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Petition to Delist the American Burying Beetle (*Nicrophorus americanus*) in Accordance with Section 4 of the Endangered Species Act

Petitioned by

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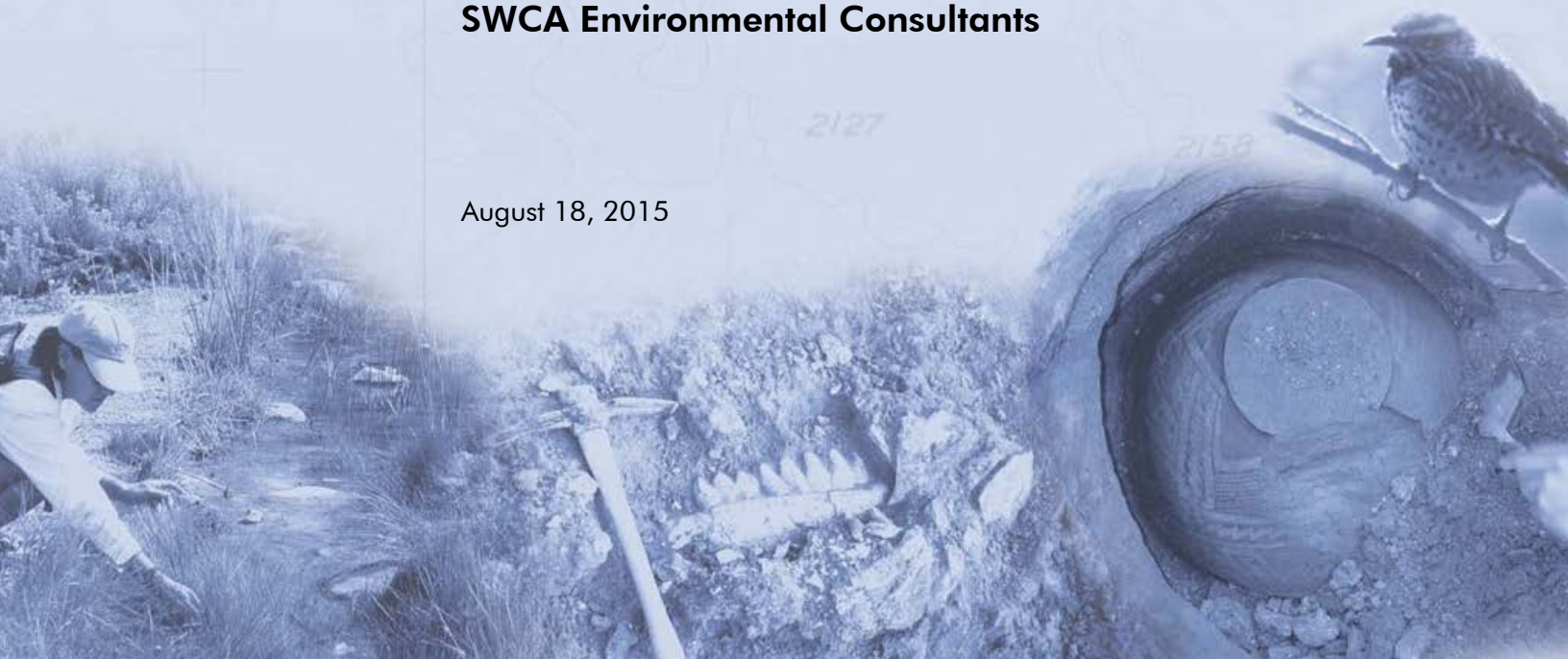

SIGNATURES

WE, THE PETITIONERS, RESPECTFULLY SUBMIT THIS PETITION TO DELIST THE FEDERALLY ENDANGERED AMERICAN BURYING BEETLE (*NICROPHORUS AMERICANUS*) TO THE U.S. FISH AND WILDLIFE SERVICE FOR CONSIDERATION PURSUANT TO SECTION 4 OF THE ENDANGERED SPECIES ACT.

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1.0 PETITIONED ACTION

The Petitioners respectfully submit this petition to delist the American burying beetle (*Nicrophorus americanus*, ABB), an endangered insect, to the U.S. Fish and Wildlife Service (USFWS) for consideration under Section 4 of the Endangered Species Act (ESA).

Nicrophorus americanus is the largest of the carrion beetles (Coleoptera: Silphidae) in North America. The USFWS listed *N. americanus* as an endangered species (i.e., a species in danger of extinction throughout all or a significant portion of its range) in 1989 (USFWS 1989). In the agency's final listing rule, the USFWS stated "once widely distributed throughout eastern North America, this species has disappeared from most of its former range" (USFWS 1989). Claims of a 90 percent reduction in the historic range of the species were the foundation of the USFWS's decision to list *N. americanus* as endangered – yet scientifically defensible, range-wide studies of presence/absence or abundance have never been completed for this highly variable and eclectically distributed species. While anecdotal evidence of a historic decline in the range and distribution of *N. americanus* exists in the public record (likely related to the demise of the passenger pigeon and the expansion of modern agriculture around the turn of the 20th century, as postulated by Sikes and Raithel 2002), there is no evidence that *N. americanus* is currently in danger of extinction across all or a significant portion of its contemporary range. Historic conditions are not relevant to current status determinations under the ESA – proper analysis of the five ESA listing factors must be based on present or threatened future conditions. In fact, the known contemporary range, distribution, and abundance of *N. americanus* is actually expanding with the application of increased and more effective survey effort, as well as the implementation of multiple captive breeding and reintroduction efforts. Furthermore, at the time of listing, the USFWS was unable to identify any actual threats to current populations of *N. americanus* and more recent analyses of threats are based largely on speculation and assumption – not actual evidence of downward pressure on the current abundance or distribution of the species. Population and habitat viability modeling involving the USFWS and other experts also indicates that all naturally occurring wild populations of *N. americanus* are of sufficient size to be demographically viable for the foreseeable future.

In short, the Petitioners request that the USFWS delist *N. americanus* from protection under the ESA, since the best available science does not support the existence of any threats significant enough to be driving *N. americanus* towards extinction in the foreseeable future.

DELISTING THE AMERICAN BURYING BEETLE IS WARRANTED

- Historic range contractions are not relevant to the current status of the species and reliance on anecdotal collection records to infer trends is fraught with bias and non-scientific analysis.
- The known range, distribution, and abundance of the species has been expanding in recent decades with additional survey effort, including a 100-fold expansion of the known range since listing and a 3% range expansion in 2015.
- All known naturally occurring wild populations are demographically viable for the foreseeable future, with little risk of extinction under estimated current conditions.
- No actual threats to the species have been substantiated with contemporary evidence of population declines.
- Recent trends in land use and land cover change within the range of the species are not significant and do not suggest current changes in the overall availability of actual habitat for the species.
- The species is easily raised in captivity and reintroduction efforts are underway, with recent advances in marking techniques that should improve the success of such efforts.

Addressing this erroneous listing as quickly as possible is of prime importance to the Petitioners. Several of the Petitioners believe that species inappropriately receiving the protections of the ESA cause significant economic harm. In the case of *N. americanus*, many land development, agriculture, transportation, and pipeline or utility operations are delayed or restricted due to the presence of the beetle (Williamson 2014). In the state of Oklahoma, *N. americanus* has cost $6.5 million in protection efforts over the last 20 years, including $1.3 million that the Oklahoma Department of Transportation spent on conservation actions in a 6-year time span (Palmer 2015). The erroneous listing of *N. americanus* has caused delays of essential road and bridge projects and costs Oklahoma taxpayers (Smoot 2015). The *N. americanus* has also caused issues with the development of the Keystone XL Pipeline, a $5.3 billion project, related to permitting and protection for *N. americanus*, as well as related lawsuits (Laskow 2012; Snyder 2013). Others believe that the objectives of the ESA are best served by focusing limited conservation resources on species that truly warrant the protections of the ESA. All Petitioners believe that *N. americanus* should no longer be listed as threatened or endangered under the ESA.

Pursuant to ESA Section 4(b)(3)(A), the question USFWS must determine at this stage is "whether the petition presents substantial scientific or commercial information indicating that the petitioned action may be warranted." This is a relatively low-threshold burden of proof. For the purposes of this decision, "'substantial information' is that amount of information that would lead a reasonable person to believe that the measure proposed in the petition may be warranted" (50 CFR 424.14(b)(1)).

