



# United States Department of the Interior

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## **American Burying Beetle (*Nicrophorus americanus*) Range-wide Presence/Absence Survey Guidance**

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### **INTRODUCTION**

This document provides guidance for designing and conducting live-trapping presence/absence surveys for the endangered American burying beetle (*Nicrophorus americanus*; ABB). This guidance replaces any previous U.S. Fish and Wildlife Service (Service) recommended ABB survey guidance. Presence/absence surveys may only be conducted by individuals possessing a valid Federal Fish & Wildlife Permit (Recovery Permit) for scientific research and recovery of the ABB, as defined under section 10(a)(1)(A) of the Endangered Species Act (ESA). Section 10(a)(1)(A) permits require all other necessary permits (*e.g.*, state, county, tribal) be obtained for the federal recovery permit to be valid. Surveyors should contact respective state resource agencies to determine if other guidelines apply and if any state permits are required. Additional permits and/or authorizations may also be required for surveying on lands managed by federal, state, or tribal agencies.

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

Section 10(a)(1)(A) (Research and Recovery) permits require possession of any other necessary permits (*e.g.*, state, county, tribal) for the federal permit to be valid. Surveyors should contact respective state resource agencies to determine if other guidelines apply and state permits are required. Additional permits and/or authorizations may also be required for surveying on lands managed by other agencies.

Responsibility lies with the surveyor to ensure surveys are conducted in accordance with this protocol and trapping efforts cover all potential ABB habitats within a project area. For surveys to be considered valid, surveyors must adhere to the protocols outlined within this document. If upon review of a proposed project package for which survey documentation is submitted and the Service determines a survey to be invalid, the package will be returned to the project proponent as incomplete. The package should be resubmitted to the Service once a valid survey is obtained. Project proponents should contact the Ecological Services Field Office in their state, or utilize that office's guidance, when assuming presence of ABBs within their project area. Refer to Appendix J for contact information specific to each Ecological Services Field Office.

This guidance is based on the most current scientific information available and is consistent with current knowledge of ABB movement patterns. The guidance will be updated as new information

becomes available. Please contact the appropriate State Ecological Services Field Office for any updates to this guidance prior to the initiation of ABB surveys each year. 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).

## **Definitions**

Biological timeframes:

Active period - the time of year when ABBs have emerged from overwintering and are actively seeking carcasses for feeding, and breeding.

Inactive period - the time of year when ABBs are below ground, overwintering and are not actively seeking carcasses for feeding and/or breeding.

Brood-rearing period – the time of year during the active period when ABBs are underground raising their young.

Survey timeframes:

Survey period – nightly trapping timeframe between 9 p.m. and 4 a.m.

Active season - the time of year during the ABB active period when surveys should be conducted to be considered valid.

Early season - the early trapping season is the time when ABBs are actively seeking carcasses, but before the young-of-year have emerged. In southern portion of the ABB range, the early season begins according to established weather criteria, and ends July 28. (See SEASONAL PARAMETERS, p. 3.)

Late season - the late trapping season is the time when most ABBs have completed brood-rearing and the young-of-year have likely emerged. In the southern portion of the ABB range, the late season begins July 29 and ends according to established weather criteria. (See SEASONAL PARAMETERS, p. 3.)

Valid survey a survey conducted during the most recent active season that meets all weather parameters, siting criteria, suitable habitat conditions and ensures all components of this guidance have been met.

This guidance addresses both the Southern and Northern portions of the currently occupied ABB range in the Midwest. States included in the Southern portion of the range include Arkansas, Kansas, Missouri, Oklahoma, and Texas. States included in the Northern portion of the range include Nebraska and South Dakota. The American burying beetle is also found in New England (Block and Nantucket Islands). Please contact the New England Ecological Services Field Office for survey guidance in Massachusetts and Rhode Island.

Trap sites should be located within the center of the area of interest, and within suitable habitat. All suitable habitat that could be impacted within a proposed project area should be surveyed. Because of the life history of the ABB, surveys are valid for only a short period of time, and are dependent on weather conditions within the area of interest, and whether they occur within the Northern or Southern portion of the occupied range. Therefore some of following guidance components are separated out

between Northern and Southern portions of the occupied range for better understanding of these differences in trapping protocols. Additionally, old surveys from previous years will be considered invalid for purposes of determining occupancy of an area once the new active season has commenced.

## **AREAS UNFAVORABLE FOR ABB**

The following 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 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.
2. Land that has already been developed and no longer exhibits surficial soils, topsoil, leaf litter, or vegetation.
3. Urban areas with maintained lawns, paved surfaces, or roadways.
4. Stockpiled soil without vegetation.
5. Wetlands with standing water or saturated soils (defined as sites exhibiting hydric-soils, vegetation typical of saturated soils, and/or wetland hydrology).
6. Pasture or grassland that has been maintained at a height of 8 inches (20 cm) or less through frequent mowing, grazing, or herbicide application.

