collected the sample. The only exception is if more than 999 samples (doubtful in bat work) are collected. In that instance, start using the next most senior person at the trapping site and start the Sample Collection Number at 001.

For example, **H048JMG** represents the **48$^{th}$** animal sampled by the team led by Josh M. Guilbert that trapping night. We also know that it is a hair sample, and only one hair sample was collected.

### Date:

As space on sample labels is limited, the date is formatted using four digits for the year, only TWO letters for the month (Table 2), and two digits for the day (e.g., **2025AP08**). This structure prevents confusion between the year, month, and day while maintaining a consistent length, which is crucial for efficient data management and analysis in electronic databases. Use the first two letters for all months except March, May, June, July, and November.

**EXAMPLE —>** Our starting example code **H048JMG2025AP08** is a hair sample, the 48$^{th}$ collected by Josh M Guilbert in 2025 on April the 8$^{th}$. Locating the correct datasheet to access the metadata is now possible.

Table 2: BRI Standard Codes for Months of the Year

| Month | Code | Reason |
|---|---|---|
| January | **JA** | Unlike "JN," "JA" can't be confused with any possible abbreviations for June or July |
| February | **FE** | |
| March | **MR** | Using just "MA" could be confused with May |
| April | **AP** | |
| May | **MY** | Using just "MA" could be confused with March |
| June | **JN** | "JU" can't be used because it's ambiguous with the possible abbreviation for July. |
| July | **JL** | "JU" can't be used because it's ambiguous with the possible abbreviation for June. The Y in "JY" is also present in a possible abbreviation for January. |
| August | **AU** | |
| September | **SE** | |
| October | **OC** | |
| November | **NV** | "NO" was rejected to prevent any confusion with the word "no." or abbreviation No. for number |
| December | **DE** | |

## 2.3 Applying codes to datasheets and samples

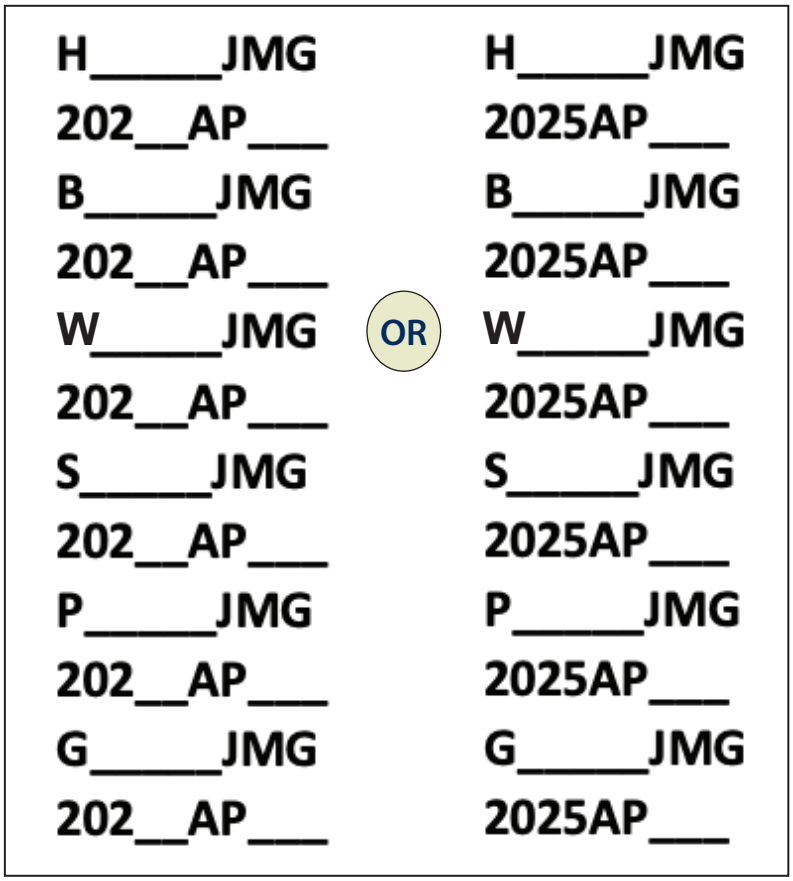
The datasheet has a SAMPLE CODE column on the far right-hand side. Preprinted on the datasheet are the seven types of samples that we collect for bats. Above these seven letters is space for the Sample Collection Number.

Since the lead collector's initials (JMG) and the date are written on the sheet, they can be omitted, though it is good practice to write the complete Sample Collection Number and Collector Initials on the first bat sample taken on each sheet. Write the Sample Collection Number on successive lines if a sample is taken and circle the relevant types of samples.

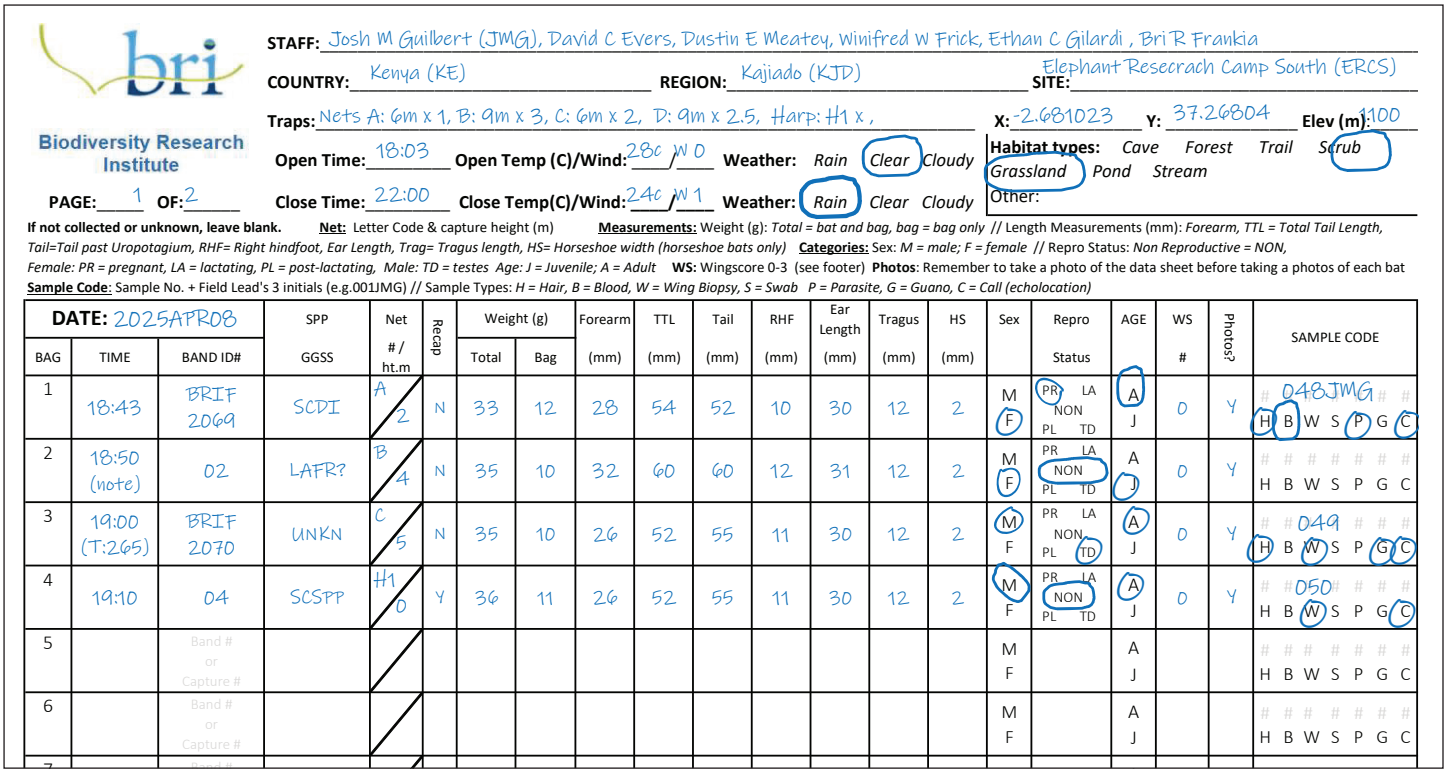
Collection tubes can be prelabeled directly, but we recommend using preprinted labels. Labels are preprinted across two lines with all the information except the last digit of the Year (optional), Sample Collection Number, and Day (Table 3).