2.0 SPECIES AND HABITAT DESCRIPTION

Nicrophorus americanus is a carrion beetle that feeds and reproduces on vertebrate carcasses within a certain size range. Carcasses used by *N. americanus* typically range from 100 to 300 grams; although, smaller, presumably suboptimal, carcasses ranging from 30 to 100 grams are also used (Kozol et al. 1988). Larger carcass size has been associated with increased reproductive output (USFWS 2014a), but

the relationship may not be strong. For example, Smith (2011), in a study by the Oklahoma Department of Wildlife Conservation funded by a USFWS Section 6 grant that was not cited in USFWS (2014a), found that "carcass size did not impact brood size or larval mass so size of carcasses may not be as much of a limiting factor as competition for carcasses and subsequent reproductive success."

Carrion beetles, such as *N. americanus*, bury their carcasses beneath the soil to help protect the carcass from scavenging by other animals. Because of this behavior, the texture and moisture content of the soil upon which a carcass is found contributes to appropriate habitat for this species. It appears that soil conditions must be somewhat conducive to excavation by *N. americanus* individuals, indicating a moderate level of pliability regardless of soil type (Anderson 1982; Lomolino and Creighton 1996); although, *N. americanus* will move carcasses up to 1 meter to better soil conditions and members of the genus have been documented using animal burrows or other similar features to "bury" carcasses (USFWS 1991, Jurzenski 2012). Soil moisture also appears to be a factor in preventing desiccation while brooding or overwintering (Bedick et al. 2006).

Vegetation cover contributes to appropriate habitat for *N. americanus* by providing the litter or detritus under which *N. americanus* are believed to shelter during the day in the species' summer active season (USFWS 2014a). Vegetative detritus also contributes to the maintenance of appropriate soil conditions during the brooding and winter inactive periods (USFWS 1991). *Nicrophorus americanus* has been observed in multiple types of vegetation communities including grasslands, grazed pastures, scrub, deciduous woodlands, pine forests, bottomland/riparian woodlands, and edge habitats. The species is highly mobile and appears to move readily between vegetation communities, indicating a lack of vegetation preference (USFWS 2014a). Habitat for *N. americanus* is not dependent upon vegetative structure or composition – or even on specific soil types, but instead is thought to rely on specific-sized carcasses lying on top of soils suitable for the burial of such carcasses. In fact, the USFWS acknowledges this association by stating in the agency's most recent, albeit informal, status review (USFWS 2014a):

> Holloway and Schnell (1997) found significant correlations between the numbers of ABBs caught in traps and the biomass of mammals and birds, irrespective of the predominant vegetation (USFWS 2008b) suggesting that the habitat *per se* is not the key environmental driver for occupation of an area by ABB, but rather the density of their reproductive resources (small mammals and birds) found within those habitats.

Nicrophorus americanus has a summer active season that typically runs between late April and September, when ambient nighttime air temperatures consistently exceed 60 degrees Fahrenheit (USFWS 1991). During this period, individuals forage, pursue mates, locate and defend suitable carcasses, and rear broods. When not engaged in brood rearing, *N. americanus* individuals are believed to shelter under vegetation litter on the ground surface during the day and are most active above ground from two to four hours after sunset (Walker and Hoback 2007, Bedick et al. 1999). Some weather conditions, including extreme temperatures, rain, and strong winds, reduce the summertime nocturnal activity of individual *N. americanus* (Bedick et al. 1999).

During their active season, *N. americanus* as a species is thought to have two peak periods of above ground activity (USFWS 2008). The first occurs over several weeks in the early summer after the beetles emerge from their winter inactive season to forage, locate suitable carcasses for feeding and brood rearing, and attract mates. Burying beetles are capable of finding a carcass between one and 48 hours after death at a distance up to two miles (Ratcliffe 1996). If successful, a mated pair will raise a brood underground near a buried carcass, a process that typically takes about 48 to 65 days (Kozol et al. 1988). Adults provide extensive parental care of their brood and typical brood sizes are between 12 and 18 larvae (Kozol 1990). A second period of above-ground activity by *N. americanus* occurs in late summer when new adults (called tenerals) emerge to feed before the next winter inactive season. The parents die off

after reproduction or during the subsequent winter. The life cycle of this beetle is thought to last about one year (USFWS 2014a). Because of this short life span, USFWS (2014a) states that each year's population levels are largely dependent on the reproductive success of the previous year, with "high numbers and abundance in one year, followed by a decline in numbers the succeeding year, or vice versa" (USFWS 2014a).

N. americanus has been reported moving distances of 0.10 to 18.6 miles in various parts of the species' range (Bedick et al. 1999, Creighton and Schnell 1998, Jurzenski et al. 2011, Schnell et al. 1997-2006). However, 6.2 miles appears to be the average maximum distance travelled by an individual beetle over six days with an average of approximately 1.03 miles per night (Creighton and Schnell 1998). This high degree of mobility and lack of fidelity to any particular vegetation or soil type means that the presence of *N. americanus* individuals at any particular location is highly variable. USFWS (2014a) states that "survey data for ABBs in Oklahoma has documented both positive and negative ABB survey results in the same calendar year and even the same ABB active season within the same general location."

Once ambient nighttime air temperatures consistently drop below 60 degrees Fahrenheit, *N. americanus* individuals bury into the soil, generally at or just below the frost line, to overwinter for a period of eight to nine months (USFWS 2014a). Again, the vegetation community at overwintering sites generally does not appear to be an influencing factor in overwinter survival rates, at least for the Oklahoma population (Holloway and Schnell 1997). Having access to a carcass during the winter appears to improve the overwinter survival rate of *N. americanus* individuals, which studies estimate ranges between 25 percent to about 70 percent (USFWS 2014a).

3.0 SCIENTIFIC AND REGULATORY HISTORY

The USFWS' decision to list *N. americanus* as endangered with extinction hinged largely on observations gleaned from historic and contemporary collection records that the species appeared to be extirpated from a significant portion of its historic range. USFWS (1991, 2014a) describes the historic range of *N. americanus* as including "over 150 counties in 35 states" that cover "most of temperate eastern North American and the southern borders of three eastern Canadian provinces." While the USFWS also notes that "documentation of records is not uniform through the broad historical range," neither the history of collection records nor current survey efforts represent a focused, systematic survey of presence or absence across this historic range over time. Nevertheless, the USFWS continues to describes the current status of *N. americanus* as dire since the "during the 20th century, the ABB disappeared from over 90 percent of its historical range" (USFWS 2014a). Instead, the when considering listing *N. americanus* as endangered in 1989, USFWS should have acknowledged that it lacked robust or even sufficient evidence of any actual contemporary decline in *N. americanus* range, distribution, or abundance that would have pointed to a trend towards extinction.

Table 1. History of range, distribution, and abundance information and regulatory decision-making for *N. americanus*.

Date	Event
1790	Olivier first describes the species, *N. americanus*, from an undesignated type locality (USFWS 1991).
circa 1850 - 1920	Historic collection records document the presence of *N. americanus* across the "Atlantic region from the middle states to Texas," and some records include notes about the "abundant," "widely distributed," and "frequent" observations of *N. americanus* during this period (Davis 1980).