NOTES: In both the Northern and Southern areas, locations adjacent to wetlands and/or riparian areas (such as sub-irrigated wet meadows) could be suitable for the ABB, as these areas may be important to ABBs seeking moist soils during dry conditions. In lab conditions, American burying beetles have been shown to seek out the moistest soils available (Hoback 2008).

## **SEASONAL PARAMETERS**

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

A valid survey must occur during the ABB active season and conform to all required weather parameters, as identified in this guidance. Surveyors should collect the necessary temperature information from data loggers and/or the weather station closest to the survey site (see more information in the *Reporting Procedures* section below) before making a decision to deploy traps.

### Northern portions of ABB range – Nebraska and South Dakota

In the Northern range, the Service considers the ABB active season to begin following five consecutive nights when temperatures at midnight are 55° Fahrenheit (F)/12.7° Celsius (C), or greater. Surveys should not be conducted during the average brood-rearing period (July 1-August 7) when most ABBs are underground and trapping results are more likely to produce false negative results. Alternatively, ABB survey results collected during the average brood rearing period may be accepted if control traps reveal teneral beetles are above ground before August 7 (control traps are explained further below.) Teneral beetles are beetles that have newly emerged from the pupal case. For results to be accepted, however, the surveyor will need to document that the ABB active season began earlier in May than normal due to an early summer.

*Control Traps (Northern Portion Only)* - A positive control trap must be used in association with ABB surveys in the Northern portions of the ABB range. A positive control establishes

that conditions were appropriate in a given geographic area and that ABBs were active during the time frame of the trapping. Only one ABB capture is necessary to establish a positive control. The positive control window may be up to seven days prior to trapping, during trapping, but not after the trapping time frame. Positive control trapping should be done in areas with a recent history of populations documented through regular research or survey work. Contact the appropriate State Ecological Services Field Office to determine if a positive control is required.

Surveys may continue in the Northern range until the midnight temperature falls below 55° F (12.7° C) for three consecutive nights.

Surveyors are encouraged to contact the appropriate State Ecological Services Field Office prior to conducting any ABB surveys to determine the locations and circumstances in which surveys are necessary and any site specific survey recommendations.

#### Southern portions of ABB range – Arkansas, Kansas, Missouri, Oklahoma, Texas

In the Southern range, the Service considers the ABB active season to begin following five consecutive nights of minimum nightly temperatures at 60° F (15.5° C), or greater (Bedick 1997, Kozol 1991, Service 1991). Surveys may continue in the Southern range until the third night following August 31 on which the minimum temperature falls below 60° F (15.5° C).

Breeding activity in the ABB tends to be asynchronous in the Southern portion of the range where brood rearing is not as temporally constrained by weather conditions (*i.e.*, longer, more variable active season). For this reason, surveys in the Southern portions of the range may be conducted at any time during the ABB active season without necessary avoidance of the brood-rearing period, or implementing a control trap as required in Nebraska and South Dakota.

#### **Timeframe Survey Results are Considered Valid**

American burying beetle density is cyclical and thus, can vary annually, but also can vary within the same active season. Additionally, other circumstances (*e.g.*, flooding, drought) can alter ABB density beyond that expected due to normal population fluctuation. As a result, in both the Southern and Northern portions of the ABB's range, surveys performed later in the active season have documented ABB presence in areas where earlier active season surveys were negative, and vice-versa. Additionally, Northern population emergence and brood-rearing are synchronized while in the Southern populations they are not. Surveys conducted after the summer brood rearing period when teneral have completed emergence more accurately represent the presence or absence of teneral ABBs prior to overwintering. Owing to these differences, some timing adjustments to trapping protocols between the Northern and Southern areas is required. Some surveys conducted for ABBs are valid only for the active season when the survey was completed, while others are valid until the end of that active season.

#### Northern portions of ABB range – Nebraska and South Dakota

In the Northern portion of the range, all survey results are considered valid until the start of the next spring active season. This provides for obtaining a valid survey that can inform occupancy of an area during the ABB's overwintering inactive period.

Southern portion of ABB range – Arkansas, Kansas, Missouri, Oklahoma, Texas

In the Southern portion of the range, surveys completed through July 28 of the current year are valid through the end of that active season. Surveys completed after July 28 will be valid until the start of the next spring active season.

Following metamorphosis from larva to adult, teneral beetles will typically emerge from underground in mid- through late-summer. However, in Oklahoma teneral emergence has been documented as early as late spring (May). The timing of emergence varies based on latitude and weather conditions.. Teneral beetles typically will overwinter as adults and comprise the breeding population the following spring and summer (Kozol 1990). American burying beetles usually live only for one year and all overwintering ABBs are believed to be that summer's brood.

Positive Results within an Active Season

For both the Northern and Southern areas, when there are multiple valid surveys within the same effective area (see Trap and Spacing Placement below) and during the same active season (See Time of Year for Surveys, p. 3), positive survey results (presence of an ABB) take precedence over negative survey results. Within the Southern portion of the ABB range, a positive survey takes precedence within the active season, but because early season surveys (before or on July 28<sup>th</sup>) expire at the end of the active season, the results of late season surveys (conducted after July 28<sup>th</sup>) will have precedence from the end of that active season until the beginning of the next active season.