These preprinted labels are attached as needed, reducing the likelihood of poorly labeled or illegible samples. Printed labels are also more precise than handwritten notes and resistant to fading over time.

Table 3: Preprinted Label Options



On the trapping night, you only fill in the missing information as needed. As soon as the data from the sheets is entered into the BRI system, new labels are printed based on the entered data. These labels include a barcode generated by the BRI tracking system and a more extensive random code. They should be applied to the original datasheet and any relevant tubes or sample envelopes as soon as possible to ensure proper identification and tracking.



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**STAFF:** Josh M Guilbert (JMG), David C Evers, Dustin E Meatey, Winifred W Frick, Ethan C Gilardi , Bri R Frankia

**COUNTRY:** Kenya (KE) **REGION:** Kajiado (KJD) **SITE:** Elephant Resecrach Camp South (ERCS)

**Traps:** Nets A: 6m x 1, B: 9m x 3, C: 6m x 2, D: 9m x 2.5, Harp: H1 x , **X:** -2.681023 **Y:** 37.26804 **Elev (m):** 1100

**Open Time:** 18:03 **Open Temp (C)/Wind:** 28c / W 0 **Weather:** Rain (Clear) Cloudy

**Habitat types:** Cave Forest Trail Scrub (Grassland) Pond Stream Other:

**PAGE:** 1 **OF:** 2 **Close Time:** 22:00 **Close Temp(C)/Wind:** 24c / W 1 **Weather:** (Rain) Clear Cloudy

**If not collected or unknown, leave blank.** **Net:** Letter Code & capture height (m) **Measurements:** Weight (g): *Total = bat and bag, bag = bag only* // Length Measurements (mm): *Forearm, TTL = Total Tail Length, Tail=Tail past Uropotagium, RHF= Right hindfoot, Ear Length, Trag= Tragus length, HS= Horseshoe width (horseshoe bats only)* **Categories:** Sex: *M = male; F = female* // Repro Status: *Non Reproductive = NON, Female: PR = pregnant, LA = lactating, PL = post-lactating, Male: TD = testes Age: J = Juvenile; A = Adult* **WS:** Wingscore 0-3 (see footer) **Photos**: Remember to take a photo of the data sheet before taking a photos of each bat **Sample Code**: Sample No. + Field Lead's 3 initials (e.g.001JMG) // Sample Types: *H = Hair, B = Blood, W = Wing Biopsy, S = Swab P = Parasite, G = Guano, C = Call (echolocation)*

**DATE:** 2025APR08

| BAG | TIME | BAND ID# | SPP GGSS | Net # / ht.m | Recap | Weight (g) Total | Weight (g) Bag | Forearm (mm) | TTL (mm) | Tail (mm) | RHF (mm) | Ear Length (mm) | Tragus (mm) | HS (mm) | Sex | Repro Status | AGE | WS # | Photos? | SAMPLE CODE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 18:43 | BRIF 2069 | SCDI | A / 2 | N | 33 | 12 | 28 | 54 | 52 | 10 | 30 | 12 | 2 | (M) F | (PR) LA NON PL TD | (A) J | 0 | Y | 048JMG (H) (B) W S (P) G (C) |
| 2 | 18:50 (note) | 02 | LAFR? | B / 4 | N | 35 | 10 | 32 | 60 | 60 | 12 | 31 | 12 | 2 | M (F) | PR LA (NON) PL TD | A (J) | 0 | Y | H B W S P G C |
| 3 | 19:00 (T:265) | BRIF 2070 | UNKN | C / 5 | N | 35 | 10 | 26 | 52 | 55 | 11 | 30 | 12 | 2 | (M) F | PR LA NON PL (TD) | (A) J | 0 | Y | 049 (H) B (W) S P (G) (C) |
| 4 | 19:10 | 04 | SCSPP | H1 / D | Y | 36 | 11 | 26 | 52 | 55 | 11 | 30 | 12 | 2 | (M) F | PR LA (NON) PL TD | (A) J | 0 | Y | 050 H B (W) S P G (C) |
| 5 | | Band # or Capture # | | / | | | | | | | | | | | M F | | A J | | | H B W S P G C |
| 6 | | Band # or Capture # | | / | | | | | | | | | | | M F | | A J | | | H B W S P G C |

**Figure 2:** Example datasheet from a capture night at Amboseli National Park. Bat 1 is a standard collection. Bat 2 species ID is uncertain and was released without collecting samples as it was showing signs of stress. Bat 3 could be a new species as it was unknown; it was released with a transmitter frequency of 265. Bat 4 had a confirmed genus identification, but the species was unknown. As photos were taken of all individuals (Face: front and profile; Body: dorsal and ventral, tail, and feet), these can be reviewed for positive species identification along with the collected DNA samples and reference calls for Bats 3 and 4. Only Bat 1 had blood drawn, as the other bats required DNA for species identification.

## 3.0 Minimum Netting Standards

If local guidance and regulations on trapping procedures are more stringent, follow those procedures. If no local guidance or regulations are available or are less stringent, use the following BRI guidance.

1. All field staff must have their rabies vaccinations and any relevant vaccines for the area up to date.
2. To ensure that staff are able to check the nets every 10 minutes, follow these instructions:
   - Maintain a minimum trapping ratio of two biologists to every three trap sites
   - No trap site is more than a couple of minutes from the processing station
3. At least one qualified bat mist netter must be present to supervise the removal of all bats from the nets.
4. After removal, place the bat in a bat bag with the following information:
   - Time of capture in the military format: (e.g., 8:00 a.m. = 08:00; 12 noon = 12:00; 4:00 p.m. = 16:00)

     HINTS to help you tell military time:

     ➤The morning hours are the same. So 1:00 a.m. is the same in both military and civilian time. This holds true all the way up to 12:59 p.m.

     ➤For everything after 12:59 p.m., just add 12 to the hours. For example, 2:00 p.m. becomes 14:00 (12+2=14), and 10:00 p.m. becomes 22:00 (10+12=22)
   - Species (if known), sex, and if pregnant or lactating.
   - The letter of the trapping location
   - For mist nets, the number of meters above ground level the bat was caught.
5. Immediately deliver the bat to the processing station and:
   - Inform the person processing the bats of the species and if pregnant or lactating. This is to allow the processor to make any relevant decisions about when to process.
   - Hang the bat bag on the bat "clothesline" to ensure it remains safe and out of the way until it is ready to be processed.
6. At the processing station:
   - Bats are processed in the order they came in except for lactating females, stress-sensitive species, or listed species; these are all placed at the front of the cue.
   - Limited processing time to 10 min per individual for basic measurements and sample collection.
   - Immediately release any individual showing signs of stress that may be impacting their welfare.
   - On the datasheet, write "NOTE" under the capture time if additional information was taken for that individual in the field notes. In the field notes, include the page and bag numbers so that the note can be easily associated with the correct individual and entered into the database.
7. Make electronic copies of all datasheets and field notes at the end of every night.

## 4.0 Options for Marking Bats During Sample Collection

Pseudo-replication can compromise study objectives and negatively affect bat health if individuals are repeatedly captured and subjected to tissue collection within a short timeframe (e.g., bleeding). Recognizing recaptures is particularly valuable in scenarios where they are likely, as it enhances the accuracy of long-term monitoring when sampling occurs at the same location over multiple years. Various permanent and temporary methods are available for identifying individual bats, each with benefits and risks. This SOP does not cover permanent methods in detail, as their application requires specialized training by an experienced biologist.

### 4.1 Bat Bands

Banding should only be conducted by properly trained individuals. This method involves applying a small, horseshoe-shaped aluminum band with a unique alphanumeric code to the bat's forearm. Consistently placing the band on the same arm for males (right) and females (ladies left) can also assist in determining sex ratios of roosting bats if the bands are visible from a distance. Researchers encountering a previously banded bat can read the band number and contact the appropriate entity that banded the bat. While banding is an efficient, cost-effective, and reliable long-term identification method, it is unsuitable for all species. Certain bat species possess physiological or behavioral traits that heighten the risk of injury from bands. Unless you are sure the species can be safely banded and are using the correct band size, avoid applying a band and consider alternative methods. If the likelihood of recapture is low, it is not worth the risk to band.