Date	Event
circa 1920 - 1950	Collections of *N. americanus* apparently decline across the eastern edge of the range. The species appeared to be largely extirpated from mainland portions of states east of the Appalachian Mountains by the 1940s. Reports of *N. americanus* from the central Midwest states declined through 1950s (USFWS 1991).
circa 1950 - 1989	Collection records and other personal communications during this period note the "lack of recently collected specimens" and "lack of success in trapping *N. americanus*," with many collectors reporting no success in collecting *N. americanus* from many localities (Davis 1980). USFWS (1989) stated that "since 1960, this once ubiquitous species has been collected only in Ontario, Kentucky, Arkansas, Michigan, Oklahoma, Nebraska… and in two New England states." *Nicrophorus americanus* distribution records during the three decades leading to the listing decision document a known range that included eight U.S. or Canadian states.
1984	USFWS recognized *N. americanus* as a candidate for listing, but noted that sufficient biological information was not available to support a proposed rule (49 FR 21670).
1989	USFWS lists *N. americanus* as endangered under the ESA on the basis of an apparent decline in historic range and abundance based on curated collection records and poorly supported assertions of contemporary declines (USFWS 1989). USFWS (1989) provided no evidence of any actual or ongoing threats to the species ("the cause of the species decline is unknown"). The known range of *N. americanus* is described as being limited to two extant populations: one in Rhode Island and another in eastern Oklahoma, "despite extensive efforts to locate additional populations." The USFWS describes the Block Island population as having an estimated population of 520 individuals in 1986, and reports the collection of only 10 individuals from the Oklahoma site over a 10-year period.
1991	USFWS publishes a recovery plan for *N. americanus* that describes the expansion of the known range in Oklahoma from a single site to four counties and reports the collection of 219 individuals from Oklahoma in 1991 – a substantial increase compared to the Oklahoma collections cited in the 1989 listing rule. USFWS considered the population on Block Island to be "apparently stable" at a level of approximately 500 individuals. USFWS proposes that the decline in *N. americanus* may be related to habitat loss and fragmentation that altered the composition of the vertebrate fauna community and reduced the abundance of carrion resources of the size preferred by *N. americanus*.
2005	Amaral et al. (2005) published a population and habitat viability assessment for *N. americanus* that estimated all naturally occurring *N. americanus* populations to be at least 1,000 individuals and projected little risk of single extinction given estimated current conditions. The assessment included input from a wide variety of experts, including the USFWS, state wildlife agencies, university researchers, zoos involved in *N. americanus* captive breeding programs, and the International Union of Concerned Scientists Conservation Breeding Specialist Group.
2008	USFWS publishes a 5-year Status Review of *N. americanus* that recommended continued endangered status despite acknowledgement that the known range and distribution of the species greatly expanded since listing, several populations occur on public lands or private conservation lands, multiple populations are estimated to be "demographically viable over the long term," captive breeding stocks and the husbandry practices are "well-established," and actual threats to the species remain either a "longstanding hypothesis" or "purely theoretical." Nor does USFWS provide any evidence of how or to what extent current populations continue to be affected by these hypothetical or theoretical threats. The range of the species at this time is known to include much broader distribution over parts of seven states.
2014	USFWS publishes an updated biological review of *N. americanus* to support its general conservation plan for addressing the purported impacts of Oklahoma oil and gas development on the species. USFWS (2014a) states that *N. americanus* is now known to occur in nine states: Block Island, Rhode Island; Nantucket Island, Massachusetts; eastern Oklahoma; western Arkansas; Loess Hills and Sandhills regions, central Nebraska; Chautauqua Hills region, southeast Kansas; south-central South Dakota; northeast Texas; and Missouri (a designated non-essential, experimental population). This distribution incudes three national wildlife refuges and several other public or private conservation areas.

Date	Event
2015	USFWS expanded yet again the known range of *N. americanus* in Oklahoma to accommodate new positive survey records from the western edge of its known distribution. The expansion added more than 500,000 acres to the range of the species in Oklahoma, an increase of approximately 3 percent (USFWS 2015a).

4.0 DELISTING PRECEDENTS

Delisting a species from the protections of the ESA may occur as a result of achieving recovery, species extinction, or new analysis that indicates that the original listing was in error. Since 1967, 59 species have been delisted (51 domestic and 8 foreign species). Of these, 19 were delisted because the original data were found to be in error, 30 have been recovered, and 10 have gone extinct (USFWS 2015b).

4.1 Recovery

The Policy and Guidelines for Planning and Coordinating Recovery issued by the USFWS in 1990 defines recovery as "the process by which the decline of an endangered or threatened species is arrested or reversed, and threats to its survival are neutralized, so that its long-term survival in nature can be ensured. The goal of this process is the maintenance of secure, self-sustaining wild populations of the species" (USFWS 1990:1). While there is a regulatory basis for the development of recovery plans, there is no requirement that recovery plans be implemented. **It is also important to recognize that neither the ESA nor the USFWS regulation establishes that recovery plans act as the sole determinant of a species' progress towards achieving recovery.**

For example, in its final rule to delist the Lake Erie water snake in 2011, the USFWS states that "recovery plans are intended to provide guidance to the USFWS, States, and other partners… they are not regulatory documents and cannot substitute for the determinations and promulgation of regulations required under 4(a)(1) of the Act" (76 Fed. Reg. 50681). In regard to implementation of recovery plans, the USFWS identifies that "there are many paths to accomplishing recovery of a species, and recovery may be achieved without all criteria being fully met" (76 Fed. Reg. 50681). Moreover, "the determination to remove a species from the Federal List of Endangered and Threatened Wildlife is ultimately based on an analysis of whether a species is no longer endangered or threatened" (76 Fed. Reg. 50681). Therefore, a species may be delisted on the basis of recovery even if the specific recovery criteria identified in the species' recovery plan have not been met.

Other examples of species that have been delisted on the basis of recovery not necessarily defined by strict adherence to published recovery plan criteria include the following:

- **Columbian White-tailed Deer (*Odocoileus virginianus leucurus*), Douglas County distinct population segment) (68 Fed. Reg. 43647) -** In 2003, the Douglas County distinct population segment of the Columbian white-tailed deer (distinguished in the 1983 revision to the recovery plan) was delisted due to recovery. Prior to listing, the species had declined by 1970 to just two known populations representing approximately 400–500 individuals. Largely as a result of conservation efforts and regulations on hunting, by 2002, the species increased to over 6,000 known individuals (68 Fed. Reg. 43651). This represents a population increase of 1,417.5% (based on a starting value of 400 known individuals). Despite this population increase, there remained only two known

populations of the species at the time of delisting, and the range of the delisted population segment included only one county in Oregon. The basis for delisting the distinct population segment was the establishment of secure habitats. The recovery plan "did not define secure habitat to include only publically owned lands; rather, it provided further guidance on secure habitat by stating that local entities, including planning commissions, county parks departments, and farm bureaus could secure habitat through zoning ordinances, land-use planning, parks and greenbelts, agreements, memoranda of understanding, and other local jurisdictions" (68 Fed. Reg. 43651). They additionally encouraged conservation organizations to contribute through "easements, leases, acquisitions, donations, or trusts" (68 Fed. Reg. 43651).

- **Robbins' Cinquefoil (*Potentilla robbinsiana*) (67 Fed. Reg. 54968) -** In 2002, the Robbins' Cinquefoil was delisted due to recovery. This determination was based on the application of protective conservation actions and the addition of new viable populations. At the time of the listing in 1980, there was only one known population of the species that had been transected by development associated with the Appalachian Trail. Within that population, approximately 2,000 individual plants were known to occur. By the time the species was delisted, more than 14,000 individual plants were known to occur at two naturally occurring localities and two transplanted localities (67 Fed. Reg. 54968). This represents a known population increase of 600%. While the recovery plan initially called for four new transplant sites, it was later determined that only two of these sites needed to be viable. In response to comments received relating to the separation from the objectives outlined in the recovery plan, the USFWS iterated that "the objectives identified during the recovery planning process provide a guide for measuring the success of recovery, but are not intended to be absolute prerequisites, and should not preclude a reclassification or delisting action if such action is otherwise warranted" (67 Fed. Reg. 54972).

- **Aleutian Canada goose (*Branta canadensis leucopareia*) (66 Fed. Reg. 15643) -** In 2001, the Aleutian Canada goose was delisted due to recovery. In 1975, 790 individuals of the species were known to exist. By 1989, the population had increased to 5,800 known individuals (an increase of 634%). As a result of that increase, the species was down-listed to threatened. In 2000, there were 36,978 known individuals (an increase of an additional 537%) and the species was delisted (66 Fed. Reg. 15643). This represents a cumulative population increase of 4,580% from the time of listing. The species was determined to be recovered due to the discovery of new localities, the introduction of captive-bred individuals that led to an expanded range, and the elimination of threats like hunting by establishing closed hunting areas.

These are just a handful of examples where species have been delisted on the basis of recovery. In these cases, the USFWS determined that the threat of extinction and decline of the species had been reversed. In many cases, the conditions considered for recovery were different from those outlined in the initial recovery planning process as new scientific information became available. In all cases, some forms of perpetual protective measures were implemented in support of continued species security.

4.2 Extinction

To date, 10 species have been delisting under the ESA due to extinction. While this is a warranted justification for the removal of a species from the protections of the ESA, it is not relevant to *N. americanus* and therefore not discussed further in this petition.

