



**2014**  
**American Burying Beetle *Nicrophorus americanus***  
**Oklahoma Presence/Absence Live-trapping Survey Guidance**

**Introduction**

This document provides guidance for designing and conducting live-trapping presence/absence surveys for the endangered American burying beetle (*Nicrophorus americanus*, ABB) throughout its current and historical range in Oklahoma. This guidance replaces any previous U.S. Fish and Wildlife Service (Service) recommended ABB survey guidance for the state of Oklahoma. These surveys may only be conducted by individuals possessing a valid Federal Fish & Wildlife Permit for scientific recovery of the ABB (Surveyors), as defined under section 10(a)(1)(A) of the Endangered Species Act (ESA), issued by the Service. Surveyors should read the Service's *ABB Impact Assessment and Mitigation Guidelines* prior to conducting any ABB surveys to determine where and in what cases surveys are recommended. Surveys for ABB conducted beyond the scope of a presence/absence survey must be coordinated with the Service. Additionally, surveyors should contact the Oklahoma Department of Wildlife Conservation to determine whether any state guidelines and/or permits apply. This guidance is based on the most current scientific data available at this time. The Service's Oklahoma Ecological Services Field Office (OKESFO) will update this survey guidance as new information becomes available.

**NOTICE:** The Service will no longer provide separate validation letters for individual surveys. Instead, responsibility to ensure that the surveys are conducted in accordance with this protocol and cover all potential ABB habitats within a project area will lie with the Permitted Biologist. The Service expects Permitted individuals to adhere to the protocols outlined within this document. If upon review, the Service discovers a survey to be invalid for any reason, the Service will return the project to the proponent as incomplete with directions to resubmit the project once they have conducted a valid survey. Additional reporting details are found below in the *Reporting Procedures* section of this document.

***Areas Unfavorable for the ABB***

This information can be used to help determine whether surveys are appropriate and provides guidance for areas to avoid when selecting the placement of traps. While the ABB uses a wide variety of habitats, the Service currently believes that areas exhibiting the following characteristics are *unfavorable* for use by ABBs based on disturbance regime, vegetation structure, unsuitable soil conditions and carrion availability:

1. Land that is tilled on a regular basis, planted in monoculture, and does not contain native vegetation.
2. Pasture or grassland that have been maintained through frequent mowing, grazing, or herbicide application at a height of 20 cm (8 inches) or less.
3. Land that has already been developed and no longer exhibits surficial topsoil, leaf litter, or vegetation.

4. Urban areas with maintained lawns, paved surfaces, or roadways.
5. Stockpiled soil without vegetation.
6. Wetlands with standing water or saturated soils (defined as sites exhibiting hydric-soils, and vegetation typical of saturated soils, and/or wetland hydrology).

NOTE: Areas adjacent to wetlands and/or riparian areas are **not** considered unfavorable for the ABB, as they may be important for ABBs seeking moist soils during dry conditions.

### **Seasonal Parameters**

#### **Time of Year for Surveys**

In order for the Service to consider a survey valid within the state of Oklahoma, surveys for the ABB must occur during the ABB active season. The Service considers the ABB active season in Oklahoma to begin after five consecutive nights when the minimum nightly temperature reaches 15.5 degrees Celsius/60 degrees Fahrenheit (°F) or greater (Bedick 1997, Kozol 1991, USFWS 1991). Over the past 10 years in Oklahoma (2003-2012), on average, the fifth consecutive night of minimum temperatures meeting or exceeding 60°F occurred on May 26 (Mesonet 2013). Surveys may continue until the first night when the minimum temperature falls below 60°F after August 31, which signifies the end of the ABB active season. Over the past 10 years in Oklahoma, on average, the first night after August 31 when minimum temperatures fell below 60°F occurred on September 14 (Mesonet 2013). These dates are provided for planning purposes only and are subject to the current year's weather/temperatures. Permitted biologists will need to ensure nightly temperature criteria have been met before trapping begins. Surveyors should collect the necessary temperature information from the closest weather station to the survey site (see more information in the Reporting Procedures section below).

#### **Timeframe Surveys are Valid**

Previously surveys performed anytime during the active season were valid until the next active season. This is not consistent with the mobile nature of the ABB and new information documenting the presence of ABBs in areas that had negative surveys earlier in the season. This revised guidance allows surveys completed prior to July 28 to be valid for only that active season. Surveys completed after July 28, however, will be valid until the start of the new active season, typically May 26.