For example in the Southern range, if a survey is performed with positive results before July 28<sup>th</sup> (early season) and another is performed after July 28<sup>th</sup> (late season) with negative results, the positive survey would determine presence within the area of interest until the end of the active season. The late season surveys would be considered valid only during the following inactive period and until the beginning of the next active season.

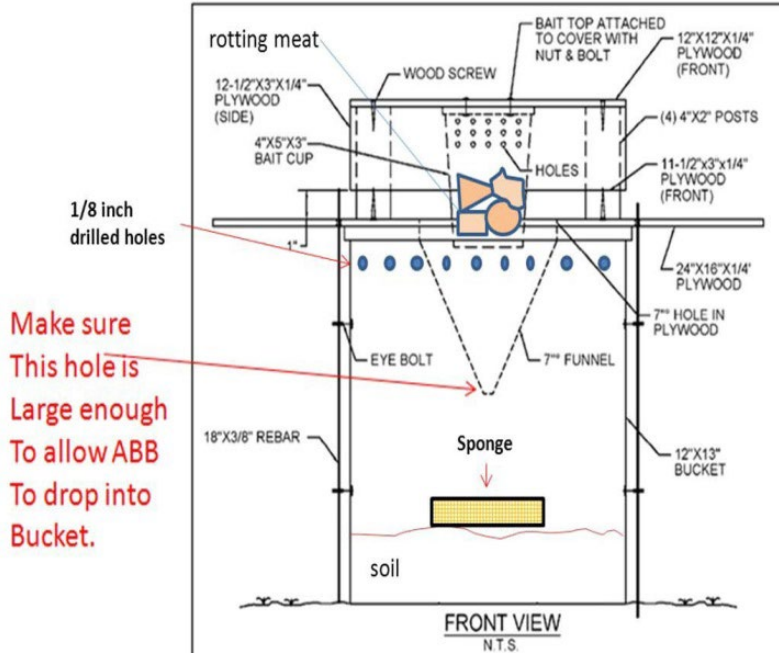
**TRAP DESIGN****General**

The Service prefers surveyors to use a 5-gallon (18.92-liter) bucket-style trap when conducting ABB presence/absence surveys. Traps must, have smooth sides, and be free of any texture or ridges that may allow ABBs to climb out of the trap. 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 buried as a pitfall trap, as described below. Above-ground bucket traps are typically used when soil is rocky and is difficult to dig. However above-ground traps also may be used in areas where rocky soils are not prevalent. Check with the appropriate State Ecological Services Field Office for guidance on the use of above-ground bucket traps versus below-ground pitfall traps for ABB surveys.

**Above-ground Bucket Trap**

See Appendix C (Leasure *et al.* 2012) for instructions, materials, figures and schematics of a typical above-ground bucket trap. Above-ground buckets must be **light in color** to help moderate high

temperatures. When selecting a funnel for the trap, the small end of the funnel MUST be large enough to allow the largest ABBs to fall through into the bucket (approximately 2.16 in (55 mm in diameter). If the opening in the small end of the funnel is not large enough, you may need to cut it off to make the hole larger (Figure 2). Surveyors should drill additional 1/8 inch (3.2 mm) diameter holes around the top edge of the bucket (Figure 2) to allow air circulation through the bucket.



**Figure 2.** Modified form of above-ground bucket trap (pictured) from Leasure *et al.* (2012) using soil and sponge in the bottom of the bucket. This design allows beetles to find refuge from other congeners, provides moisture to reduce the risk of desiccation, and reduces stress to ABBs.