4.3 Original Data in Error

The third acceptable criteria for delisting are instances where the original data used to support the listing is determined to be in error. In such cases, **delisting may be warranted if the analysis of new information or a reanalysis of the original information indicate that the existence or magnitude of threats to the species, or both, do not support a conclusion that the species is at risk of extinction now or in the foreseeable future**. Examples of species that have been delisted on the basis of an erroneous listing include:

- **Pine Barrens treefrog *(Hyla andersonii)* (48 Fed. Reg. 52740) -** In 1983, the Florida population of the Pine Barrens treefrog was delisted due to a finding that the original data were in error. The USFWS stated "recent evidence indicates that the species is much more widely distributed than originally known" (48 Fed. Reg. 52740). At the time of the listing, there were only seven known localities of this species in Florida and the predominant threat was cited as "the present or threatened modification, or curtailment of its habitat or range" (48 Fed. Reg. 52741). By 1979, several more populations were identified, and by 1980 there were over 150 confirmed occupied locations for the species (an increase of at least 2,042%). The final rule noted that while the overall distribution of the species was relatively limited, the likelihood of discovering more known localities in consideration with the additional new sites discovered indicated that "the Florida population is relatively secure for the immediate future" (48 Fed. Reg. 52741).

- **Rydberg Milk-Vetch (*Astragalus perianus)* (54 Fed. Reg. 37911) -** In 1989, the Rydberg Milk-Vetch was delisted on the basis of erroneous data. At the time when this species was listed, there was only one known locality. The subsequent delisting was based on the discovery of 11 additional localities over nine years of research (an increase of 1,100%). This delisting was supported by the existence of regulatory mechanisms that minimized the impacts of the threats identified in the initial listing factors.

- **McKittrick pennyroyal *(Hedeoma apiculatum)* (58 Fed. Reg. 49244)** - In 1993, the McKittrick pennyroyal was delisted because of "the number of newly discovered populations and the remote and inaccessible nature of the habitat" (58 Fed. Reg. 49244). This species was at the time of listing and continues to be only known from two counties, one each in Texas and New Mexico. At the time of listing, there were 7 known localities of the species. At the time of delisting, there were 36 known populations of the species (an increase of 414%) (58 Fed. Reg. 49245). The USFWS determined that since this plant species occurs in hard-to-reach habitats, it is likely that its distribution is even broader than the confirmed locations, and that its natural preferred habitat limits the likelihood of human-related impacts.

- **Utah (Desert) Valvata snail *(Valvata utahensis)* (75 Fed. Reg. 52272) –** In 2010, the Utah Valvata snail was delisted on the basis of new information. At the time of listing in 1992, the species was believed to occur in only "a few springs and mainstream Snake River sites" at, isolated points along the Snake River. The species was delisted after data showed that the species range extended an additional 122 miles beyond the initially identified range (an increase in the known range of 118.5%). The USFWS determined that due to the increased range of the species, the listing factors would not contribute to the likelihood of the species being threatened with extinction in the foreseeable future. Among the threats discussed, impacts to its habitat from agricultural and industrial purposes were excluded as threats because "the species persists in these varied mainstem Snake River systems, including impounded reservoir habitats" (75 Fed. Reg. 52280).

This distinction is critical because despite the continued presence of previously perceived threats, the proven ability of the species to continue to thrive in those conditions supported delisting.

5.0 JUSTIFICATION FOR THE PETITIONED ACTION

Herein, the Petitioners present and analyze the credible scientific or commercial information that would lead a scientifically accurate species status review to conclude that delisting of *N. americanus* may be warranted. The following assessment demonstrates how the original listing was in error, even given the information available at the time, and that information that became available subsequent to the listing decision continues to demonstrate that *N. americanus* is not now threatened and never was at risk of extinction in the foreseeable future. Therefore, the Petitioners believe that *N. americanus* should be delisted.

5.1 Original Listing in Error

In 1989, the USFWS stated in its final listing rule for *N. americanus* (USFWS 1989:29654):

> Endangered status is warranted by the decline in the species' range from more than a third of the continental United States and parks of southeastern Canada to only two verified populations. Failure of 1986 efforts to relocate the species in Arkansas and Michigan suggests that whatever caused the decline of the species was at work at least as recently as the mid 1970's. While it is not improbable that other remnant populations will be discovered in the future, it is likely that those populations remain vulnerable to the factors that have caused the general decline of the species. Further, there is no known way to reverse any decline that might occur in the known populations.

The Petitioners believe that the USFWS erred in 1989 when it determined that *N. americanus* was endangered with extinction over all or a significant portion of its range. The best scientific and commercial information available at the time of listing was not sufficient to demonstrate that any one or a combination of the five factors necessary for listing described in Section 4(a)(1) of the ESA was at the time driving *N. americanus* towards extinction. Instead, the USFWS based its listing decision on largely antidotal evidence of a historic reduction in the range of *N. americanus*, a misunderstanding of the current range and distribution of the species, and speculation about the existence of unspecified "threats" that were presumed to be causing a decline in the species. In fact, at the time of listing, USFWS had no information at all about any threats acting on the species and no credible information on trends in the *N. americanus* population – let alone any evidence of current or recent declines. Therefore, the USFWS had no rational basis for determining in 1989 that *N. americanus* was endangered with extinction. Clearly, the listing was in error.

5.1.1 Historic Range Contraction Not Relevant to Current Status

The assertions made by USFWS in the 1989 listing rule about the purported decline in the range of *N. americanus* were based on data gleaned from historic and contemporary entomological collections housed in permanent repositories. Relying on historical collections to make conclusions about trends in a species' range or abundance is inappropriate due to significant issues with collector bias, variations in collection methods and levels of effort, and problems with "presence only" data sets (Davis 1980; Pearce and Boyce 2006; Jeppsson et al. 2010; Shaffer et al. 1998). In fact, there is a wealth of information in the scientific literature warning of such issues. In a similar instance of using natural history collections (NHCs), Jeppsson et al. (2010:1950) is very clear about the perils of collection bias stating that "a major

drawback in using historical collections, however, is that such data sources in most cases are based on nonstandardized sampling methods. Thus one needs to consider potential biases in the data, such as changes in sampling effort, changes in sampling methods and the effects of increased knowledge on species biology." They go further and detail those biases (Jeppsson et al. 2010:1941):

> Potential sources of bias: (1) *No records of absences* – There is usually no knowledge about species absences, making it difficult to know whether a lack of records is due to species absence, non-detection (e.g. from stratified presence/absence studies) or that the location has not been visited (e.g. for presence only data); the real reason is, however, usually unknown [37]; (2) *Changes in sampling effort* – It cannot be assumed that the sampling effort has been constant over time, because NHCs usually stem from many years and many sources. Therefore, the yearly number of records of a specific species is not only dependent on the population size, but also on the yearly sampling effort; (3) *Changes in spatial coverage of sampling* – Three possible biases may arise. First, if the sampled area is constant, population increases due to expansion of the distribution may remain undetected. Second, if the sampled area changes with time, perceived population changes may not be real [21, 57]. Third, different collectors may recognize a name of a location as different in extension, giving the impression of changed spatial coverage; (4) *Changes of collection methods* – New knowledge on species' biology and new collection methods may increase species detection and collection, resulting in apparent but not necessarily true positive population trends; (5) *The attractiveness to collect a certain species may change* – NHCs depend on the willingness of collectors to collect specimens of different species. The attractiveness of a species is, among other things, influenced by the charisma of its visual characteristics, its sensitivity to human-induced habitat changes, its rarity, its red-list status, or its protection status. If any of these factors change with time, so may the collection effort for the species."

These same biases, plus additional important points, are also described in Shaffer et al. (1998). These authors discuss assumptions that must be considered when using such data, including two very relevant points to the USFWS's assertions about *N. americanus*: 1) that "the 'expertise' of the collectors is 'equal'" and 2) "normal biotic and abiotic factors regulations population fluctuations were the same during the sampling periods" (Shaffer et al. 1998:29).

The other main problem with the USFWS's claims of *N. americanus* declines inferred from historical collection data is related to the Jeppsson et al. (2010) warning about reliance on presence-only data. Pearce and Boyce (2006:406) discusses species abundance and distribution modelling and states: "knowledge of only the presence of a species presents a number of data-quality issues" and "…making use of 'presence-only' data, consisting only of observations of the organism but with no reliable data on where the species **was not** [emphasis added] found. Sources for these data include atlases, museum and herbarium records, species lists, incidental observation databases and radio-tracking studies." They also caution scientists by stating, "Our caveat is that researchers must be mindful of study design and the biases inherent in the presence data and be cautious in the interpretation" (Pearce and Boyce 2006:410).