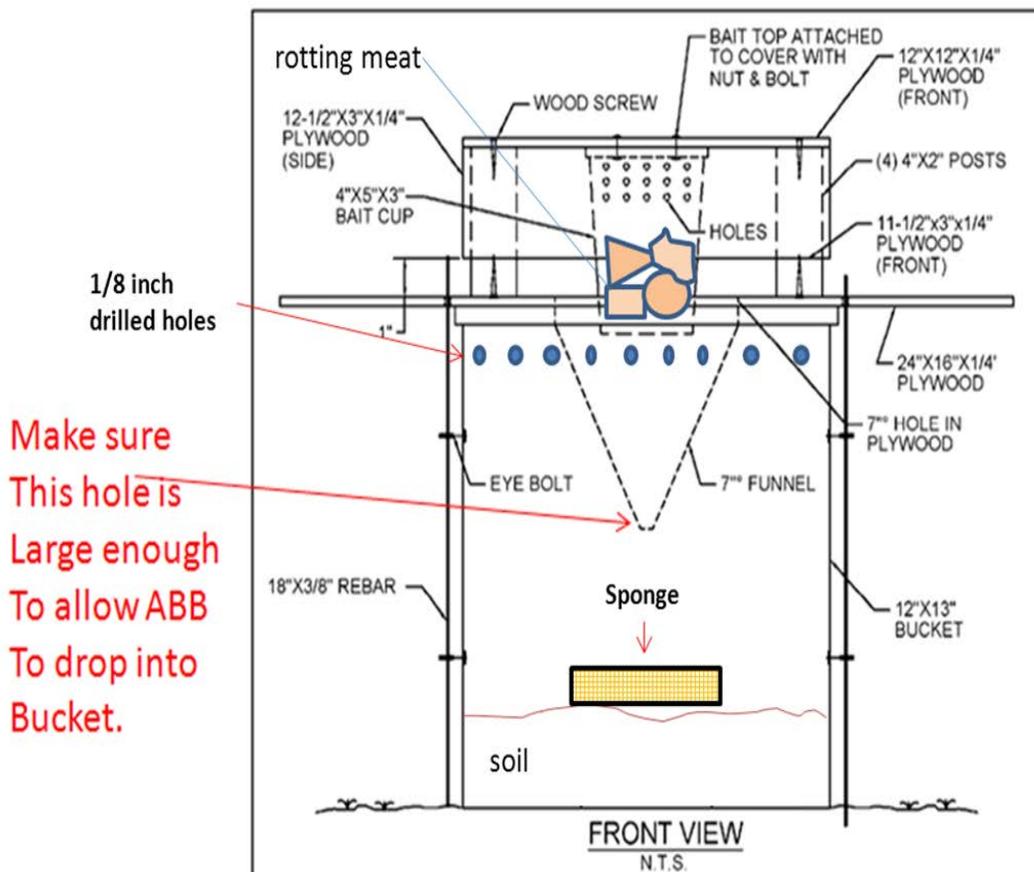
Following metamorphosis from larva to adult, teneral (adult ABBs newly emerged from the pupal case) typically emerge from underground in late summer; though timing can vary based on latitude and weather conditions. For example presence/absence surveys in Oklahoma have documented tenerals in early summer of 2013 (USFWS species files). Typically, tenerals overwinter as adults and comprise the breeding population the following spring and summer (Kozol 1990). ABBs usually live for only one year and all ABBs that overwinter were produced the previous summer. In Oklahoma, by July 28, most new or teneral ABBs should have emerged and be actively seeking carcasses. Surveys completed after July 28<sup>th</sup> should more accurately represent the presence or absence of teneral ABBs prior to overwintering.

**Trap Design**

**General**

The Service requires surveyors to use an 18.92-liter (5-gallon) bucket-style trap when conducting ABB presence/absence surveys. Traps must be light in color, have smooth sides, and be free of any texture or ridges to prevent ABBs from climbing out. Each trap consists of a bucket with cover and bait. Utilization of trap designs and equipment that deviate from the traps described herein must be coordinated with and approved by the Service prior to deployment. Surveyors may place buckets above ground or bury them as a pitfall trap, as described below.

**5-gallon Above-ground Bucket Trap**



**Figure 1.** Alternate form of Leasure et al. 2012, pictured using soil and sponge in the bottom of the bucket. This allows beetles to find refuge from other congeners, decreases competition, and decreases stress to ABB's.