### Pitfall Bucket Trap

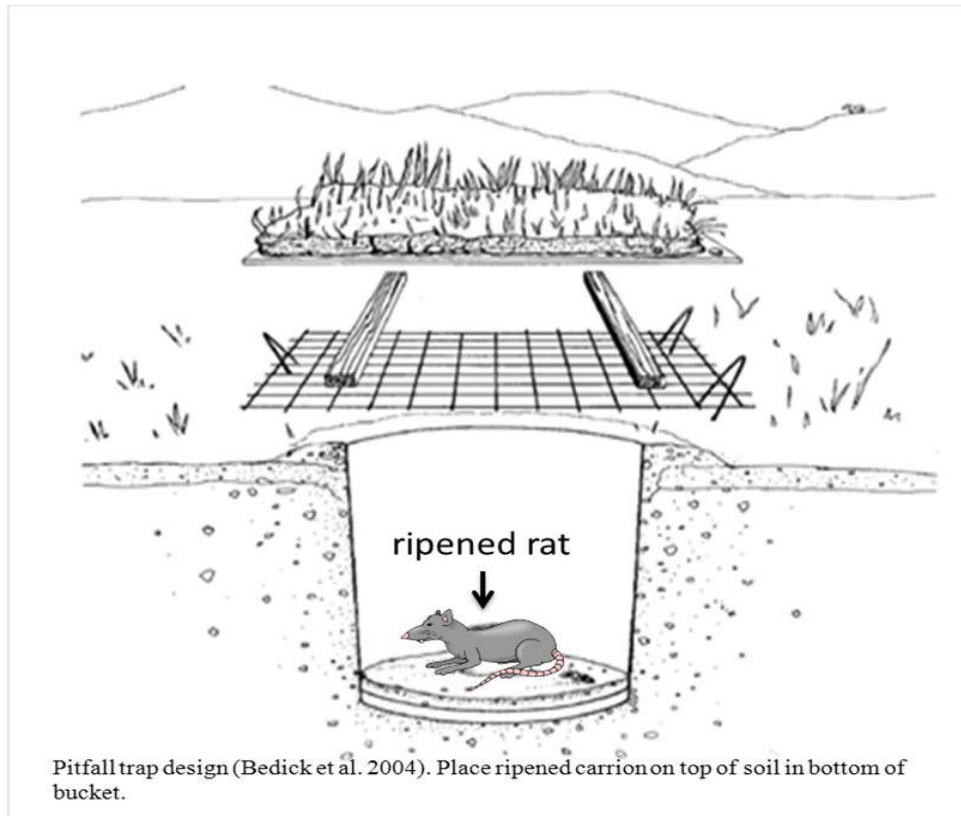
The pitfall bucket trap design follows Bedick *et al.* (2004), although refinements and modifications have been made to the trap design to provide for better performance and safety, such as allowing ABB access to bait within the trap to decrease competition and provide moisture for captured beetles. Holes allowing air circulation do not need to be provided for pitfall traps. Pitfall bucket color is inconsequential because traps will be under-ground.

A schematic of the improved design is pictured in Figure 3. The following is a general list of items needed to build these pitfall traps.

#### Materials

1. Two 5-gallon (18.92 liter) buckets with a diameter of 11.2 in (28.5 cm) or greater
2. Piece of plywood at least 4 in (10.2 cm) wider than diameter of bucket
3. Piece of wire mesh or hardware cloth (1 in ( $\geq 2.5$  cm) mesh size) to allow ABB to enter but still exclude scavengers
4. Four garden staples or stakes
5. Two 1-in by 1-in (2.5 cm by 2.5 cm) wooden strips large enough to hold the cover off the bucket

## 6. Shovel or ground auger



**Figure 3.** Pitfall trap design typically used when soil is sand or loamy and can be easily dug (based on Bedick *et al.* 2004)

Dig a hole approximately the size the bucket. Place the bucket in the hole then place the second bucket inside of the first bucket. The rim of the bucket should be 2-3 inches (5-8 cm) above ground level and a berm of soil built up to the rim of the bucket to form a gradient from ground level upwards to the rim for ABBs to access the bucket. The higher level is necessary to prevent runoff from entering the survey buckets, flooding the bucket, and drowning ABBs or other insects. Place approximately 2-3 inches (5-8 cm) of moist soil in the bottom of the inside bucket to give trapped carrion beetles room to burrow into the soil to avoid competitors, high temperatures, and low moisture levels.

If using a pitfall 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 3. Place the wire mesh over the buckets and secure in place with the garden staples or stakes to help exclude vertebrate scavengers. The piece of wire mesh should allow ABBs access to the trap, but prevent larger animals from accessing the bait.

Lay the 1-in x 1-in wooden strips over the wire mesh and place a hard cover on top of the wooden strips.

Place additional weight (plug of sod from bucket excavation, soil, rocks, etc.) on top of the trap cover to reduce bait loss to vertebrate scavengers and to prevent wind or small animals from dislodging the

cover, as depicted in Figure 3.

## TRAP DEPLOYMENT

A cover is necessary to deter scavenger access to the trap, prevent rainfall from entering the trap, and provide shade to captured insects to inhibit desiccation. The cover 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.

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. Often trapping occurs along public road rights-of-way—do not place traps in the bottom of ditches where water could inundate the trap and drown ABBs and other insects. Close traps if high winds or severe thunderstorms are predicted for the survey area.

### Minimum Survey Effort (Temporal Scale)

To accurately determine presence/absence of ABBs, surveyors should set traps for a minimum of **five consecutive nights**. Surveys conducted over five consecutive nights will reduce the potential for false negatives (Bedick *et al.* 2004, Hoback 2011 unpublished, Butler *et al.* 2012). Additional trapping effort may be required if weather conditions, disturbed traps, or missing bait invalidate survey results. See “Weather Requirements” section below for additional information about timing of surveys with invalid nights.