### 4.2 PIT Tagging

PIT tagging requires more expertise and training than banding. A small electronic chip is injected via a hypodermic needle under the bat's skin between the shoulder blades. PIT tags are more expensive than bands ($2-10 per tag compared to $0.50 per band) and require specialized reading equipment. They do allow automated data collection if readers are placed at key locations. However, unlike bands, PIT tags are not visibly identifiable without a reader, which means that other researchers may not realize a bat is tagged. Some smaller bat species may be unsuitable for PIT tagging. Additionally, some bats may eject tags post-release, though using medical-grade super glue to seal the wound can reduce ejection rates.

### 4.3 Photo Identification

Bats possess unique wing collagen patterns akin to human fingerprints. Using photo identification software such as $I^3S$, researchers can identify and track individuals over extended periods. This method requires clear, backlit photographs of each outstretched wing (with consistent distance, direction, wing position, and angle), typically using a lightbox and a mounted camera. Both wings should also be used as to double check that the correct ID is made and as a back-up if one of the wings is damaged between captures. Photos of a bat's uropatagium can also be helpful in some species. While this method is effective for identification and does not pose a risk to bats post-release, it is time consuming both in field and lab time, while not currently providing immediate results in the field.

### 4.4 Temporary Markings

Temporary markings can provide short-term identification without the need for permanent alterations. Some biological samples, such as hair or wing biopsies, may leave visible marks for weeks after collection.

1. Wing biopsies should never be conducted solely for marking purposes, but they can serve as valuable indicators of recaptures when taken for other research purposes.
2. Hair trimming is another temporary marking option but must be applied with care. Hair should not be cut down to the skin or performed on bats preparing for hibernation. Detecting hair trims may require careful inspection, as their effect is less apparent than that of wing biopsies.
3. Applying nail polish to the claws is an option for larger bat species, typically fruit bats. Different color combinations can even be used to ID individuals over several weeks. The drying time makes this impractical on busy trapping nights.

## 5.0 Whole Blood Collection

The nonlethal collection and analysis of whole blood samples in bats is used to identify the recent dietary uptake of contaminants, such as mercury (Evers 2018), and various stable isotopes (i.e., δ13C, δ15N, δ34S) that allow for diet reconstruction and identifying migratory origins. Blood samples can be obtained through venipuncture of veins of the wing or tail.

Micro-hematocrit capillary tubes are preferred for laboratory analyses but require specific storage and shipping arrangements. If capillary tubes are unavailable, vacutainers are an adequate replacement and can store a larger sample volume.

> **IMPORTANT:** Contaminant analyses require blood to be stored in Lithium heparinized receptacles, while stable isotope analyses require blood to be stored in sterile receptacles. For easy sample storage and shipping, blood dried on Whatman cards can be used for contaminant and stable isotope analyses (Perkins and Basu 2018; Barst et al. 2020).

Rule of thumb for the maximum volume of blood: Blood extraction should never exceed 1% of an individual's total body weight (Eshar & Weinberg 2010). Approximately 10% of a bats weight is blood (Eshar & Weinberg 2010); therefore, up to 10% of the volume of blood in a bat can be drawn. For example, a 1000g adult fruit bat has approximately 100 g of blood. From this, a maximum of 10 g of blood can be taken (1 g = 1 mL). A bat weighing 20 g has 2 g of blood; therefore, a maximum of 0.2 mL or 200 µL of blood can be collected.

> **IMPORTANT:** BRI does not recommend collecting the maximum amount in any species.

### 5.1 Supplies for Venipuncture*

| General Procedure | Piercing Procedure |
|---|---|
| ☐ Datasheet | ☐ 26–27 gauge needles |
| ☐ Map of country/sampling site | ☐ Micro-hematocrit capillary tubes (use heparinized for contaminants, sterile for stable isotopes) |
| ☐ Portable (~5L) cooler | ☐ Leica Microsystems Critoseal™ |
| ☐ Ice pack | ☐ 6 mL archive vacutainer |
| ☐ Isopropyl alcohol pads | ☐ Styptic powder (BleedStop, Kwik stop) |
| ☐ Dry cotton balls | |
| ☐ Ultra-fine Sharpie™ permanent marker | |
| ☐ Sandwich-size Ziploc™ plastic bags | |
| ☐ Portable Sharps container | |
| ☐ *Optional:* Whatman blood cards | |
| ☐ *Optional:* Silica Gel Desiccant Packets (for Whatman card storage only) | |
| ☐ Microtube storage box | |

**For information on where to purchase supplies, see resources in the Appendices.*

## 5.2 Bat Blood Collection

Standard protocols for the collection of bat blood are outlined in this section. For each bat, a series of standard measurements must be recorded on the sample datasheet.

***Procedure***

1. Locate the acute ulnar in the wing (Figure 1) or a vein in the tail portion of the wing membrane (preferred).
2. Prick vein with a needle

   **IMPORTANT** —> do not go through both vein walls in patagium, only the top one; (only in uropatagium can you prick needle through both walls).
3. Allow blood to pool (usually happens very quickly).
4. Collect blood by placing the capillary tubes or microtainer below the pooled blood (a downward angle will allow the blood to be more easily pulled into the capillary tube or microtainer).
5. Collect 1-2 capillary tubes or at least 0.2 cc's in a microtainer.

   **IMPORTANT** —> only fill capillary tubes a minimum ¼ to ½ maximum.
6. Hold a fresh cotton swab on the collection area until bleeding has stopped (typically within 10 seconds).
   - If using Whatman cards, select one of the capillary tubes, prior to sealing, to be used to deposit blood onto the card.
   - Store card in a plastic bag with desiccant packets.
7. Use either Critocaps (preferred) or Critoseal to seal each end of the capillary tube.
8. Place capillary tubes in a vacuum vial and properly label all vials.
9. Store all blood samples in cooler with ice packs while in the field.
10. Transfer samples to a freezer for storage as soon as possible; they must remain frozen until analysis.

## 5.3 Blood Sampling Labeling Format

Ensure that the Whatman cards also include the following information:

1. Sample I.D. Code (refer to section 2.2)
2. Species
3. Age and Sex
4. Country
5. State or Province
6. Blood volume

**IMPORTANT:**

All samples MUST have a unique Sample I.D. Code that is labeled correctly and legibly.