Although not relevant to the 1989 listing decision, it is possible that *N. americanus* did incur a historic decline due to threats that are no longer relevant in today's current conditions. The USFWS (1991) offered several examples of historic declines in optimally sized carrion resources for *N. americanus*:

> Since the middle of the 19th century, two species of birds in the favored weight range for *N. americanus*, the passenger pigeon (*Ectopistes micratorius*) and the greater prairie chicken (*Tympanuchus cupido*), have been eliminated from the eastern North American fauna…Further, several other birds in this weight class, particularly certain gallinaceous

> birds such as the wild turkey (poults), waterfowl, and shorebirds, have severely declined rangewide. Wild turkeys, for example, occurred throughout the range of the American burying beetle, and until recently, were extirpated from much of their former range…The cessation of fertilizing agricultural fields with whole fish (prohibited, for example, by law on Long Island about 1920 according to Robert Latham *in litt*.), probably resulted in large-scale carrion reductions in areas where this practice was formerly common, particularly along coasts or rivers.

However, none of these historic carrion source declines were relevant to the listing of *N. americanus* in 1989. The passenger pigeon and the greater prairie chicken may have indeed been an abundant carrion source for *N. americanus* historically, but their declines began in late 1800s and their extinctions/extirpations occurred in the early 1900s (Kates 2005; Smithsonian Institution 2001), which are not pertinent to determining listing status in 1989 or continued listing today. While the decline of wild turkey populations in the U.S. in the early 1900s may have played a role in a historic decline of *N. americanus*, the range-wide comeback of this species was well underway in the 1970s (Iowa Department of Natural Resources 2015) and again not relevant to determining listing status in 1989 or continued listing today. Furthermore, the use of fish on farmlands as fertilizer that historically (i.e., early 1900s), provided carrion availability to *N. americanus* was an unnatural man-made resource that was only done in a small portion of the range of *N. americanus*; thus, not applicable to the range-wide abundance discussion of *N. americanus*.

The Petitioners note that the available evidence at the time, however flawed, pertaining to the presumed historic contraction of the *N. americanus* range had (and continues to have) no bearing on whether or not the species' range is currently contracting. As Davis (1980) points out in his paper on *N. americanus* collections, "the range at the turn of the century is only of historical importance. The present limits of its distribution are unknown. Almost nothing is known of its biology" (Davis 1980:245). Listing Factor A pertains to the "present or threatened" destruction, modification, or curtailment in habitat or range. If USFWS cannot demonstrate a present or likely future downward trend in habitat or range pushing a species toward extinction in the foreseeable future, this listing factor has not been substantiated. As the USFWS stated in a 2001 guidance document pertaining to the preparation of species status assessments for taxa under consideration for listing, "it is important to distinguish between current (say within the last 10 years) and historical trends; historical trends provide background and perspective, while current trends provide the evidence that listing is warranted or unwarranted" (USFWS 2001:4).

5.1.2 Unfounded Claims of Contemporary Population Decline and Restricted Distribution

In the 1989 listing rule, the USFWS made several claims about the presumed current decline of *N. americanus*. However, as described below, the USFWS did not have reliable information upon which to draw this conclusion. First, the final listing rule presented the known range of *N. americanus* as being composed of only two populations: one in eastern Oklahoma and another on an island off the coast of New England (Block Island, Rhode Island). However, subsequent survey efforts reported in the 1991 Recovery Plan quickly proved this distribution to be incorrect. Next, the listing rule (USFWS 1989) made assumptions regarding the *N. americanus* population based on the presence of five other Silphid congeners. USFWS (1989 states that "...the sporadic pattern of these collections at a blacklight that has reportedly been operated for more than 5000 hours since 1976 and the fact that at least five other species of *Nicrophorus* are regularly collected at this site, suggest that the size and stability of this population may be a matter of concern." However, the USFWS provided no data on the ecological relevance of using these other species as a surrogate for *N. americanus*. Finally, the investigations cited in the listing rule regarding the then current distribution and range of *N. americanus* were grossly inadequate for this purpose since they provided only one year of survey data for a species whose presence varies widely in

space and time without any information about methodology and/or level of effort used to select and survey the collection sites.

The USFWS reported that *N. americanus* had been collected from at least eight states during the 30 years prior to the listing decision: Kentucky, Arkansas, Michigan, Oklahoma, Nebraska, two New England states, and the Canadian state of Ontario (USFWS 1989). However, at the time of listing, the USFWS noted that the "once ubiquitous" *N. americanus* was then only known to occur in two locations, one at either end of its historic range. In the final listing rule, the USFWS expresses concern that "extensive" efforts during the 1980s to relocate the species in at least two of the recently documented states of occurrence (Arkansas and Michigan) were not successful, and that other efforts to locate the species in Oklahoma were also not successful. However, the USFWS soon discovered, with the application of additional survey effort, that *N. americanus* actually occurred in many other locations. By the time of the 5-year Status Review in 2008, the USFWS recognized that the distribution of *N. americanus* included dozens of counties across several states, and in 2015 the USFWS expanded even further (by more than 500,000 acres or nearly 3 percent) the range of the species in Oklahoma to accommodate positive survey results documented beyond the western edge of the previously "known" range (USFWS 2015a). Clearly, the "extensive" and "significant" efforts to locate *N. americanus* in the 1980's prior to listing were not particularly effective at detecting the presence of the species over large portions of the historic range. The USFWS erred in 1989 when it presumed the range of *N. americanus* had decreased to only two small localities. The USFWS itself actually admits in the 2008 5-year Status Review that "the immediate threat of extinction has thus subsided in the 18 years since listing." (USFWS 1991:4).

The USFWS's conclusions about the presumed decline of *N. americanus* in the 1989 listing rule are unreliable since the USFWS failed to describe how collection efforts during the 30 years prior to listing compared to the 100+ years of historic collection efforts since the species was first described in 1790. As we discussed above, reliance on entomological collections to ascertain trends for range, distribution, or abundance are significantly flawed. The USFWS did not have a rational basis for making conclusions about trends in the status of the *N. americanus* with the data that was available at the time. The agency relied on largely incidental and anecdotal information, collected in a scattered and non-standardized fashion, to infer the current status of the species. As described above, the data available to the USFWS at the time was not sufficient for this purpose and led the agency to make unsupported conclusions about the *N. americanus*.

As part of its rationale for inferring a decline in *N. americanus* over time, the USFWS made comparisons with collection records for other congeneric species of carrion beetles. The 1989 listing rule repeatedly notes that insect collectors regularly collect other silphids at sites, often in abundance, implying that the lack of *N. americanus* collections or the low number of *N. americanus* collections was an indicator that *N. americanus* populations were in decline. However, the USFWS and the greater scientific community had very little information about the specific ecology of *N. americanus* itself, let alone how the ecology of *N. americanus* compared to that of other silphids. No science was available at the time that investigated the relationships among different carrion beetles. Davis (1980), one of the few publications actually cited by USFWS in the final listing rule, actually states "almost nothing is known of its biology and anyone knowing of a population is requested to contact the author" (Davis 1980:249). The USFWS provided no rational basis for using the distribution, abundance, or collection frequency of other silphids as a surrogate for inferring the status of *N. americanus*.

The USFWS noted in the final listing rule that:

> … failure of extensive efforts in 1986 to recapture American burying beetles at the sites of most recent captures in Arkansas and Michigan suggests a continuing constriction of the species' range. Significant efforts in 1986 and 1987 to locate American burying

> beetles on another New England island, where a 1985 capture was reported, were unsuccessful. Other recent unsuccessful capture efforts were conducted in northwestern Pennsylvania, New Jersey, New York (Long Island), Tennessee, western North Carolina, Torreya State Park in Florida, and on mainland areas in New England. The abundance of the species in collections (including student collections) with capture dates prior to 1950 and the ease of capture at blacklight and pitfall traps experienced at the site of the known extant island population confirm that these unsuccessful efforts to locate American burying beetles are indicative of their decline throughout most of their former range.

The USFWS describes these collection efforts as "extensive," despite involving only a year or two of survey effort. No other information was provided to document the methods or level of effort used to select or survey collection sites. The USFWS should have recognized instead that limited surveys do not appear to be sufficient to determine the status of *N. americanus*, at any scale, when the presence of *N. americanus* is highly variable. In fact, the USFWS describes in the final listing rule a pattern of *N. americanus* collections made by an individual in Oklahoma between 1976 and 1988 that actually demonstrates the wide variability of *N. americanus* detectability at a single site over a period of several years (Table 2). These collections were made at blacklight over more than 5,000 hours between 1976 and 1988 (USFWS 1989).