### **Weather Requirements or Disturbed Traps/bait**

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 when:

1. Nighttime temperature during the survey period falls below 55° F (12.7° C) in the Northern portion of range (based on midnight temperature), or below 60° F (15.5 C) in the Southern portion of the range (based on minimum temperature),
2. Wind speed is greater than 10 mph in excess of 20% of the time (1 hour 24 minutes) between 9:00 p.m. and 4:00 a.m.,
3. Precipitation exceeds 0.5 inches between 9:00 p.m. and 4:00 a.m., or
4. Surveys are interrupted by 3 consecutive nights of unsuitable weather conditions, disturbed traps, or a combination of both.

Minimum survey effort shall include five consecutive nights of suitable weather conditions and undisturbed traps. Surveyors should collect the necessary precipitation, temperature, humidity, 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 or disturbed traps invalidate 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 valid nights of sampling, unless surveys are interrupted by three or more cumulative nights of unsuitable weather, disturbed traps, or a combination of both.

Record which survey nights did not meet trapping requirements on the “*ABB Survey Data Collection*



*Form*” (Appendix A) and the total number of nights with unsuitable weather conditions, and/or disturbed traps on the “*ABB Survey Summary Report*” (Appendix B). For submissions to the Oklahoma Ecological Services Field Office only, record this data in the “*EEC Workbook*.” The *EEC Workbook* contains all required documents in an easy to use Excel workbook format rather than having separate documents to submit. The “*EEC Workbook*” also reduces the size of email load and reduces times for Service personnel to verify and culminate survey information. Surveys with over 10 transects will require the use of multiple workbooks.

### **Trap Spacing and Placement**

The effective survey radius for each trap is 0.5 miles (0.8 km). Therefore, surveyors should space traps no more than 1.0 miles (1.6 km) apart to achieve adequate survey results. The Service determined this effective survey radius based on ABB mobility, size, recorded movement distances, and the distance from which ABBs can detect carrion. Surveyors should place traps generally along the upwind edge of the survey area. In general, low elevation, mesic meadows with a thick layer of vegetation litter are more conducive to ABB capture than dry, elevated areas. Surveyors should place traps along the upwind edge of the survey area at the highest elevation possible to ensure the scent plume permeates the area of interest. Do not place traps in depressions that may hold water if rain occurs. Traps should not be placed in locations susceptible to disturbance or destruction (*i.e.*, cattle trails, areas where livestock congregate, etc.).

Exercise good judgement when placing traps. For example, do not place traps near ranch houses to reduce the risk of a dog digging up the bucket to access the bait. Avoid placing traps near stock tanks as ranchers have expressed concern about cattle avoiding watering because they detect decomposing bait.

To most accurately represent the area of interest and void bias towards one habitat type over another, traps should be placed as close as possible to the interest area’s center. If traps cannot be placed near the center, justification should be provided in the Notes section of the Survey Data Collection Forms and submitted with survey summary.

### **Baiting and Checking Traps**

Any type of carrion is suitable for use as bait, as long as it is proportional in size to the trap and produces a pungent odor 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 5 days, or until adequately aged to produce a sufficiently robust odor. Bait will ripen faster in hotter temperatures. Take care to not fill the container or bag completely full. This will allow for expansion as gas is produced as the bait ripens.

The Service recommends placing bait on top of soil in the bottom of the pitfall bucket traps with whole carcasses, hair/feathers intact. Surveyors may use ripened previously frozen, 9.7-13.2 ounce (275-374 gram) laboratory rats (*Rattus norvegicus*) as bait (available from pet stores and online dealers). Rats are preferred, but if rats are not available, bait items of comparable size and structure may be used. Additionally, if using the above-ground 5-gallon bucket, surveyors should utilize the bait cup attached to the lid to ensure the pungent odor of carrion is effectively dispersed. This bait need not be a whole carcass and may consist of aged pieces with neither skin nor hair.

Setting and baiting traps consists of:

1. Wash all buckets with bleach and thoroughly rinse with water prior to each survey effort.
2. Secure the bucket in or on the ground.
3. Place approximately 1-2 in (2.5 to 5.1 cm) 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.
4. Place a wetted sponge and/or soil in the bottom of the 5-gallon bucket. The rotting carcass in below- and above-ground traps also releases moisture during decomposition providing soil moisture.
5. If you are using a pitfall trap, place the carcass on top of the soil in the bottom of the trap. If the 5-gallon above-ground bucket trap is used, surveyors must place bait in a perforated bait cup attached to the lid and may place additional bait in the bottom on top of the soil layer.
6. When checking traps, care must be taken to ensure no ABB remain inside the bait (*e.g.*, whole carcass), especially if the bait is removed from the trap. During trapping efforts, surveyors must replace any bait that has dried out, is full of maggots, and/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. Leave old bait in the pitfall trap (unless excessive maggots are present) and supplement with new prepared bait.
7. Secure the tops of the traps to ensure predators do not have access to the contents of the bucket.
8. All traps must be in place and baited by dusk each night.