**Figure 3.** Direct draw blood collection from the cutaneous ulnar vein using a manual syringe.

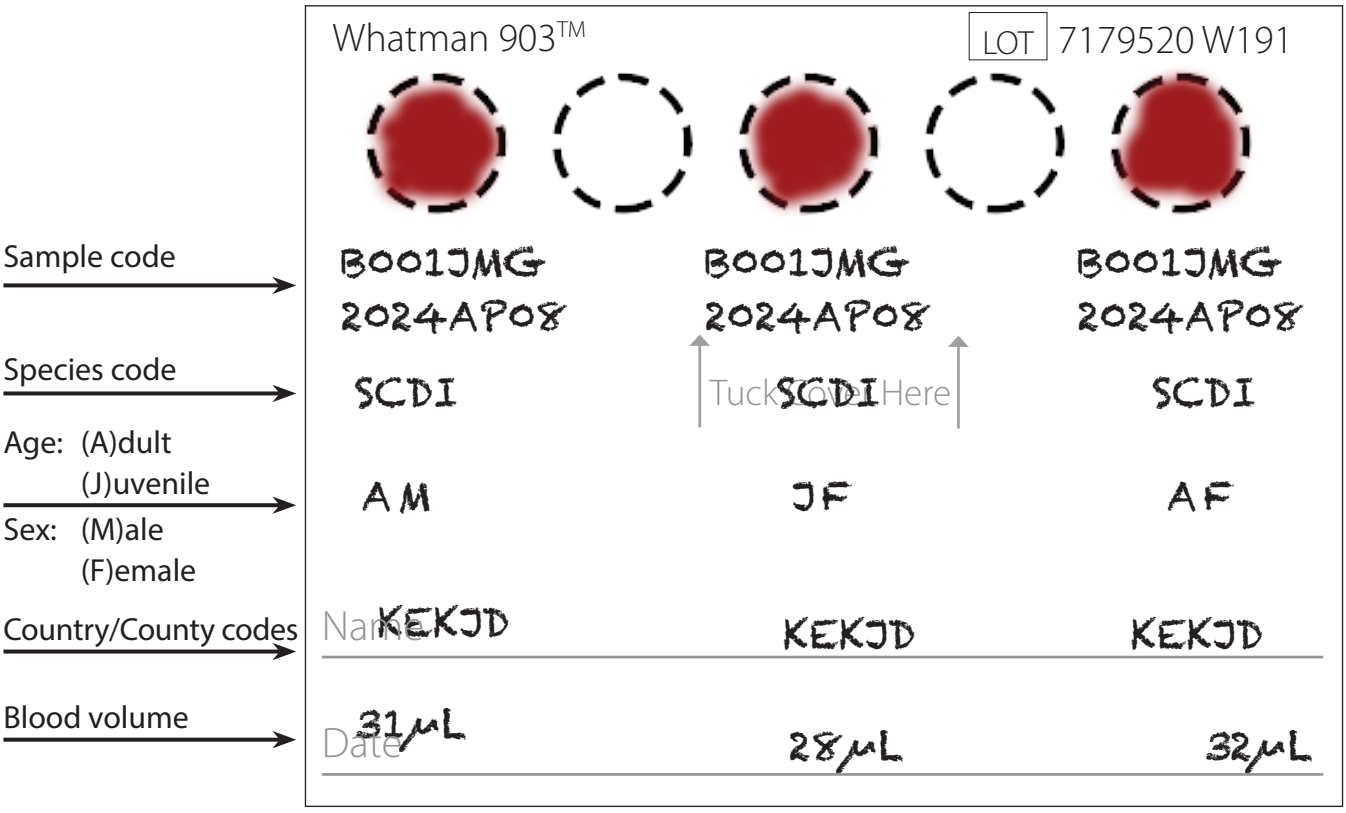



**Figure 4.** Facsimile of a completed Whatman card with appropriate metadata filled in. **NOTE** - the Card comes with preprinted words Tuck Cover Here, Name, and Date. Write over those words.

# 6.0 Hair Sample Collection

The collection of hair samples is useful in identifying the body burden of heavy metals, such as mercury, because methylmercury is typically transferred to hair during growth (Evers 2018). Collected samples will provide important information in developing awareness about potential risks associated with mercury pollution. It is important to make sure all samples are collected in a safe and clean manner. Collaborating organizations are asked to record basic information for each sample. Sampling bat hair is indicative of chronic mercury exposure in bats.

## 6.1 Supplies for Hair Collection

- ☐ Datasheet
- ☐ Map of country/sampling site
- ☐ Stainless steel cuticle scissors
- ☐ Coin envelope, small plastic zip lock style bags, or vials (1.5 to 2ml Eppendorf tubes)
- ☐ Permanent marker & ballpoint pen

## 6.2 Hair Collection Procedure

1. Record bat species and the common name on the datasheet.
2. Collect a hair sample using small stainless-steel cuticle scissors.
3. Clip hair from the belly and back and other locations as needed. Clip as close to the skin as possible without cutting the bat. The hair follicle does not need to be harvested. It will take 4-5 scissor swipes to get enough of the sample (~0.01 grams of hair). This will be approximately enough hair to cover the nail of your little finger.
4. Store hair in individually labeled sample containers (e.g., coin envelopes, plastic zip lock style bags, vials).
5. Ensure scissors are cleaned between each bat sampled by wiping the scissors with alcohol swabs and visually inspecting them to make sure there is no hair from a previous bat to avoid cross-contamination.
6. For samples in envelopes, store in a dry environment with dessicant. DO NOT refrigerate or freeze samples.

## 6.3 Hair Sample Labeling Format on Coin Envelope

**IMPORTANT:** All samples MUST have a unique sample I.D. that is labeled correctly and legibly.

***Follow this format for labeling hair samples:***

- ☐ Use an alpha-numeric code of species [2-letter code]
- ☐ Year, Month, Day (e.g., 2025 APR 08)
- ☐ Species (Latin name)
- ☐ Location (Site, Town, County, State or Province, Country)
- ☐ Length of forearm (mm), body mass (g)
- ☐ Age (A = adult; J = juvenile)
- ☐ Sex (M=male; F = female)
- ☐ Reproductive condition for females (P = pregnant; L = lactation; PL = post-lactation; NR = nonreproductive),
- ☐ Reproductive condition for males: testestestes descended (TD) and nonreproductive (NR)

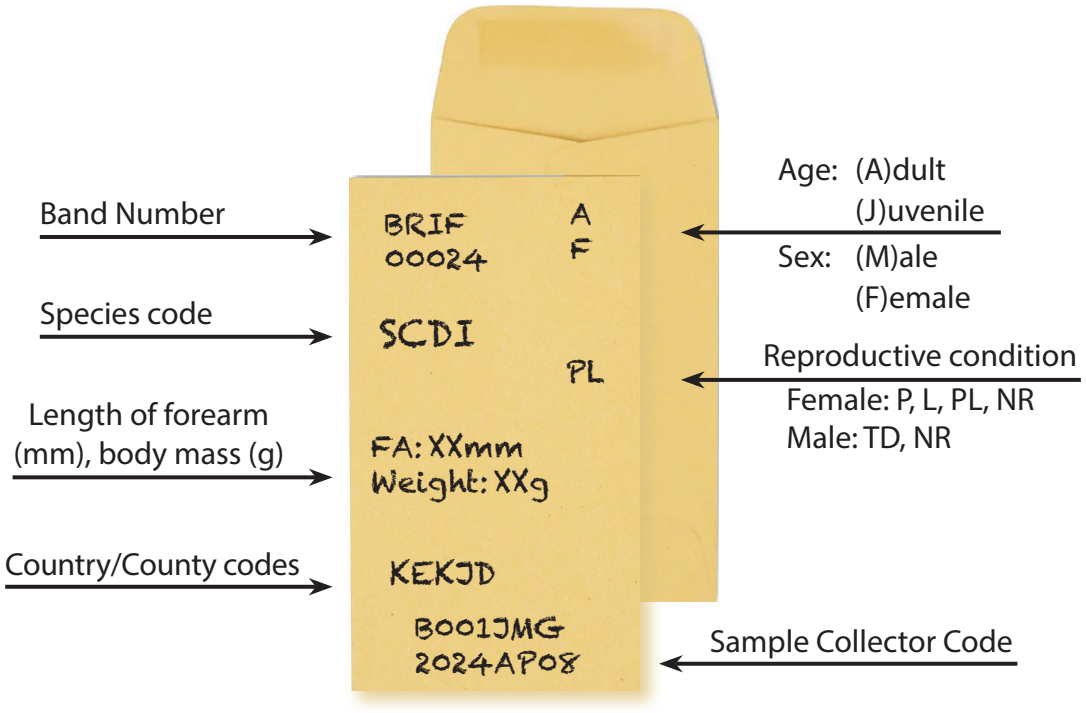



**Figure 5:** Correct labeling convention for individual samples to be shipped.

## 7.0 Wing Punch Sample Collection

Collecting genetic samples from bats can provide information for:

- Species confirmation
- Identification of new undescribed species.
- Individual identification in mark-capture studies
- Quantifying species diversity between populations and detecting gene flow between them
- Identification of beneficial genes in populations under stress
- Age estimation via DNA methylation

DNA can be extracted from blood, guano, and even hair samples, provided they include the follicle. The easiest and most robust method of DNA collection from bats is a biopsy sample from the wing or tail membranes. Bats' wings are often damaged during flight and foraging, resulting in a strong selection pressure for fast healing (Khayat et al. 2019). Depending on the species and biopsy size/location, complete healing typically occurs within five weeks during the summer but can take up to 13 weeks during the winter (Vasquez et al. 2014).

There are two options for storing DNA samples:

1. WET - in ethanol (70-98%)
2. DRY - in silica desiccant

IMPORTANT: While ethanol* is preferred (especially for long-term storage), if the samples are going to be shipped, this causes significant issues. Airlines do not allow ethanol, even in small quantities. If there are concerns over the ability to ship samples, default to desiccant. **NOTE:** Ethanol CANNOT be Isopropanol or ethanol with an additive to prevent people from drinking it as both of these will degrade the DNA.

If blood is drawn from bats, collecting a wing punch sample should NOT be done so as to reduce stress on the animal. If the wing has any existing damage, other than a few small pinpricks <0.5 mm, DO NOT take a wing punch. DO NOT take more than one wing punch from each wing.