See Appendix C (Leasure et al. 2012) for instructions, materials, figures and schematics. Funnels used to make these traps can come in different sizes. When selecting a funnel for your trap, the small end of the funnel **MUST** be large enough to allow a large ABB to fall through into the bucket (approximately 55 mm – 2.16 inches). If the funnel's small end opening is not large enough, you may need to cut it off to make the hole larger (**Figure 1**). Surveyors should drill

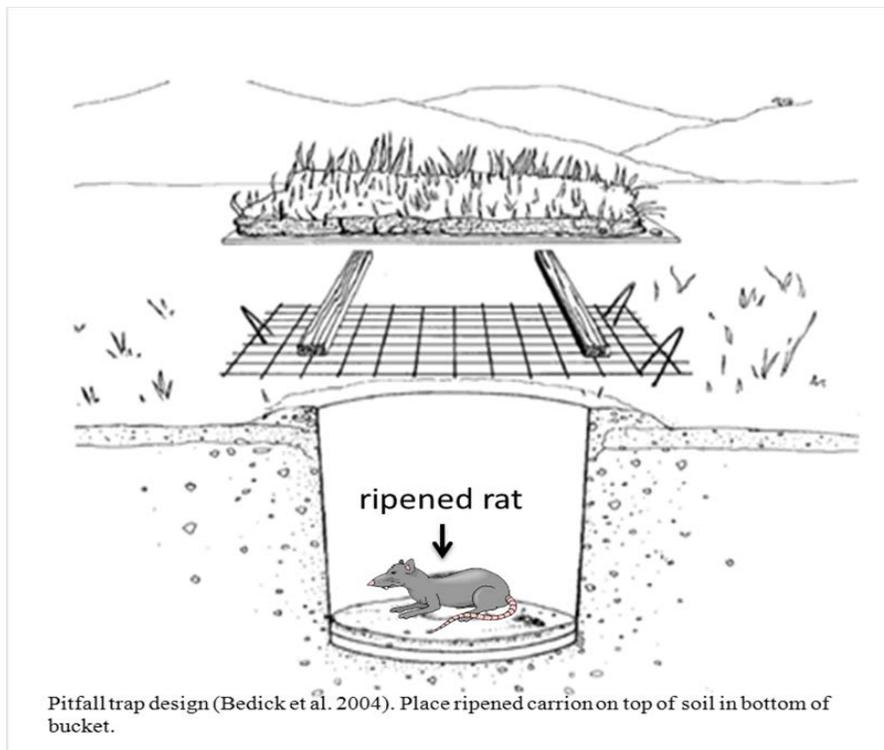
additional 3.2 mm (1/8 inch) holes around the top edge of the bucket (see figure 1) to allow air circulation through the bucket while preventing beetles from escaping.

### 5-gallon Pitfall Bucket-Trap

This pitfall trap design follows Bedick et al. 2004, although biologists have recommended a few modifications to this trap over the years to provide for better performance, such as allowing ABB access to bait within the trap to decrease competition and provide moisture for captured beetles. A schematic of the improved design is pictured in **Figure 2**. The following is a list of items needed to build these pitfall traps.

#### Materials

1. Two 18.92 liter (5-gallon) buckets with a diameter of 28.5 centimeters (11.2 inches) or greater
2. Piece of plywood at least 10.2 centimeters (4 inches) wider than diameter of bucket
3. Piece of wire mesh ( $\geq 2.5$  centimeters [1-inch] mesh size) to allow ABB to enter but still exclude scavengers.
4. Four garden staples
5. Two 2.5 centimeters by 2.5 centimeters (1-inch by 1-inch) sticks large enough to hold the cover off the bucket
6. Shovel or ground auger



**Figure 2.** Pitfall trap design (based on Bedick et al. 2004)

Place one bucket inside the other bucket, and place both in a pre-dug hole. Stacking the buckets one inside the other facilitates removal of trapped insects by easily pulling the top bucket out, while the second bucket remains in the ground to maintain the integrity of the hole. The rim of the buckets should be 1.2 to 2.5 centimeters (0.5 to 1.0 inch) above ground level and a berm of soil built up to the rim of the bucket to create a gradient from ground level upwards to the rim for ABBs to access the bucket. This also prevents water runoff from filling the bucket.

If using a pit-fall trap design in areas where scavengers are a significant problem, surveyors should install wire mesh between the pitfall trap and the cover as pictured in **Figure 2**. Place the wire mesh over the buckets and secure in place with the garden staples to help exclude vertebrate scavengers. The piece of wire mesh should allow ABBs access to the trap, but prevent larger animals from stealing the bait. Surveyors should secure the wire mesh to the ground with stakes.

Lay the 1 x 1 sticks over the wire mesh and place a hard cover on top of the sticks.

Place additional weight (soil, rocks, etc.) on top of the trap cover to reduce bait loss to vertebrate scavengers and to prevent wind or small animals from moving the cover, as depicted in **Figure 2**.

Do not place traps in areas where inundation during rainfall events could occur as ABBs can drown easily in even a small amount of water. Close traps if high winds or severe thunderstorms are predicted for the survey area.

A cover is required to deter scavenger's access to the trap, to prevent rainfall from entering the trap, and to provide shade to captured insects to inhibit desiccation. The cover over traps should be rigid, light in color, weighted or secured to the trap or ground. Covers over pitfall traps should be raised off the trap about 1 to 2 inches to allow ABBs to crawl into the trap and to allow the scent of the bait to better permeate the air.