Table 2. Collection of *N. americanus* at an Oklahoma site between 1979 and 1988 by blacklight (USFWS 1989).

Year	*N. americanus* Collections
1979	1 specimen
Unknown date between 1979 and 1987	1 specimen; all other years collected 0 *N. americanus* specimens
1987	7 specimens
1988	1 specimen

The data from this collection series should have pointed USFWS to conclude that the inability to relocate *N. americanus* in Arkansas, Michigan, and other states – evidence cited by USFWS of recent and continued decline in the population due to exposure to unidentified threats – may simply have been the result of variability in the distribution and abundance of *N. americanus* at any given time and location. Instead, the USFWS erroneously concluded that conditions at the known Rhode Island population were typical of the species' ecology (USFWS 1989).

This presumption was unfounded since most of the historic *N. americanus* range did not involve islands. In fact, the natural conditions of Block Island, Rhode Island, had been highly altered for an extensive period. As stated in the 1991 Recovery Plan, "the Block Island population occurs on glacial moraine deposits vegetated with a post-agricultural maritime scrub plant community" and "Block Island was totally deforested by the mid-1700'…, and only in very recent decades has vigorous woody growth reappeared following the abandonment of grazing and agricultural practices" (USFWS 1991:15). Clearly, the conditions found on Block Island are not similar to the forests, prairies, or other vegetation communities where *N. americanus* has been documented across the eastern United States. Thus, the USFWS incorrectly presumed that the habitat parameters of an outlier population were representative of the conditions of the entire species.

5.1.3 No Information on Actual Threats to the Species

A clear error in the original listing rule is inability of the USFWS to identify any actual threats to the species or to demonstrate that any one or a combination of the five listing factors was actually driving *N. americanus* towards extinction; particularly regarding evidence of the "present or threatened destruction, modification or curtailment of habitat or range." The listing rule relies entirely on an assertion of the apparent decline of *N. americanus* from most of its historic range and an unfounded hypothesis that "the extent of the species' decline suggests that any newly discovered populations are also vulnerable to whatever factors have caused their disappearance elsewhere" (USFWS 1989). Instead, the USFWS acknowledged in the final listing rule that "habitat generally similar to that of the known population is not rare" (USFWS 1989).

The USFWS also states, without attribution, that "a low reproductive rate (compared with other insects) limits the ability of this species to rebound from any period of elevated mortality" as a potential threat under Listing Factor E (other natural or manmade factors affecting its continued existence) (USFWS 1989). However, the USFWS provides no evidence in the listing rule that *N. americanus* actually has a low reproductive rate compared to other insects – or even other silphids – and provides no substantiation that its reproductive rate is somehow limiting the population size or its ability to recover from stressors.

5.1.4 2008 5-year Status Review Did Not Adequately Consider New Information

The USFWS prepared a 5-year Status Review for *N. americanus* in 2008. The purpose of a 5-year status review is to ensure that listed species have the appropriate level of protection under the ESA. The reviews assess whether or not the status of a listed species has changed since the time of its listing or its last status review, and whether it should be classified differently or delisted. However, this review also included information that pre-dated the listing decision, clearly demonstrating that the USFWS did not consider all of the available science in its original 1989 listing decision (USFWS 2008, USFWS 1989). In the agency's 2008 5-year Status Review of *N. americanus*, the USFWS perpetuated their assertions regarding the historic range and abundance of *N. americanus* and recommend retaining endangered status, despite the discovery of additional populations. However, the size of the historic range is irrelevant to a species current listing status – only the range at time of listing or in light of the "present or threatened" curtailment of range is relevant to such regulatory decisions.

In the time since *N. americanus* was listed as endangered, numerous surveys of wild populations, as well as several reintroductions of captive-raised stock, were conducted and subsequently increased the known range of the species from two states (Rhode Island and Oklahoma) to seven states (Arkansas, Kansas, Nebraska, Oklahoma, Rhode Island, South Dakota, and Texas) in 2008 (USFWS 2008). The USFWS even stated in their 2008 5-year Status Review that "documentation that the ABB occurs throughout a more extensive range than that know at the time of listing is the most significant new information pertinent to this status review" (USFWS 2008:17). This increase in known range was primarily a product of an increased level of survey effort and more effective capture methodologies (i.e., capture with baited pitfall traps rather than at blacklight). With this information, USFWS should have recognized that there was never a threat to extinction in the first place—merely a lack of surveys to properly search for *N. americanus.* Instead, the USFWS justified continued listing, again, primarily on the basis that "even with the discovery of additional ABB populations, the species remains extirpated from about 90 percent of its historic range, and there is a significant disparity in distribution between the eastern and western portions" (USFWS 2008).

Significantly, USFWS (2008) did not adequately consider the findings of Amaral et al. (2005) that stated:

> … ABB populations in habitats that are able to maintain 1,000 beetles or more are viable long-term in the absence of severe catastrophic events or reduction in carrying capacity through reduced carcass availability, habitat loss or fragmentation… Currently, all naturally occurring ABB populations are estimated to be at least 1,000 individuals. The ABB model projects little risk of single population extinction and no risk of metapopulation extinction over the next 50 years given estimated current conditions.

The USFWS fails to acknowledge that Amaral et al. (2005) took into account "current conditions" and probabilities for catastrophic events. Instead, the agency (2008) relied on speculation and mere suggestion about the "possible factors" that contributed to the presumed disappearance of the species from parts of its historic range. In the listing factor analysis presented in the 5-year Status Review, USFWS discussed the current extent and potential for future changes to a variety of surface land uses, like agriculture, forestry, urban development, oil and gas production, and military training; pointing to these activities as evidence of habitat loss and fragmentation. However, USFWS provides no connection between the extent and magnitude of these land use changes and actual habitat for *N. americanus*, which is based on the vertebrate fauna community – not vegetation. Sikes and Raithel (2002) correctly points out that "…the factors that led to the decline of *N. americanus* may not all still be present."

Relying on an assessment of land use changes was not sufficient to demonstrate the loss, modification, or curtailment of habitat for N. *americanus*. The USFWS cites Trumbo and Bloch 2000, Sikes and Raithel 2002, Wolf and Gibbs 2005, Schnell et al. 2006 as "confirming the adverse effects of habitat modification and fragmentation on burying beetle abundance, diversity, and success" (USFWS 2008). However, none of the studies cited actually confirm the existence of "adverse effects" on *N. americanus*. Neither Trumbo and Bloch (2000) nor Wolf and Gibbs (2005) study *N. americanus* at all, but instead involve other species of carrion beetle in Michigan, Connecticut, and Maryland. Trumbo and Bloch (2000) even emphasize that different species of carrion beetle demonstrated different levels of activity in different "habitat types" (forested, edge, or open), which make the extension of their findings to *N. americanus* unsupportable. The other two publications cited as "confirmation" of this relationship also fail to support the USFWS's statement. Sikes and Raithel (2002) is a presentation of several hypotheses on the historic decline of *N. americanus*, not a scientific study presenting data about the adverse effects of habitat modification and fragmentation on *N. americanus* abundance, diversity, and success. Schnell et al. (2006) simply summarizes monitoring efforts on a commercial forest site. The assertion by USFWS in the 2008 5-year Status Review that scientific evidence confirmed that habitat modification and fragmentation adversely affects *N. americanus* was unsupported.

5.2 Continued Listing Not Warranted

We have demonstrated that the original listing of *N. americanus* was in error, based on faulty assumptions about the species' range, distribution, and abundance following what was likely a historic shift in the faunal composition of the eastern United States with the demise of the passenger pigeon. It is now clear that *N. americanus* exhibits stable and robust populations across several states and at least five different ecoregions. This post-passenger pigeon range, distribution, and abundance (where *N. americanus* are variably present at relatively low densities across eight to ten states) represents the "new normal" condition for *N. americanus*. In this context, there is no information to suggest that the status of the species is currently in decline.

Below we present a review of the current status of the species that incorporates new information since the time of the 2008 5-year Status Review and appropriately measures the current status of the species against its recent – not historic – range, distribution, and abundance. The USFWS's own guidance for preparing species status assessments (USFWS 2001) clearly states that "it is important to distinguish between

current (say within the last 10 years) and historical trends; historical trends provide background and perspective, while current trends provide the evidence that listing is warranted or unwarranted."