Exposure to full sunlight and temperatures over 77° F (25° C) even for a few hours, can result in mortality (Kozol 1990, Service 1991, Kozol 1992). Traps must be checked no later than **10:00 a.m. daily in the Southern portion** of the range and by **12 p.m. in the Northern portion** of the range to minimize any temperature-related mortality. On days of extreme heat, checking traps prior to these times may be necessary to avoid 77° F even in the Northern portion of the range. Delay in checking ABB traps exposes captured ABBs and other insects to heat stress and mortality. 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.

Checking traps consists of:

1. Record and release all *Nicrophorus* and Silphidae species.
2. Replace any missing or dry bait and moisten the sponge.
3. Replace/repair any disturbed parts of the trap.
4. Return the bait to the trap after recording all *Nicrophorus* and Silphidae species.
5. Replace the cover.

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. All ABBs held for observation should be placed in ventilated containers and kept out of direct sun in a cool, shaded location. Process any dead ABBs as described below under “*Accidental Death of ABBs.*”

## Ant Colonies

Surveyors should survey area for presence of ant colonies to ensure traps are not placed within 23 ft (7 m) of any ant colonies. If ants are in a trap, the surveyor should relocate the trap at least 23 ft away.

### Trap site reclamation

Once the survey is complete, always backfill the hole that was excavated for the bucket trap and remove any marking placed to indicate the presence of a trap (*i.e.*, any and all flagging). Return the trapping area to the state that you found it to avoid concerns by the public.

## PROCESSING CAPTURES

### Identification and processing of *Nicrophorus* Species

Components of a completed survey package may vary between field offices, but, at a minimum, will include the daily field data sheets, the electronic summary sheet, and weather data. The State Ecological Services Field Office may require photographs of each ABB captured if deemed necessary and feasible, as is the case in Oklahoma. This is not the case in Nebraska where carrion beetles are so abundant that photographing each individual is not feasible. Only complete survey packages will be accepted. The Service prefers information submitted via electronic media. If the “*ABB Survey Data Collection Form*” (Appendix A) is sent by U.S. mail, then all accompanying information, including the accompanying “*ABB Survey Summary Report*” (Appendix B) must also be submitted by U.S. mail at this time so all data and summaries are received together in the respective field offices. This can be accomplished by mailing a compact disk, thumb drive or similar media containing the required information.

For surveys in Oklahoma, the Oklahoma Ecological Services Field Office prefers the use of the automated “*EEC Workbook*” for data collection and submission of ABB surveys. The “*EEC Workbook*” is available on the ABB webpage at [http://www.fws.gov/southwest/es/oklahoma/ABB\\_Add\\_Info.htm](http://www.fws.gov/southwest/es/oklahoma/ABB_Add_Info.htm). This workbook captures the daily survey data, and automatically transfers the pertinent data to the Survey Summary Report that is also found within the workbook. Weather data, pictures, and any other trapping data can then be added to various tabs within the same workbook for submission. If more than 10 traps (transects) are deployed in a single survey project, additional *EEC Workbooks* with sequential trap numbers should be created for each 10-trap workbook, with all workbooks being submitted 30 days after survey completion.

Surveyors must identify and record all Silphidae species captured. Appendix D provides descriptions of the *Nicrophorus* species and Appendix E provides a dichotomous key. These appendices also are available from the ABB webpage mentioned previously.

Processing ABBs includes collecting data on gender determination, age determination, pronotal width (if required by State field office), marking (if authorized,) and data recording of all captured ABBs. Surveyors must record all information on the “*ABB Survey Data Collection Form*” (Appendix A) For submissions to the Oklahoma office this information will be recorded within the “*EEC Workbook*.” Check with your State Ecological Services Office for which forms are required in your area.

Photographs, if required, should have the highest resolution possible. Photos of ABB should show the ABB on top of grid paper, inside a transparent container, such as a Petri dish. Photos should be

taken from directly above the subject, and the size (gauge) of the grid should be indicated (*e.g.* ¼ inch, 10mm, etc.). Add photos in a separate tab to the “*EEC Workbook*,” and submit as part of the complete survey package. Photographic images taken in the field on a piece of reference grid paper can be analyzed using freeware such as ImageJ (<http://imagej.nih.gov/ij/>) as long as the gauge-size of the grid is specified.

American burying beetles are sensitive to prolonged heat exposure. Surveyors must not 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 or moistened paper towels and store the containers in an ice cooler until processing commences. The plastic containers should be stored away from direct sunlight.

Surveyors should not mark (clipping of elytra, adhesion of bee tags, painting) ABBs in any way unless approved by the Service, as indicated on issued permits. Morphometric measurements of individuals, such as pronotal width, can be measured using a caliper or via photographic images.