### **Trap Deployment**

#### **Minimum Survey Effort (Temporal Scale)**

To determine presence/absence of ABBs, surveyors should set traps for a minimum of **five (5) consecutive nights** (Bedick et al 2004). *This is a change from previous guidance that recommended a minimum of three nights.* Surveys with 5 consecutive nights reduce the potential for false negatives and are consistent with recommendations in Bedick et al. 2004, Butler et al. 2002, and guidance used in other portions of the ABB range. A minimum survey effort of 5 nights was required to eliminate false negatives in 123 surveys conducted in 2011 (Hoback 2011 Unpublished). See "Weather Requirements" section below for additional information about timing of surveys with invalid nights.

#### **Weather Requirements**

The following environmental conditions are not conducive to ABB presence/absence surveys and therefore invalidate survey results unless additional nights of surveying are added. Additional night(s) of surveying are required in Oklahoma when:

- Nighttime temperature falls below 60°F (during the survey period),
- Wind speed is greater than 10 mph in excess of 20% of the time between 9:00 p.m. and 4:00 a.m. (1 hour 24 minutes),
- Precipitation exceeds 0.5 inches between 9:00 p.m. and 4:00 a.m., or
- Surveys are interrupted by 3 nights of unsuitable weather conditions.

Minimum survey effort should include five consecutive nights of suitable weather conditions. Surveyors should collect the necessary precipitation, temperature, and wind information from the closest weather station to the survey site (see more information in the Reporting Procedures section below). If unsuitable weather conditions invalidates one or more survey nights during the overall survey effort, surveyors should continue surveying until they reach five valid nights. It is not necessary to restart surveys to obtain five (5) consecutive nights of sampling, unless surveys are interrupted by three (3) consecutive nights of unsuitable weather. Record which survey nights did not meet weather requirements on the “*ABB Survey Data Collection Form*” (Appendix A) and the total number of nights with unsuitable weather conditions on the “*ABB Survey Summary Report*” (Appendix B).

#### *Disturbed bait or traps*

An additional night of trapping is required for every night the trap or bait is disturbed. Record which survey night(s) the disturbance occurred on the “*ABB Survey Data Collection Form*” (Appendix A) and the total number of nights of trap disturbance on the “*ABB Survey Summary Report*” (Appendix B).

#### *Trap Spacing and Placement*

**The effective survey radius for each trap is 0.8 km (0.5 miles).** Therefore, surveyors should space traps 1.6 km (1.0 mile) apart to achieve adequate survey results. The Service determined this effective survey radius based on the ABB’s mobility, size, recorded movement distances, and the distance from which ABBs can detect carrion.

Surveyors should place traps at the highest elevation in the survey area and along the upwind edge of the survey area, if possible. High elevation areas take precedent over upwind placement. (Do not place traps in depressions that may hold water if rain occurs.)

#### *Baiting and Checking Traps*

Any type of carrion is suitable for use as bait, as long as it is the appropriate size in correlation with trap size and produces a pungent odor that ABBs are able to detect (Bedick et al 2004, Leasure *et al.* 2012). All bait must be aged or ripened and emit a pungent odor to be effective. Surveyors should store the bait outside in airtight containers for 2 to 3 days, or until adequately aged to produce a sufficiently robust odor. Do not fill the container or bag completely full, because as the bait rots, gas pressure inside the container increases, and expands the container.

The Service recommends that surveyors bait the bottom of the pitfall bucket traps with whole

carcasses, hair/feathers intact. Surveyors may use previously frozen, 275-374 gram (9.7-13.2 ounce) laboratory rats (*Rattus norvegicus*), available from pet stores and online dealers, as bait. If rats are not available, bait items of comparable size and structure may be used. Additionally, if using the aboveground 5-gallon bucket, surveyors will utilize the bait cup attached to the lid to ensure that the pungent odor of carrion is effectively dispersed. This bait need not be a whole carcass and may consist of aged pieces that have neither skin nor hair. Baiting traps consists of:

1. Emplace or secure the bucket to the ground
2. Place approximately 2.5 to 5.1 centimeters (1 to 2 inches) of loose, friable, moist (but not wet) soil with little or no clay content in the bottom of the pitfall bucket or above-ground bucket if bait is placed in the bottom. When checking traps, care must be taken when sifting the dirt for ABB presence.
3. Place a wetted sponge and/or soil in the bottom of the 5-gallon bucket. (All traps require the use of a wetted sponge.)
4. If you are using a pitfall trap, place the carcass on top of the soil in the bottom of the trap. If you are using the 5-gallon above-ground bucket trap, surveyors must place the bait in the perforated bait cup that is attached to the lid and may place additional bait in the bottom (if soil is added).
5. During trapping efforts, surveyors must replace any bait that has dried out or no longer emits a pungent odor with new, prepared bait. Do not leave discarded or old bait at or near the current trapping area. This could lure ABBs away from the baited traps. Surveyors must wash all buckets with bleach and thoroughly rinse with water prior to each trapping survey effort.
6. Secure the tops of the traps to ensure predators do not have access to the contents of the bucket.
7. All traps must be in place and baited by dusk each night.