5.2.1 Range, Distribution, and Population Size

When listed as endangered in 1989, the USFWS described the known range of the species as occurring in a single Oklahoma site and at a relatively robust and stable population in Rhode Island. The best approximation of the current range of *N. americanus* is provided by the list of counties of known or suspected occurrence maintained by the USFWS on its Environmental Conservation Online System website (USFWS 2015c); except for Oklahoma, where the USFWS Oklahoma Ecological Services Field Office provides more specific range information for that state (USFWS 2015a). Table 3 and Figure 1 summarize the current extent of the known range for *N. americanus*, and show that *N. americanus* is known or suspected to occur across more than 51 million acres in 98 counties and ten states.

In 2008, USFWS described the extant range of *N. americanus* as including parts of seven states: Arkansas, Kansas, Nebraska, Oklahoma, South Dakota, Texas, and Rhode Island. By 2014, USFWS described the current range of *N. americanus* as including parts of nine[1] states (adding the state of Massachusetts and a non-essential, experimental population in Missouri to the list). Not included in either the 2008 or 2014 accountings are significant efforts by USFWS and others to reintroduce *N. americanus* to four different sites in Ohio that have released more than 1,000 captive bred *N. americanus* into the wild. USFWS (2014) states that "to date no ABBs have been captured in post-release years" in Ohio; although, this assertion is contradicted by USFWS (2008) that instead says "relatively few" *N. americanus* have been caught during post-release monitoring. In 2015, USFWS expanded yet again its description of the known range to include more than 500,000 acres to the western edge of the range in Oklahoma to accommodate new survey results (USFWS 2015a). In fact, the current known range in Oklahoma expands even the previously understood historic range of the species, as mapped in Sikes and Raithel (2002) (Figure 2)

1 USFWS (2014) includes an error in reporting the number of states with current records of occurrence. The text identifies nine states with current occurrences: Rhode Island, Massachusetts, Oklahoma, Arkansas, Nebraska, Kansas, South Dakota, Texas, and Missouri; but summarizes this information as including only eight states.

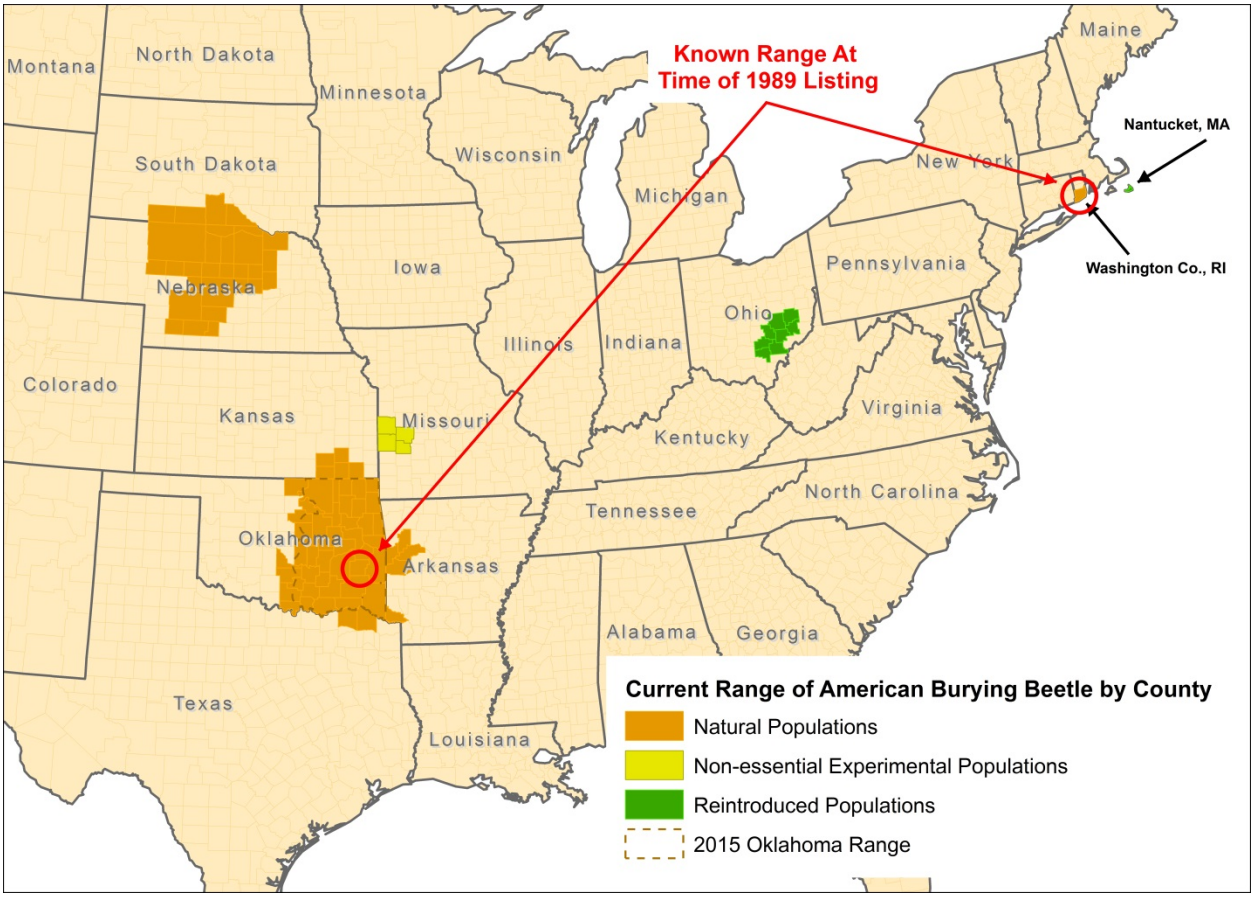

Figure 1. Known range of *N. americanus* since listing as endangered in 1989.

Therefore, the known range of *N. americanus* acknowledged by the USFWS has expanded from approximately 473,000 acres to more than 51,000,000 acres over a span of 26 years, representing a more than 100-fold expansion in size of the known range – two orders of magnitude. The extent of the known range including eight to ten states of occurrence has held relatively stable since the mid-2000s. However, as the 2015 known range expansion in Oklahoma suggests, the pattern of expanded survey effort leading to expanded known range indicates that the full extent of the current range of this species has not been delineated and it is likely that additional survey efforts will continue to expand the area across which the species is known to occur.

Even as recent as the 2014 biology review, the USFWS emphasizes the purported "90 percent decline" in the historic range of the species as evidence of the need for continued endangered status. However, it is more appropriate in the context of ESA listing decisions to instead emphasize the 100-fold expansion of the known range since listing. As the USFWS (2001) status review guidance indicates, this period of reference is a more appropriate basis for assessing the status of the species than the presumed range of *N. americanus* gleaned from occasional collections and anecdotal records from entomologists reported 100 years ago.