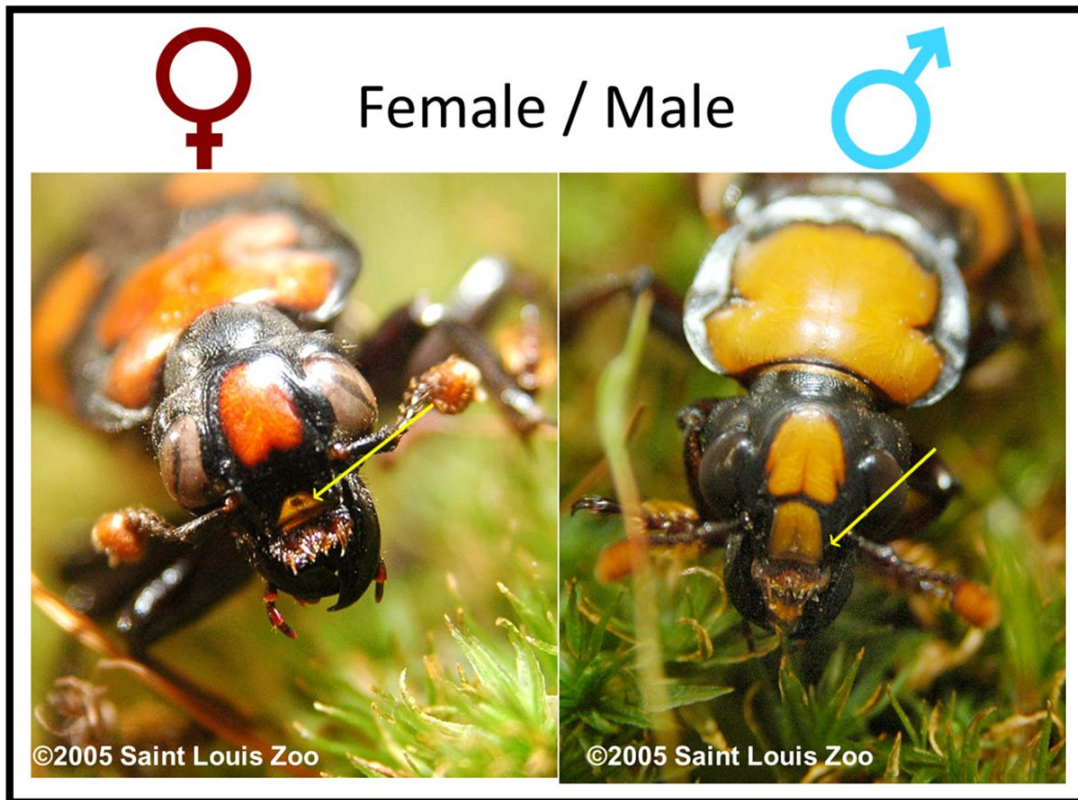
American burying beetles are to be released near (within 609 m/2000 ft) the trap site where captured, but at least 10 ft (3 m) away from foot traffic near the site, and a minimum of 500 ft (152 m) from any vehicle path to avoid trampling or crushing. To release ABBs, surveyors may excavate a small diameter hole approximately 5 inches deep in moist soil and gently place the individual ABB in the excavated hole. ABBs may be released into grass/leaf litter if litter is a minimum of 3 inches thick.

### **Age Determination**

Any ABBs pupated during the current active period are referenced as new (*i.e.*, newly emerged or teneral) and ABBs pupated the previous year are referenced as old (emerged the previous active period and overwintered as adults). Surveyors can distinguish newly emerged ABBs from older ABBs by their softer bodies, more shiny appearance, and a pronotum that appears more orange (less red) and lighter in hue (Figure 4). If soft-bodied teneral beetles are identified during surveying, make a note in the comments area on the “*ABB Survey Data Collection Form*” (Appendix A) and include with the “*ABB Survey Summary Report*” (Appendix B) or in the “*EEC Workbook*.” Older ABBs have a red rather than orange pronotum, are deeper in hue, are often missing body parts (especially legs or antennae), and 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 important to consider the time of year when assessing age. More mature ABBs will emerge earlier in the active season while there may be higher numbers of younger ABBs captured later.

### **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 4). Surveyors must record ABB gender on the “*ABB Survey Data Collection Form*” or record all within the “*EEC Workbook*.”



**Figure 4.** Distinguishing female from male ABB, and old from new cohorts. Color variations are not indicative of male vs female, but can be seen within the species. The female (left) is darker in hue and appears more red - consistent with an older adult's senescent coloring. The male (right) is lighter in hue and appears more orange - consistent with characteristics of a teneral adult.

## REPORTING PROCEDURES

Surveyors should collect the necessary precipitation, temperature, humidity, 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). 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). If uncertain regarding acceptable weather stations, contact your state field office. Local temperatures during the survey should be collected using an on-site data logger. Print out and submit all data logger information along with information from the weather reporting website and submit data with survey results. 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); or record all within the “*EEC Workbook*.”

## Location Data

Surveyors should document the GPS location (decimal degrees, NAD 83,) legal description of each trap, and note the general habitat characteristics of the trap site. Habitat notes whether the area is disturbed or native, woodland or grassland, and then note any other component of the landscape with potential to affect the trapability of ABB within the survey radius.