Surveyors must check and clear all ABB traps by 10:00 a.m. every day the traps are set. Surveyors may bait traps at the same time they check traps each morning, provided the bait does not dry out. Because ABBs are nocturnal, the risk of ABB captures during the day is extremely low. However, exposure to full sunlight and temperatures over 25°C (77°F) even for a few hours, can result in mortality (Kozol 1990, USFWS 1991, Kozol 1992) and traps must be checked by 10:00 a.m to minimize any temperature-related mortality.

Checking traps consists of:

1. Record and release all *Nicrophorus* species
2. Replace any missing or dry bait and moisten the sponge
3. Replace/resituate any disturbed parts of the trap

Surveyors should immediately release any injured or lethargic ABBs that are clearly alive. Surveyors should monitor all ABBs that appear to be dead, holding for at least 20 minutes for accurate determination of their condition. Process any dead ABBs as described below under “*Accidental Death of ABBs*”.

### Ants

Surveyors should not place traps within 7 meters (23 feet) of any ant colonies. If ants are in a trap, the surveyor should relocate the trap at least 23 feet away.

### Processing Captures

#### Identification and processing of *Nicrophorus* Species

Surveyors must identify and record all *Nicrophorus* species. Appendix D provides descriptions of the *Nicrophorus* species, and Appendix E provides a dichotomous key.

Processing ABBs includes gender determination, age determination, taking measurements (if required,) marking (if authorized) and data recording of all ABBs captured. Surveyors must record all information on the “*ABB Survey Data Collection Form*” (Appendix A) if gathered.

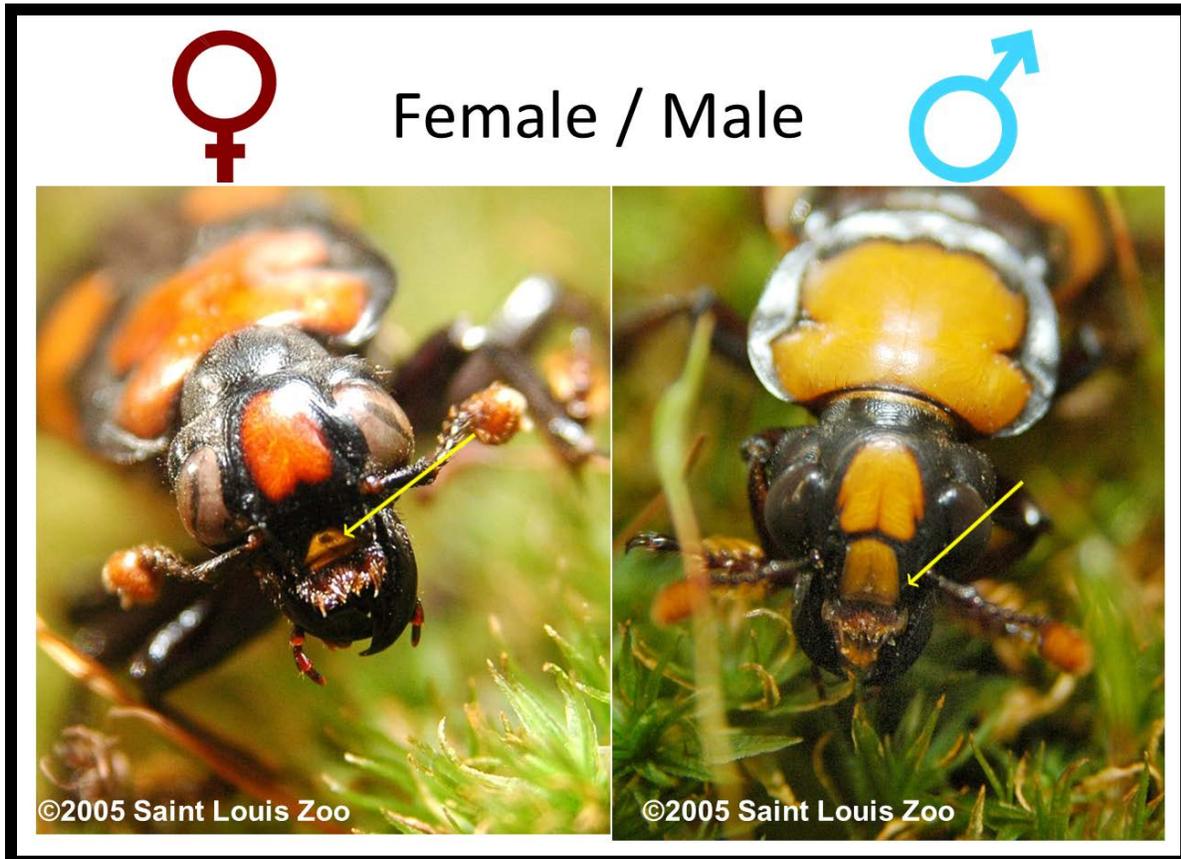
ABBs are sensitive to prolonged heat exposure. Surveyors cannot hold captured ABBs for longer than 30 minutes, preferably much less. If more than 10 minutes is required for processing, surveyors should place ABBs in a hard plastic container with a damp sponge, which should be stored in an ice cooler until processing commences. The plastic container should be stored away from direct sunlight.