### 7.1 Supplies for Wing Punch Collection

- [ ] Bat Datasheet
- [ ] Map of country/sampling site
- [ ] Biopsy punches (1.5-5mm)
- [ ] Cutting surface
- [ ] Ethanol 70-99%
- [ ] Desiccant
- [ ] Lighter (Optional)
- [ ] Coin envelope, filter paper, small plastic zip lock style bags, vials (Eppendorf tube)
- [ ] Microtube Storage Box
- [ ] Permanent marker AND ballpoint pen

## 7.2 Wing Punch Collection Procedure

1. Record bat species and the common name on the datasheet.
2. Ensure the work surface (cutting surface) has been sterilized to prevent cross-contamination.
3. The bat handler lays the bat on its back on the cutting mat with its wing fully extended. The wing membrane should be taut but DO NOT overextend the wing.
4. The sample collector selects a section of the wing without any veins close to the body of the bat and at least 2 cm from the edge of the wing.
5. Push the biopsy punch straight down firmly so that all of the punch tip makes contact with work surface at the same time. Exert pressure along the edge of the blade of the punch 2-3 times to ensure that a clean cut has separated the tissue without twisting.
6. Lift the punch up and check cut is clean. The tissue may be found within the punch if not on the cutting surface.

   A. **If the cut is not clean and the sample is still partially attached to the wing, use the tweezers to gently pull the tissue away from the wing and cut it off with a scissor**. DO NOT use the tweezers to pull the tissue from the wing. Remove the completely detached tissue with tweezers into either:

   B. **A small section of coffee filter paper stored in a coin envelope with desiccant**.
   Fold the filter paper in half 3-4 times to ensure the sample does not fall out. Place the folded paper in a small labeled coin envelope with desiccant, and ensure that at least some of the desiccant is of the color-changing variety to detect when it is saturated. Place all envelopes from each night in a Ziplock bag with additional desiccant. Store the bag of samples in a dry location and check the desiccant monthly to determine if the desiccant needs changing.

   C. **A vial with desiccant (Eppendorf tube) in the bottom.**
   The sample can be placed directly into the tube. Store the bag of samples in a dry location and check the desiccant monthly to determine if the desiccant needs changing.

   D. **A vial of ethanol (Eppendorf tube), place samples into a freezer as soon as possible.**
   If trapping over multiple nights, a new sample box should be used so that freezing and refreezing of samples does not occur.

7. Repeat the procedure on the opposite wing for a second backup sample; DO NOT take more than one sample from each wing or sample a bat with anything other than minor injuries to the wing.
8. Sterilize the cutting surface by wiping it down with ethanol wipes.

Ideally, a new punch should be used for each individual, but if collecting many samples with limited supplies, you can flame sterilize the punch using a lighter and ethanol. Dip the tip of the punch in the ethanol. Light the tip away from the workstation and ethanol. Wait for the flame to extinguish on its own, do not shake it to put out the flames. Let the punch cool for at least one minute before reusing it. Replace the punch when you have any problems making a clean cut.

### 7.3 Wing Punch Storage and Labeling Format

If storing the wing punch sample using desiccant in coin envelopes, follow the same format described above for hair samples. If stored in Eppendorf tubes, there is insufficient space on the tube for that level of information. Write the sample code (see section 2.2) on the side of the tube. Record the box number and the well number where the sample is stored on the datasheet. Keep a copy of the datasheet with the samples.

## 8.0 Swab Sample Collection

Collecting swab samples allows for the identification of the presence of pathogens such as White Nose Syndrome. It is essential to make sure all samples are collected safely and cleanly to prevent environmental contamination. Collaborating organizations are asked to record basic information for each sample.

### 8.1 Supplies for Swab Collection

- ☐ Datasheet
- ☐ Map of country/sampling site
- ☐ Sterile Q-tips
- ☐ Sterile Distilled water
- ☐ Storage vials (Eppendorf tubes)
- ☐ Microtube Storage Box
- ☐ Strong scissors
- ☐ Permanent marker & ballpoint pen

### 8.2 Swab Collection Procedure

1. Before starting fieldwork, fill 5-10 vials with sterile distilled water.
2. Record bat species and the common name on the datasheet.
3. Dip the tip of the Q-tip into sterile water.
4. Gently brush the Q-tip along the bat's nose five times, then five times along the bat's forearm. With each brush, roll the Q-tip in your fingers so that the entire surface of the Q-tip comes in contact with the bat with each brush.
5. Place the Q-tip in the vile. You may need to cut/snap the end off with the scissors. DO NOT USE THE HAIR-CUTTING SCISSORS!
6. Store the samples in a refrigerator or freezer.

### 8.3 Swab Sample Labeling Format

Eppendorf tubes should all be labeled with the sample code (see section 2.2) on the side of the tube. Record the box number and the well number where the sample is stored on the datasheet. Include a copy of the datasheet with the samples.

# 9.0 Parasite and Guano Sample Collection

Studies investigating bat ectoparasites or bat diet via guano use the same procedure. Both parasites and guano can be directly sampled from the bat or out of the bat bag during processing. Not all bats will have parasites or will produce guano when captured; therefore, these samples are opportunistic. If the bats have been feeding 1-2 hrs. before being captured, the probability of them producing guano increases. Most bats with a full stomach will produce guano within 10 minutes if held in a bag. This should not be done on species that are easily stressed or females who are lactating/pregnant. These individuals should be released straight away. Multiple Parasites or Guano pellets can be included in a single sample. If two different species of Parasite are observed they should be collected as separate samples.

## 9.1 Supplies for Parasite and Guano Collection

- ☐ Datasheet
- ☐ Tweezers
- ☐ Map of country/sampling site
- ☐ Storage vials (Eppendorf tubes)
- ☐ Microtube Storage Box
- ☐ Permanent marker & ballpoint pen

## 9.2 Parasite and Guano Collection Procedure

1. While processing the bat keep a watchful eye on the hair and body for either parasites or guano. Also inspect the bag once processing is complete or by a third party.
2. Once either is detected, pause current activities as soon as possible and attempt collection.
3. Using tweezers, gently pick up the parasite or guano and place in the tube. Try to avoid squishing, either.

## 9.3 Parasite and Guano Sample Labeling Format

Eppendorf tubes should all be labeled with the sample code (see section 2.2) on the side of the tube. Record the box number and the well number where the sample is stored on the datasheet. Include a copy of the datasheet with the samples.

## 10.0 Procedural Tables

**Table 4.** Tissue sampling procedural chart for mercury analysis. Tissue selection is dependent on the focal taxonomic group(s) and research objective(s).

| Desired tissue | Collection method | Suitable focal taxa | Receptacle | Minimum Amount | Storage |
|---|---|---|---|---|---|
| Blood | Piercing | All taxa | Lithium heparinized capillary tube | 0.4 µL | Freezer |
| | | | Whatman card | 1 card | Refrigerator or room temperature |
| Hair | Clipping | All taxa | Paper coin envelope or small vial with dessicant | 2 hairs | Room temperature |
| Skin–dry | Wing/tail punch | All taxa | Paper coin envelope or small vial with desiccant | 1.5-5mm | Room temperature |
| Skin–wet | Wing/tail punch | All taxa | Small vial with ethanol (70-98%) | 1.5-5mm | Freezer |
| Parasites | Bat body/ bag | All taxa | Small vial, optional ethanol (70-98%) | 1 sample | Refrigerator/freezer |
| Guano | Bat body/ bag | All taxa | Small vial | 1 sample | Refrigerator/freezer |

### 10.1 Metadata Requirements

Please clearly print at least the following information on each archive vial, paper coin envelope, or sample tag using a permanent marker:

- ☐ Band number, if applicable
- ☐ Sampling code
- ☐ Full Latin name
- ☐ Date (please use letters for the month instead of numbers (e.g., 2025 APR 08)
- ☐ Sampling location name, state or province, and country

**IMPORTANT:**
If you are contributing samples to BRI or another research group/ agency, initiate collaboration at the earliest convenience.

**Please organize all metadata using the preferred templates and submit to BRI via the forms.**

Please send any accompanying banding data for all sampled bats as an Excel spreadsheet or a .csv file. A copy of these datasheets can be obtained from **josh.guilbert@briwildlife.org**

The identification of individual bats can be achieved via photo ID of one or both wings. Collecting this data is advisable if banding is not possible or if the work is conducted in an area where photo ID has been done in the past. Take a clear, ventral-side photo of the outreach wing, with the collagen fibers visible. Note the photo numbers on the datasheet.