## Additional Information

For those who train others in their organization to survey for ABB, the trainer will need to indicate on each of the daily data forms who was in attendance. This creates a record of how long they were in the field, whether or not an ABB was captured, and if the trainee was present for placement, recovery of the traps and trap site reclamation. The comment/notes line on the daily data sheets is for extraneous information such as this. Add any relevant information to this line. (e.g., field hands attending, any conditions that could have impacted your survey, weather anomalies, invasive species, the presence of cattle, etc.).

## Survey Submission

For each survey effort, surveyors should complete an “*ABB Survey Data Collection Form*” (Appendix A), an “*ABB Survey Summary Report*” (Appendix B), and if required by the State Ecological Services Field Office, a digital photo of each ABB captured. Surveyors should electronically submit Appendix B (“*ABB Survey Summary Report*”) and the digital photographs (if required) to the State Ecological Services Field Office and to [abbcontact@fws.gov](mailto:abbcontact@fws.gov) for every survey conducted (even if no ABBs were captured). Survey reports may also be required in association with state permits and should be submitted to the appropriate state agencies by the surveyor. Surveyors should submit Appendix B in Excel format only. Surveyors may submit the “*ABB Survey Data Collection Forms*” either electronically or by mail, however, mailed forms will also need to be submitted in an electronic format. When submitting the data forms, combine all forms into a single pdf file. If sending survey information by U.S. mail, all information will be contained within one submission cover. Electronic forms and information should be placed onto a compact disk, for mailing. 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 made. The Oklahoma Ecological Services Field Office requires the use of the automated “*EEC Workbook*” for survey submissions. The “*EEC Workbook*” contains all required documents in an easy to use excel workbook format rather than having separate documents to submit. The “*EEC Workbook*” also reduces the size of email load and reduces times for Service personnel to verify and culminate survey information. Surveys with over 10 transects will require the use of multiple workbooks.

Permittees must submit the results of their ABB surveys within 30 days of survey conclusion. This information is also submitted during the required end of year research and recovery permit reports [ESA section 10(a)(1)(A)] The Service reserves the right to request surveyors provide ABB survey results at any time. It is the project proponent’s and surveyor’s responsibility to ensure surveys are conducted in accordance with this protocol and the effective traps’ radii cover all potential ABB habitats within a project area. The Service will, periodically check submitted surveys for accuracy and review all surveys that are part of a submitted Project Review Package (as part of section 7 consultation or technical assistance process).

Specific data entry criteria are necessary to maintain functionality of the Service’s ABB GIS spatially explicit database. Surveyor adherence to these input rules is of great importance in allowing the public access to the beetle occurrence database in a timely manner.

1. All names (*e.g.*, companies, months, locations, soil types, plant species, and persons) should be spelled out with no abbreviations (*e.g.*, May instead of 5, Joe Smith instead of J. Smith) and no punctuation (*e.g.*, Joe L Smith instead of Joe L. Smith).
2. Latitude and longitude should be reported in decimal degrees (NAD 83). Longitude should have a negative sign preceding the number. Do not enter the directional component (“N” or “W”) within the cell.
3. Township-Range-section will be numbers only. Do **not** enter “T”, “R”, or “S” in the cell. **Do** enter directional components (*i.e.* N, S, E, W.)

Each survey should be named according to the project’s name for which the surveys are performed 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 query, if questions arise, or if the survey is for a specific project.

1. Specify the project proponent and the project name in the ABB survey report and any other correspondence submitted to the Service (*e.g.*, Acme Company, XYZ pipeline).
2. Entitle each email submission with the name of the project (*e.g.*, Acme oil well 14).

### **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 calendar days of the mortality to the State Ecological Services Field Office and [abbcontact@fws.gov](mailto:abbcontact@fws.gov). Surveyors should refer to their section 10(a)(1)(A) research and recovery permit to ensure other requirements related to notification have been met. Surveyors must 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) or 70% Isopropyl rather than preserving as dried specimens. Specimens, once preserved, should then be stored in a freezer until delivered to the Service or Service-approved facility. 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 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 (quarter section minimum), and latitude/longitude coordinates (decimal degrees; NAD 83).

Contact your State Ecological Services Field Office for recommendations as to which facility or facilities would accept specimens. Surveyors should deliver dead specimens, along with a hardcopy of the “*ABB Accidental Death Form*” (Appendix F) to the State Ecological Services Field Office or a Service-approved facility.

### **Protocols and Forms**

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

## CONCLUSION

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

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*ABB Survey Guidance Appendices*

- Appendix A — ABB Survey Data Collection Form Survey Guidance
- Appendix B — ABB Survey Summary Report Survey Guidance
- Appendix C — Leasure *et al.* 2012
- Appendix D — Description of *Nicrophorus* Species
- Appendix E — Dichotomous Key
- Appendix F — ABB Accidental Death Form
- Appendix G — Carrion Types for Attracting ABBs
- Appendix H — ABB Summary Report Entry Guidance
- Appendix I — EEC Workbook - ABB Data Forms May 2017 ([Excel](#))
- Appendix J — Contact Information - Ecological Services Field Offices