Surveyors cannot mark (clipping of elytra, adhesion of bee tags, painting) ABBs in any way unless approved by the Service. If the surveyor desires to measure the pronotum or other features of individuals, pronotal width can be measured using images taken in the field on a piece of grid paper and analyzed using the freeware ImageJ (<http://imagej.nih.gov/ij/>).

Release ABBs near (within 609 meters/2,000 feet) the transect where they were captured, but at least 3 meters (10 feet) away from foot traffic along the transect and a minimum of 152 meters (500 feet) from any vehicle pathway, to avoid trampling.

Gender Determination

The gender of ABBs is distinguishable by the orange-red marking located between the frons and mandibles on the head. These markings are rectangular on males and triangular on females (Figure 3). Surveyors must record ABB gender on the “*ABB Survey Data Collection Form*”.



**Figure 3.** Distinguishing female from male ABB and shows color variations within the species. This female is darker in hue and appears more red, consistent with an older adult coloring; while this male is lighter in hue and appears more orange, consistent with characteristics of a teneral adult.

Age Determination

ABBs that have pupated during the current active season are referenced as new (i.e., newly emerged or teneral) and ABBs pupated the previous year are referenced as old (emerged the previous active season and overwintered as adults). Surveyors can distinguish newly emerged ABBs from older ABBs by their softer bodies, a more shiny appearance, and the pronotum appears more orange (less red) and lighter in hue (**Figure 3**). Older ABB’s pronotum appears red rather than orange, are deeper in hue, are often missing body parts (especially legs or antennae), and their mandibles appear more worn at the tip. Surveyors must record the ages of ABBs as old, young, or unknown, on all data forms. It is also important to consider the time of year when assessing age. More mature ABBs will emerge earlier in the season while there may be higher numbers of younger ABBs captured later in the season.

## Reporting Procedures

Surveyors should collect the necessary precipitation, temperature, and wind information from the weather station closest to the survey site, which can be found at

<http://www.wunderground.com/history/> (or other appropriate weather-reporting website, such as a Mesonet site that would provide the required data). Surveyors must record this information on the “*ABB Survey Data Collection Form*” and include the total number of valid nights surveyed on the “*ABB Survey Summary Report*” (Appendix B).

To automatically find the closest weather station:

- From the homepage, hover over the Weather tab and click on the bold Weather History heading.
- Enter the closest town to the survey site and the date of the survey into the drop down menus. Remember that the valid hours of a survey are from 9:00 p.m. to 4:00 a.m. This requires the surveyor to review the weather data for two consecutive days for each night of survey effort (i.e., the night of the 3<sup>rd</sup> and morning of the 4<sup>th</sup> to determine if the survey effort for the 4<sup>th</sup> is valid).
- The weather data for the day selected will display at the top of the page. Scroll down this page to view the hourly weather data.
- If the weather station that Weather Underground takes you to does not contain all the necessary information, you will need to search for a personal weather station using the Personal Weather Station (PWS) option in Weather Underground.

To locate the closest Personal Weather Station in Weather Underground:

- Type <http://www.wunderground.com/weatherstation/setup.asp> in your web browser.
- Under the PWS network box on the right side of the page, select Oklahoma from the “select a state” drop down box.
- Review the list of weather stations and select the closest **reputable** weather station to your survey site (i.e., city hall, hospital, emergency management center).
- Enter the date into the drop down box and click view.
- Ensure that the weather station contains all the required data to validate the survey effort.