## 11.0 Storage of Samples

***Please follow these requirements:***

1. Whole blood samples in capillary tubes or vacutainers should be immediately stored in a cooler with ice or ice packs in the field.

   **IMPORTANT:** Blood samples should then be transferred to a freezer AS SOON AS POSSIBLE, or within 24 hours of collection, and remain frozen until analysis. While heavy metals, such as mercury, in the blood are stable, freezing samples prevents blood degradation.

2. Dried blood spots on Whatman cards should be stored with a desiccant packet in separate sealed plastic bags (to reduce the influence of moisture). Ideally, these should be stored in a 4°C refrigerator (to prevent molding), but can also be stored at room temperature away from direct sunlight prior to shipping and analysis.

3. Hair sample envelopes should ideally be stored in a sealed plastic bag at room temperature away from direct sunlight prior to shipping and analysis.

4. DNA samples should ideally be stored in ethanol (70-98%) in a freezer. DO NOT use isopropyl alcohol or any alcohol that has an additive to prevent people from drinking it. This will denature the DNA and render the sample useless. If stored using desiccant, samples should be in a cool, dry location and checked regularly (monthly) to see if the desiccant needs replacing.

5. Swabs can be stored temporarily in a fridge or long-term in a freezer

6. Parasites can be stored temporarily in a refrigerator or long-term in a freezer. If no genetic studies are to be conducted on the sample, then they may be preserved in isopropyl alcohol if a freezer is not available.

7. Guano can be stored temporarily in a refrigerator or long-term in a freezer.

## 12.0 Shipment of Samples

If you are submitting samples to BRI for collaboration, ***thank you for contributing!*** At least two weeks prior to shipping any samples, please complete the metadata submission form to allow sufficient time for BRI to file the proper permits. BRI will send all completed forms required for transport once the permits have been issued. After all other permits have been approved (see 14.0 Required Permits), please schedule a shipment with your carrier service of choice.

***To package the tissue samples, please follow these instructions:***

- Use a small cooler to secure and insulate all blood samples during shipment.
- Place ice pack(s) inside the cooler to insulate the frozen blood.
- If archive vials are glass, it is **IMPORTANT** to pad the samples with bubble wrap or newspaper inside the cooler to avoid breakage.
- Hair and dried blood spots on Whatman cards do not need special packing and do not need to be kept cold (if shipped within 3–4 months after collection).
- Place the cooler in a cardboard box and fill the empty space with additional packing materials, such as bubble wrap or newspaper, to secure the cooler during shipment.
- Include a set of all necessary permits and forms at the top of the packing material before sealing the package with packing tape (see 14.0 Required Permits). Attach a second set of permit copies in a plastic pouch on the exterior of the package.

**Please include the following details on the shipping label and package exterior:**

Biodiversity Research Institute
276 Canco Road
Portland, Maine 04103, USA

WILDLIFE :: USFWS :: MBTA

EXTRA COPIES OF DOCUMENTS INSIDE BOX

**IMPORTANT:**

To avoid postal or customs delays, ship samples on a Monday or Tuesday, and never just before a federal holiday.

When asked by the shipping representative if you are shipping anything perishable, answer **NO**.

## 13.0 Required Permits

***For shipments within the United States, please include the following:***

1. A copy of the collector's federal USFW Threaten and Endangered permit.
2. A copy of the collector's state scientific collecting permit.
3. A copy of the importer's USDA import permit * (not required if samples were collected within the U.S.)

***For shipments outside of the United States, please include the following:***

1. A copy of the importer's USDA import permit*
2. A copy of the importer's CDC permit.
3. USFWS Form 3-177 (Declaration of importation or exportation of fish or wildlife)
4. FedEx Declaration of Biological Shipments*
5. FedEx Commercial Invoice
6. CITES export permit, if applicable
7. A copy of the origin country's export permit, if applicable

*Forms provided by BRI via email - see below.

**IMPORTANT:**

Shipments arriving in the United States may be denied entry, destroyed, or returned if they do not include the appropriate permits. For further questions or clarifications, or if you are interested in collaborating, feel free to contact BRI via phone, email, or visit us at our website:

www.briwildlife.org

For further questions or clarifications, or if you are interested in collaborating, feel free to contact BRI via phone, email, or visit us at our website:

Josh Guilbert, Ph.D., Director, Mammal Program
josh.guilbert@briwildlife.org
Biodiversity Research Institute | Portland, ME USA
+1 (207) 839–7600
bri@briwildlife.org
www.briwildlife.org/mammal

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Perkins M, Lane OP, Evers DC, Sauer A, Adams EM, O'Driscoll NJ, Edmunds ST, Jackson AK, Hagelin JC, Trimble J, Sunderland EM (2019) Historical patterns in mercury exposure for North American songbirds. Ecotoxicology 29:1161–1173. https://doi.org/10.1007/s10646-019-02054-w

# Appendix A: Country Alpha 2-letter Codes — Afghanistan to Lesotho

| Country | Code |
|---|---|
| Afghanistan | AF |
| Åland Isl | AX |
| Albania | AL |
| Algeria | DZ |
| American Samoa | AS |
| Andorra | AD |
| Angola | AO |
| Anguilla | AI |
| Antarctica | AQ |
| Antigua | AG |
| Argentina | AR |
| Armenia | AM |
| Aruba | AW |
| Ascension | SH |
| Australia | AU |
| Austria | AT |
| Azerbaijan | AZ |
| Bahamas | BS |
| Bahrain | BH |
| Bangladesh | BD |
| Barbados | BB |
| Barbuda | AG |
| Belarus | BY |
| Belgium | BE |
| Belize | BZ |
| Benin | BJ |
| Bermuda | BM |
| Bhutan | BT |
| Bolivia | BO |
| Bonaire | BQ |
| Bosnia | BA |
| Botswana | BW |
| Bouvet Island | BV |
| Brazil | BR |
| Brit. Indian Ocean Terr. | IO |
| Brunei Darussalam | BN |
| Bulgaria | BG |
| Burkina Faso | BF |
| Burundi | BI |
| Cabo Verde | CV |
| Caicos Isl. | TC |
| Cambodia | KH |
| Cameroon | CM |
| Canada | CA |
| **Country** | **Code** |

| Country | Code |
|---|---|
| Central African Republic | CF |
| Chad | TD |
| Chile | CL |
| China | CN |
| Christmas Island | CX |
| Cocos Isl. | CC |
| Colombia | CO |
| Comoros | KM |
| Congo | CG |
| Congo (Dem Repub) | CD |
| Cook Isl. | CK |
| Costa Rica | CR |
| Côte d'Ivoire | CI |
| Croatia | HR |
| Cuba | CU |
| Curaçao | CW |
| Cyprus | CY |
| Czechia | CZ |
| Denmark | DK |
| Djibouti | DJ |
| Dominica | DM |
| Dominican Republic | DO |
| Ecuador | EC |
| Egypt | EG |
| El Salvador | SV |
| Equatorial Guinea | GQ |
| Eritrea | ER |
| Estonia | EE |
| Eswatini | SZ |
| Ethiopia | ET |
| Falkland Isl | FK |
| Faroe Isl. | FO |
| Fiji | FJ |
| Finland | FI |
| France | FR |
| French Guiana | GF |
| French Polynesia | PF |
| French Southern Terr.s | TF |
| Futuna | WF |
| Gabon | GA |
| Gambia | GM |
| Georgia | GE |
| Germany | DE |
| Ghana | GH |
| **Country** | **Code** |

| Country | Code |
|---|---|
| Greece | GR |
| Greenland | GL |
| Grenada | GD |
| Grenadines | VC |
| Guadeloupe | GP |
| Guam | GU |
| Guatemala | GT |
| Guernsey | GG |
| Guinea | GN |
| Guinea-Bissau | GW |
| Guyana | GY |
| Haiti | HT |
| Heard Island | HM |
| Herzegovina | BA |
| Holy See | VA |
| Honduras | HN |
| Hong Kong | HK |
| Hungary | HU |
| Iceland | IS |
| India | IN |
| Indonesia | ID |
| Iran | IR |
| Iraq | IQ |
| Ireland | IE |
| Isle of Man | IM |
| Israel | IL |
| Italy | IT |
| Jamaica | JM |
| Jan Mayen | SJ |
| Japan | JP |
| Jersey | JE |
| Jordan | JO |
| Kazakhstan | KZ |
| Keeling Isl. | CC |
| Kenya | KE |
| Kiribati | KI |
| Korea (North) | KP |
| Korea (South) | KR |
| Kuwait | KW |
| Kyrgyzstan | KG |
| Lao | LA |
| Latvia | LV |
| Lebanon | LB |
| Lesotho | LS |
| **Country** | **Code** |