## 2-inch Fractional Water Index

Surveyors should document and record on the “*ABB Survey Data Collection Form*” and “*ABB Survey Summary Report*” the 2-inch fractional water index using the closest Mesonet station ([http://www.mesonet.org/index.php/weather/daily\\_data\\_retrieval](http://www.mesonet.org/index.php/weather/daily_data_retrieval)) to your trap locations. Per the Mesonet: “The Daily Averaged Fractional Water Index at 2 inches [provides] the 24-hour-averaged soil moisture at 2 inches (5 cm) under native sod for the previous day. Fractional water index ranges from 0 (completely dry) to 1.0 (completely saturated) ... updated once each day between 7 and 8 a.m.” The Service is using this information to help identify abiotic components associated with ABB abundance.

### Location Data

At each trap, a GPS location (in decimal degrees, NAD 83) and digital photograph (JPEG format) must be taken to document the location of the trap and the general habitat characteristics of the trap site. The purpose of these photographs is to establish the site characteristics of the trapping site and to ensure traps are set in favorable ABB habitat.

### Submission

For each survey effort, surveyors should complete an “*ABB Survey Data Collection Form*” (Appendix A), an “*ABB Survey Summary Report*” (Appendix B), and a digital photo of each emplaced trap. Surveyors should electronically submit Appendix B (“*ABB Survey Summary Report*”) and the digital photographs to ***ABBContact@fws.gov*** for **every** survey conducted. Surveyors should submit Appendix B in Excel format only. Surveyors may decide whether to submit the “*ABB Survey Data Collection Forms*” either electronically or by mail. If surveyors choose to submit the data forms electronically, they should do so as one pdf file. Surveyors must ensure all reports are **accurate** and **complete**. The Service will consider incomplete and/or inaccurate submissions as invalid. When sending corrected forms, surveyors should indicate on the form that it is a corrected form, the project name, and identify each specific correction.

Permittees must submit their results within 30 days of the survey effort, but the Service will no longer issue letters of validation (hard copy or e-mail) for surveys. It is the project proponent and surveyor’s responsibility to ensure that the surveys are conducted in accordance with this protocol and cover all potential ABB habitats within a project area. The Service will, however, periodically spot check submitted surveys for accuracy and review all surveys that are part of a submitted Project Review Package (as part of the Endangered Species Act Consultation or Technical Assistance process). When submitting a Project Review Package, project proponents should include the digital photos, as well as appendices A and B as part of their consultation package.

Specific data entry criteria are required to maintain functionality of the Service’s ABB database. All names of companies, months, locations, soil types, plant species, persons, etc. are to be spelled out, no abbreviations (i.e., May instead of 5, Joe Smith instead of J. Smith, with no punctuation (i.e., Joe L Smith instead of Joe L. Smith). Report all latitude and longitude data in decimal degrees with NAD 83 coordinate system/projection. Longitude should have a negative sign preceding the number. Do not include the N or W with the latitude or longitude number. Each survey should have a specific and individual name to distinguish it from other surveys (e.g., Acme oil well 14). Specific and individual survey report identifiers are necessary to ensure the proper survey is referenced when the Service responds to a survey effort, if questions arise, or if the survey is for a specific project. Specify the project proponent and their project name in the ABB survey report and any other correspondence submitted to the Service (Acme Company, XYZ pipeline). The project proponent is the company that is ultimately responsible for the project, not just the consulting firm that may have hired you to perform these surveys.

### Accidental Death of ABBs

Surveyors must record all mortalities of ABBs on the “*ABB Accidental Death Form*” (Appendix F). Surveyors must submit this form electronically within two (2) calendar days of collection via email to [abbcontact@fws.gov](mailto:abbcontact@fws.gov). Surveyors must also submit the hardcopy “*ABB Accidental Death Form*” with their annual permittee report.

Surveyors should put any dead specimens on ice until they can be prepared for submission. When storing and submitting dead specimens, surveyors will preserve all ABB mortalities in 70-90% ethanol (preferable; better) or 70% Isopropyl (rubbing alcohol; easier) rather than preserving as dried specimens. Mortalities thus preserved should then be stored in a freezer until delivered to the Service or Service-approved facility. This will allow the specimens to be scientifically useful. Each specimen must have a unique alphanumeric name assigned by the surveyor and included inside each container to ensure future identification. This alphanumeric name should be the first letter of the first two (2) words of the permittee company or individual (e.g., Acme Company, first dead ABB = AC001). Additionally, a label must accompany the specimen and include: the date the ABB was found dead, permittee, legal description of where the beetle was found (down to quarter section at least), and a latitude and longitude coordinate in decimal degrees; NAD 83.

Surveyors should deliver dead specimens, along with a hardcopy of the “*ABB Accidental Death Form*” (Appendix F) to the Service or a Service-approved facility. The Oklahoma Ecological Services Field Office will provide recommendations as to which facility or facilities would be acceptable for deposits.

### Protocols and Forms

All forms (including the ABB survey guidance appendices listed below) are located on the Oklahoma Ecological Services Field Office’s website  
[http://www.fws.gov/southwest/es/Oklahoma/ABB\\_Add\\_Info.htm](http://www.fws.gov/southwest/es/Oklahoma/ABB_Add_Info.htm).

### **ABB Survey Guidance Attachments**

Survey Guidance Appendix A- ABB Survey Data Collection Form  
Survey Guidance Appendix B- ABB Survey Summary Report  
Survey Guidance Appendix C- Leasure et al. 2012  
Survey Guidance Appendix D- Description of Nicrophorus Species  
Survey Guidance Appendix E- Dichotomous Key  
Survey Guidance Appendix F- ABB Accidental Death Form

### **Other Federal and/or State Requirements**

Surveyors need a state permit to conduct surveys for the ABB in Oklahoma. Contact the Oklahoma Department of Wildlife Conservation for more information.

## **Conclusion**

The Service appreciates compliance with this protocol and associated reporting. The reports enable the Service to monitor the status of the ABB. However, these surveys also provide the necessary information for companies to avoid impacts to ABBs from project implementation. Additionally, maintaining a survey database provides data that can be utilized by the public during project planning.

## **Note**

This document is based on the best scientific and commercial data available at the time of its development. The OKESFO updates this survey protocol as necessary due to new findings.

To ensure you have the most recent version, go to\_

**[http://www.fws.gov/southwest/es/oklahoma/ABB Add Info.htm](http://www.fws.gov/southwest/es/oklahoma/ABB_Add_Info.htm)**

## References

- Bedick, J.C., 1997. Distribution and ecology of the American burying beetle (*Nicrophorus americanus* Oliver) in south-central Nebraska. Master's Thesis, University of Nebraska, Lincoln. 94 pp.
- Bedick, J.C., Brett C. Ratcliffe, W. Wyatt Hoback, and Leon G. Higley. 1999. Distribution, ecology and population dynamics of the American burying beetle *Nicrophorus americanus* Olivier (Coleoptera, Silphidae) in South-central Nebraska, USA. *Journal of Insect Conservation* 3(3): 171-181.
- Bedick, J.C., B.C. Ratcliffe, and L.G. Higley. 2004. A new sampling protocol for the endangered American burying beetle, *Nicrophorus americanus* Olivier (Coleoptera, Silphidae). *The Coleopterists Bull.* 58: 57-70.
- Butler, S. R., R. Harms, K. Farnsworth-Hoback, K. Koupal, J. Jurzenski, W. Hoback. 2012. Standardized capture rates of the endangered American burying beetle, *Nicrophorus americanus* Olivier (Coleoptera: Silphidae) using different trap protocols. *Journal of Insect Conservation*. DOI 10.1007/s10841-012-9545-5.
- Creighton, J.C. and G. Schnell. 1998. Short-term movement patterns of the endangered American burying beetle *Nicrophorus americanus*. *Biological Conservation* 86: 281-287.
- Kozol, A.J. 1990. Suggested survey protocol for *Nicrophorus americanus*, the American burying beetle. Unpublished report.
- Kozol, A.J. 1991. Annual monitoring of the American burying beetle on Block Island. Unpublished report to The Nature Conservancy, 294 Washington Street, Boston, MA. 15 pp.
- Kozol, A.J. 1992. A guide to rearing the American burying beetle, *Nicrophorus americanus*, in Captivity. Department of Biology, Boston University. Unpublished Report to U.S. Fish and Wildlife Service, Concord, New Hampshire. P.O. No. 53410-1-5486.
- Leasure, D.R., D.M. Rupe, E.A. Phillips, D.R. Opine, and G.R. Huxel. 2012. Efficient new above-ground bucket traps produce comparable data to that of standard transects for the endangered American burying beetle, *Nicrophorus americanus* Olivier (Coleoptera: Silphidae). *The Coleopterists Bulletin.* 66: 209-218.
- Mesonet. 2013. Past data and files. Available on-line at [http://www.mesonet.org/index.php/weather/daily\\_data\\_retrieval](http://www.mesonet.org/index.php/weather/daily_data_retrieval). Accessed October 22, 2013.
- Schnell, G.D. and A.H. Hiott. 1995. 1995 Annual report of trapping and relocation activities concerning the endangered American burying beetle (*Nicrophorus americanus*). Sam Noble Oklahoma Museum of Natural History, University of Oklahoma. Unpublished.
- Schnell, G.D., and A.H. Hiott. 2003. 2003 Annual report of trapping and relocation activities

concerning the endangered American burying beetle (*Nicrophorus americanus*). Sam Noble Oklahoma Museum of Natural History, University of Oklahoma. Unpublished.

Hoback, W.W. 2011. Summary of August 2011 American Burying Beetle Trap and Relocate Efforts in Nebraska, Keystone XL Pipeline Project - Steele City Segment. Unpublished