# Appendix B: Country Alpha 2-letter Codes — Liberia to Zimbabwe

| Country | Code |
|---|---|
| Liberia | LR |
| Libya | LY |
| Liechtenstein | LI |
| Lithuania | LT |
| Luxembourg | LU |
| Macao | MO |
| Madagascar | MG |
| Malawi | MW |
| Malaysia | MY |
| Maldives | MV |
| Mali | ML |
| Malta | MT |
| Malvinas Isl | FK |
| Marshall Isl. | MH |
| Martinique | MQ |
| Mauritania | MR |
| Mauritius | MU |
| Mayotte | YT |
| McDonald Isl | HM |
| Mexico | MX |
| Micronesia (Fed States) | FM |
| Miquelon | PM |
| Moldova | MD |
| Monaco | MC |
| Mongolia | MN |
| Montenegro | ME |
| Montserrat | MS |
| Morocco | MA |
| Mozambique | MZ |
| Myanmar | MM |
| Namibia | NA |
| Nauru | NR |
| Nepal | NP |
| Netherlands | NL |
| Nevis | KN |
| New Caledonia | NC |
| New Zealand | NZ |
| Nicaragua | NI |
| Niger | NE |
| Nigeria | NG |
| Niue | NU |
| Norfolk Island | NF |
| North Macedonia | MK |
| Northern Ireland | GB |
| Northern Mariana Isl. | MP |

| Country | Code |
|---|---|
| Norway | NO |
| Oman | OM |
| Pakistan | PK |
| Palau | PW |
| Palestine | PS |
| Panama | PA |
| Papua New Guinea | PG |
| Paraguay | PY |
| Peru | PE |
| Philippines | PH |
| Pitcairn | PN |
| Poland | PL |
| Portugal | PT |
| Principe | ST |
| Puerto Rico | PR |
| Qatar | QA |
| Réunion | RE |
| Romania | RO |
| Russian Federation | RU |
| Rwanda | RW |
| Saba | BQ |
| Saint Barthélemy | BL |
| Saint Helena | SH |
| Saint Kitts | KN |
| Saint Lucia | LC |
| Saint Martin (French) | MF |
| Saint Pierre | PM |
| Saint Vincent | VC |
| Samoa | WS |
| San Marino | SM |
| Sao Tome | ST |
| Saudi Arabia | SA |
| Senegal | SN |
| Serbia | RS |
| Seychelles | SC |
| Sierra Leone | SL |
| Singapore | SG |
| Sint Eustatius | BQ |
| Sint Maarten (Dutch) | SX |
| Slovakia | SK |
| Slovenia | SI |
| Solomon Isl | SB |
| Somalia | SO |
| South Africa | ZA |
| South Georgia | GS |

| Country | Code |
|---|---|
| South Sandwich Isl | GS |
| South Sudan | SS |
| Spain | ES |
| Sri Lanka | LK |
| Sudan | SD |
| Suriname | SR |
| Svalbard | SJ |
| Sweden | SE |
| Switzerland | CH |
| Syrian Arab Republic | SY |
| Taiwan | TW |
| Tajikistan | TJ |
| Tanzania | TZ |
| Thailand | TH |
| Timor-Leste | TL |
| Togo | TG |
| Tokelau | TK |
| Tonga | TO |
| Trinidad and Tobago | TT |
| Tristan da Cunha | SH |
| Tunisia | TN |
| Turkey | TR |
| Turkmenistan | TM |
| Turks Isl. | TC |
| Tuvalu | TV |
| Uganda | UG |
| Ukraine | UA |
| United Arab Emirates | AE |
| United Kingdom | GB |
| United States of America | US |
| Uruguay | UY |
| US Minor Outlying Isl. | UM |
| Uzbekistan | UZ |
| Vanuatu | VU |
| Venezuela | VE |
| Viet Nam | VN |
| Virgin Isl. (British) | VG |
| Virgin Isl. (U.S.) | VI |
| Wallis | WF |
| Western Sahara | EH |
| Yemen | YE |
| Zambia | ZM |
| Zimbabwe | ZW |

# Appendix C: Country Codes Alphabetically by Code — AD to KW

| Country | Code |
|---|---|
| Andorra | AD |
| United Arab Emirates | AE |
| Afghanistan | AF |
| Antigua | AG |
| Barbuda | AG |
| Anguilla | AI |
| Albania | AL |
| Armenia | AM |
| Angola | AO |
| Antarctica | AQ |
| Argentina | AR |
| American Samoa | AS |
| Austria | AT |
| Australia | AU |
| Aruba | AW |
| Åland Isl | AX |
| Azerbaijan | AZ |
| Bosnia | BA |
| Herzegovina | BA |
| Barbados | BB |
| Bangladesh | BD |
| Belgium | BE |
| Burkina Faso | BF |
| Bulgaria | BG |
| Bahrain | BH |
| Burundi | BI |
| Benin | BJ |
| Saint Barthélemy | BL |
| Bermuda | BM |
| Brunei Darussalam | BN |
| Bolivia | BO |
| Bonaire | BQ |
| Saba | BQ |
| Sint Eustatius | BQ |
| Brazil | BR |
| Bahamas | BS |
| Bhutan | BT |
| Bouvet Island | BV |
| Botswana | BW |
| Belarus | BY |
| Belize | BZ |
| Canada | CA |
| Cocos Isl. | CC |
| Keeling Isl. | CC |

| Country | Code |
|---|---|
| Congo (Dem Repub) | CD |
| Central African Republic | CF |
| Congo | CG |
| Switzerland | CH |
| Côte d'Ivoire | CI |
| Cook Isl. | CK |
| Chile | CL |
| Cameroon | CM |
| China | CN |
| Colombia | CO |
| Costa Rica | CR |
| Cuba | CU |
| Cabo Verde | CV |
| Curaçao | CW |
| Christmas Island | CX |
| Cyprus | CY |
| Czechia | CZ |
| Germany | DE |
| Djibouti | DJ |
| Denmark | DK |
| Dominica | DM |
| Dominican Republic | DO |
| Algeria | DZ |
| Ecuador | EC |
| Estonia | EE |
| Egypt | EG |
| Western Sahara | EH |
| Eritrea | ER |
| Spain | ES |
| Ethiopia | ET |
| Finland | FI |
| Fiji | FJ |
| Falkland Isl | FK |
| Malvinas Isl | FK |
| Micronesia (Fed States) | FM |
| Faroe Isl. | FO |
| France | FR |
| Gabon | GA |
| Northern Ireland | GB |
| United Kingdom | GB |
| Grenada | GD |
| Georgia | GE |
| French Guiana | GF |
| Guernsey | GG |
| Ghana | GH |

| Country | Code |
|---|---|
| Gibraltar | GI |
| Greenland | GL |
| Gambia | GM |
| Guinea | GN |
| Guadeloupe | GP |
| Equatorial Guinea | GQ |
| Greece | GR |
| South Georgia | GS |
| South Sandwich Isl | GS |
| Guatemala | GT |
| Guam | GU |
| Guinea-Bissau | GW |
| Guyana | GY |
| Hong Kong | HK |
| Heard Island | HM |
| McDonald Isl | HM |
| Honduras | HN |
| Croatia | HR |
| Haiti | HT |
| Hungary | HU |
| Indonesia | ID |
| Ireland | IE |
| Israel | IL |
| Isle of Man | IM |
| India | IN |
| Brit. Indian Ocean Terr. | IO |
| Iraq | IQ |
| Iran | IR |
| Iceland | IS |
| Italy | IT |
| Jersey | JE |
| Jamaica | JM |
| Jordan | JO |
| Japan | JP |
| Kenya | KE |
| Kyrgyzstan | KG |
| Cambodia | KH |
| Kiribati | KI |
| Comoros | KM |
| Nevis | KN |
| Saint Kitts | KN |
| Korea (North) | KP |
| Korea (South) | KR |
| Kuwait | KW |

# Appendix D: Country Codes Alphabetically by Code — AD to KW

| Country | Code |
|---|---|
| Cayman Isl. | KY |
| Kazakhstan | KZ |
| Lao | LA |
| Lebanon | LB |
| Saint Lucia | LC |
| Liechtenstein | LI |
| Sri Lanka | LK |
| Liberia | LR |
| Lesotho | LS |
| Lithuania | LT |
| Luxembourg | LU |
| Latvia | LV |
| Libya | LY |
| Morocco | MA |
| Monaco | MC |
| Moldova | MD |
| Montenegro | ME |
| Saint Martin (French) | MF |
| Madagascar | MG |
| Marshall Isl. | MH |
| North Macedonia | MK |
| Mali | ML |
| Myanmar | MM |
| Mongolia | MN |
| Macao | MO |
| Northern Mariana Isl. | MP |
| Martinique | MQ |
| Mauritania | MR |
| Montserrat | MS |
| Malta | MT |
| Mauritius | MU |
| Maldives | MV |
| Malawi | MW |
| Mexico | MX |
| Malaysia | MY |
| Mozambique | MZ |
| Namibia | NA |
| New Caledonia | NC |
| Niger | NE |
| Norfolk Island | NF |
| Nigeria | NG |
| Nicaragua | NI |
| Netherlands | NL |
| Norway | NO |
| Nepal | NP |

| Country | Code |
|---|---|
| Nauru | NR |
| Niue | NU |
| New Zealand | NZ |
| Oman | OM |
| Panama | PA |
| Peru | PE |
| French Polynesia | PF |
| Papua New Guinea | PG |
| Philippines | PH |
| Pakistan | PK |
| Poland | PL |
| Miquelon | PM |
| Saint Pierre | PM |
| Pitcairn | PN |
| Puerto Rico | PR |
| Palestine | PS |
| Portugal | PT |
| Palau | PW |
| Paraguay | PY |
| Qatar | QA |
| Réunion | RE |
| Romania | RO |
| Serbia | RS |
| Russian Federation | RU |
| Rwanda | RW |
| Saudi Arabia | SA |
| Solomon Isl | SB |
| Seychelles | SC |
| Sudan | SD |
| Sweden | SE |
| Singapore | SG |
| Ascension | SH |
| Saint Helena | SH |
| Tristan da Cunha | SH |
| Slovenia | SI |
| Jan Mayen | SJ |
| Svalbard | SJ |
| Slovakia | SK |
| Sierra Leone | SL |
| San Marino | SM |
| Senegal | SN |
| Somalia | SO |
| Suriname | SR |
| South Sudan | SS |

| Country | Code |
|---|---|
| Principe | ST |
| Sao Tome | ST |
| El Salvador | SV |
| Sint Maarten (Dutch) | SX |
| Syrian Arab Republic | SY |
| Eswatini | SZ |
| Caicos Isl. | TC |
| Turks Isl. | TC |
| Chad | TD |
| French Southern Terr.s | TF |
| Togo | TG |
| Thailand | TH |
| Tajikistan | TJ |
| Tokelau | TK |
| Timor-Leste | TL |
| Turkmenistan | TM |
| Tunisia | TN |
| Tonga | TO |
| Turkey | TR |
| Trinidad and Tobago | TT |
| Tuvalu | TV |
| Taiwan | TW |
| Tanzania | TZ |
| Ukraine | UA |
| Uganda | UG |
| US Minor Outlying Isl. | UM |
| United States of America | US |
| Uruguay | UY |
| Uzbekistan | UZ |
| Holy See | VA |
| Grenadines | VC |
| Saint Vincent | VC |
| Venezuela | VE |
| Virgin Isl. (British) | VG |
| Virgin Isl. (U.S.) | VI |
| Viet Nam | VN |
| Vanuatu | VU |
| Futuna | WF |
| Wallis | WF |
| Samoa | WS |
| Yemen | YE |
| Mayotte | YT |
| South Africa | ZA |
| Zambia | ZM |
| Zimbabwe | ZW |

Biodiversity Research Institute

**STAFF:**_____

**COUNTRY:**_____ **REGION:**_____ **SITE:**_____

**Traps:**_____ **X:**_____ **Y:**_____ **Elev (m):**_____

**Habitat types:** *Cave Forest Trail Scrub Grassland Pond Stream*

Other:_____

**PAGE:**_____ **OF:**_____

**Open Time:**_____ **Open Temp (C)/Wind:** ____/____ **Weather:** *Rain Clear Cloudy*

**Close Time:**_____ **Close Temp(C)/Wind:** ____/____ **Weather:** *Rain Clear Cloudy*

**If not collected or unknown, leave blank.** **Net:** Letter Code & capture height (m) **Measurements:** Weight (g): *Total = bat and bag, bag = bag only* // Length Measurements (mm): *Forearm, TTL = Total Tail Length, Tail=Tail past Uropotagium, RHF= Right hindfoot, Ear Length, Trag= Tragus length, HS= Horseshoe width (horseshoe bats only)* **Categories:** Sex: *M = male; F = female* // Repro Status: *Non Reproductive = NON, Female: PR = pregnant, LA = lactating, PL = post-lactating, Male: TS = testes Age: J = Juvenile; A = Adult* **WS:** Wingscore 0-3 (see footer) **Photos**: Remember to take a photo of the data sheet before taking a photos of each bat

**Sample Code**: Sample No. + Field Lead's 3 initials (e.g.001JMG) // Sample Types: *H = Hair, B = Blood, D = DNA, S = Swab P = Parasite, G = Guano, C = Call (echolocation)*

| **DATE:** YYYYMMMDD | | | SPP | Net | Recap | Weight (g) | | Forearm | TTL | Tail | RHF | Ear Length | Tragus | HS | Sex | Repro | AGE | WS | Photos? | SAMPLE CODE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BAG | TIME | BAND ID# | GGSS | # / ht.m | | Total | Bag | (mm) | (mm) | (mm) | (mm) | (mm) | (mm) | (mm) | | Status | | # | | |
| 1 | | Band # or Capture # | | | | | | | | | | | | | M F | PR LA NON PL TD | A J | | | # # # # # # # H B W S P G C |
| 2 | | Band # or Capture # | | | | | | | | | | | | | M F | PR LA NON PL TD | A J | | | # # # # # # # H B W S P G C |
| 3 | | Band # or Capture # | | | | | | | | | | | | | M F | PR LA NON PL TD | A J | | | # # # # # # # H B W S P G C |
| 4 | | Band # or Capture # | | | | | | | | | | | | | M F | PR LA NON PL TD | A J | | | # # # # # # # H B W S P G C |
| 5 | | Band # or Capture # | | | | | | | | | | | | | M F | PR LA NON PL TD | A J | | | # # # # # # # H B W S P G C |
| 6 | | Band # or Capture # | | | | | | | | | | | | | M F | PR LA NON PL TD | A J | | | # # # # # # # H B W S P G C |
| 7 | | Band # or Capture # | | | | | | | | | | | | | M F | PR LA NON PL TD | A J | | | # # # # # # # H B W S P G C |
| 8 | | Band # or Capture # | | | | | | | | | | | | | M F | PR LA NON PL TD | A J | | | # # # # # # # H B W S P G C |
| 9 | | Band # or Capture # | | | | | | | | | | | | | M F | PR LA NON PL TD | A J | | | # # # # # # # H B W S P G C |
| 10 | | Band # or Capture # | | | | | | | | | | | | | M F | PR LA NON PL TD | A J | | | # # # # # # # H B W S P G C |

WS: **0**: <5% splotches, NO discolored flaking forearm (DFF), no necrotic tissue, no holes, membrane intact. **1:** 5-50% splotches, DFF = Auto score of 1, no necrotic, no holes, membrane intact. **2**: 50-90% splotches, DFF, few areas of necrotic issue, small holes <5 mm in diameter holes, Necrosis edges no loss of area **3:** >90% splotches, DFF, Abundant necrosis, large holes >5 mm in diameter holes, Noticeable loss of membrane area

Sample labels month Code: January:**JA**, February:**FE**, March:**MR**, April:**AP**, May:**MY**, June:**JN**, July:**JL**, August:**AU**, September:**SE**, October:**OC**, November:**NV**, December:**DE**