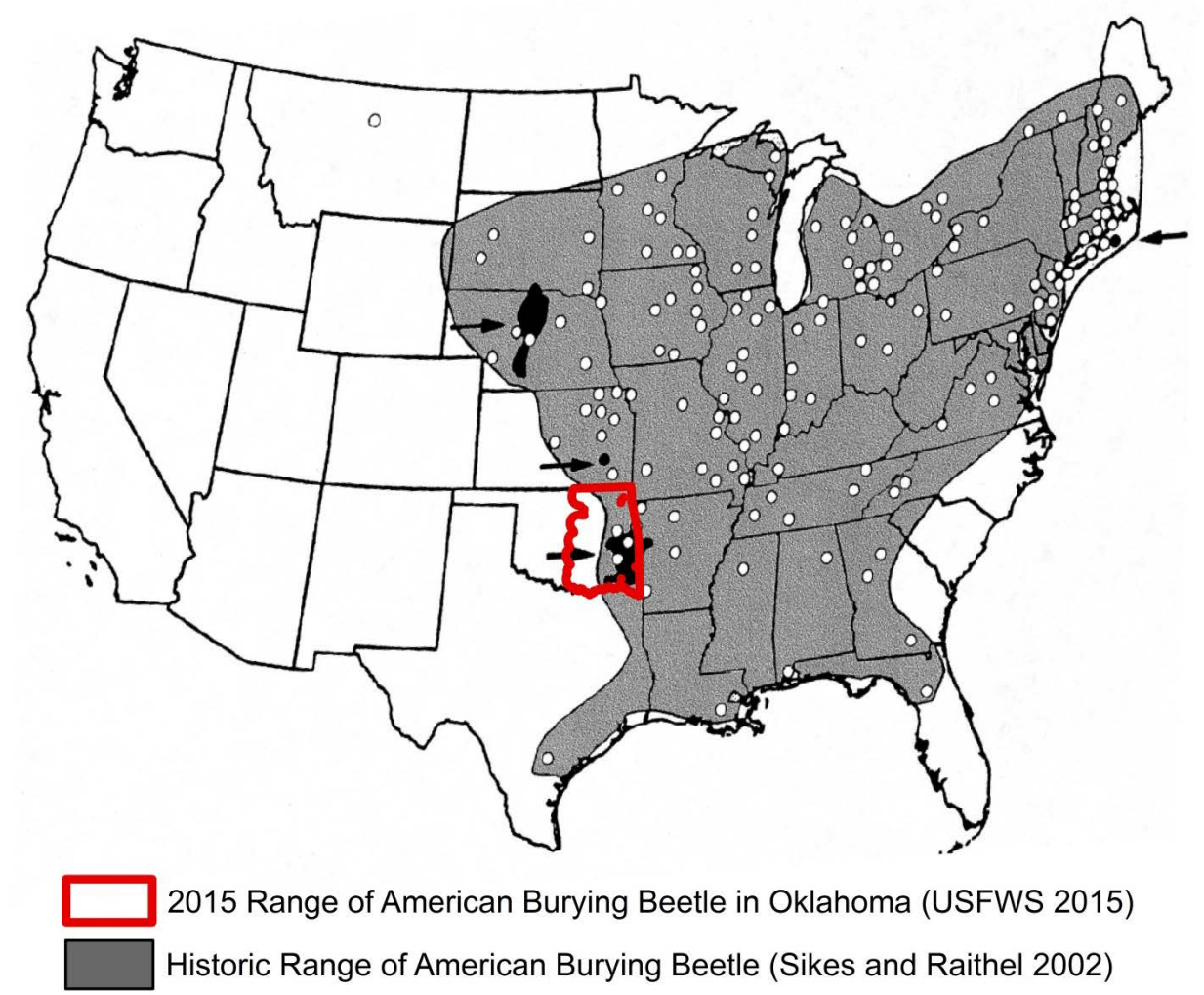

Figure 2. Historic range and current Oklahoma range of *N. americanus* (modified from Sikes and Raithel 2002).

The population of *N. americanus* is also substantially larger and more robust than known at the time of listing. The USFWS described the Block Island population as having an estimated population of 520 individuals in 1986, and reported the collection of only 10 individuals from the Oklahoma site over a 10-year period between 1979 and 1988. The estimated size of the current population includes more than 40,000 individuals across the range, and the populations in seven of the ten states comprising the current range have been recently described as stable or increasing in size (Backlund 2008, Jurzenski et al. 2011, Amaral et al. 2005, USFWS 2008). Moreover, population and habitat viability modeling by Amaral et al. (2005) suggests that:

> … ABB populations in habitats that are able to maintain 1,000 beetles or more are viable long-term in the absence of severe catastrophic events or reduction in carrying capacity through reduced carcass availability, habitat loss or fragmentation… Currently, all naturally occurring ABB populations are estimated to be at least 1,000 individuals. The ABB model projects little risk of single population extinction and no risk of metapopulation extinction over the next 50 years given estimated current conditions.

Furthermore, genetic studies of extant *N. americanus* populations across the range revealed little evidence that the populations in Rhode Island, Arkansas, South Dakota, Oklahoma, and Nebraska have unique genetic variation (Szalanski et al. 2000). In fact, Szalanski et al. (2000) found "no evidence to suggest that these five populations should be treated as separate, genetically independent conservation segments." Clearly, *N. americanus* currently maintains several redundant and well distributed populations that each has long-term viability, barring "severe catastrophic events" or reduced carrying capacity in occupied habitats.

Table 3. Current range, distribution, and estimated abundance of *N. americanus*.

STATE	COUNTIES OF KNOWN OR SUSPECTED OCCURRENCE*	APPROXIMATE RANGE (square miles)	ESTIMATED POPULATION SIZE (number of individuals)	TRENDS
South Dakota	4	3,467,188	~500-1,000 (Backlund 2008)	Stable (Backlund 2008)
Nebraska	25	18,794,346	~5,000 (Peyton 2003, Jurzenski 2012)	Stable/Increasing (Jurzenski 2012)
Kansas	5	2,003,610	Unknown (USFWS 2014a)	Unknown (USFWS 2014a)
Oklahoma	43**	19,541,875	>30,000 (Amaral et al. 2005)	Stable/Increasing (USFWS 2008)
Texas	2	1,271,430	Unknown (USFWS 2014a)	Declining/Possibly Extirpated (USFWS 2014a)
Arkansas	5	2,142,309	3,000-5,000 (Amaral et al. 2005)	Increasing (USFWS 2008)
Missouri (experimental, non-essential population)	4	1,834,310	240 released (USFWS 2012)	Increasing (Amaral et al. 2005)
Ohio	7	2,413,150	~1,000 released (U.S. Forest Service 2011)	Unknown (U.S. Forest Service 2011)
Rhode Island	1	214,773	1,000-2,000 (USFWS 2008)	Increasing (USFWS 2008)
Massachusetts	1	30,151	300 (Amaral et al. 2005)	Stable (Amaral et al. 2005)
Natural or Reintroduced Populations	94	49,878,834	~40,800 to ~44,300	
Non-essential, Experimental Populations	4	1,834,310	240	

Entire Range	98	51,713,144	~41,040 to ~44,540

*USFWS (2015c) **USFWS (2015a)

5.2.2 Analysis of Listing Factors

The ESA does not identify a minimum population, range, or distribution that must be achieved and maintained to warrant delisting a species. A listing or delisting determination is to be based entirely on the risk of species extinction from any one or a combination of the five factors provided in the ESA.

Listing Factor A (present or threatened destruction, modification, or curtailment of habitat or range):

The best available science indicates that *N. americanus*, a species that has been documented across 15 different ecoregions (USFWS 2008), is not dependent on any particular vegetation community, soil type, or even animal species. In this respect, *N. americanus* is clearly a habitat generalist (Holloway and Schnell 1997, Jurzenski et al. 2014). But, the actual habitat of *N. americanus* is best described as vertebrate carrion (species identity is not important) within a specific size range lying over soils that are conducive to burying (i.e., being neither too wet, too loose, nor too compact). This habitat is "scarce and unpredictable in space and time" (Jurzenski et al. 2014) and *N. americanus* are well adapted to detect and travel long distances to find its eclectically distributed habitat wherever it occurs. There is no evidence that *N. americanus* are constrained by human activities such that so-called "unfavorable" land uses necessarily present a barrier to movement.

Some researchers have postulated that changes in land use and land cover from human activities have changed the composition of the faunal community in ways that decreased the number of wildlife of the size class preferred by *N. americanus* and increased the populations of scavengers that compete with *N. americanus* for carrion, ultimately reducing the amount of carrion habitat available to *N. americanus*. Sikes and Raithel (2002) note that scavenger populations of coyotes, skunks, raccoons, and opossums have increased substantially over the past century, but do not provide information that suggests these trends are still relevant today. Jurzenski and Hoback (2011) state that "unfortunately, there are no published data comparing the number of vertebrate scavengers, including opossums, in areas with extant ABB populations and areas that no longer support these populations." In fact, Sikes and Raithel (2002) acknowledge that "…the factors that led to the decline of *N. americanus* may not all still be present."

Sikes and Raithel (2002) note that "most of the historical *N. americanus* collections, at least in the eastern portion of its range, occurred during the period when much of the landscape was highly agricultural." Therefore, it is difficult to establish that even intense changes in land use and land cover present a threat to the habitat of *N. americanus*.

To the extent that changes in land use and land cover may lead to changes in the composition of the vertebrate fauna community and affect the availability of *N. americanus* habitat, as summarized by Sikes and Raithel (2002), Table 4 shows how land use and land cover within the current known range of *N. americanus* have changed between 2001 and 2011, based on data provided by the National Land Cover Dataset (NLCD) (Homer et al. 2011). Land use/land cover classes that could provide suitable conditions for burying carrion include forests, shrub/scrub, grassland, pasture/hay, woody wetlands, and emergent woodlands; land use/land cover classes unlikely to provide suitable conditions for burying carrion include open water, developed uses, barren land, and cultivated crops. Between 2001 and 2011, approximately 195,092 acres of land within the current known range of the *N. americanus* (as defined by the 94 counties of occurrence shown in Figure 1) were converted from a potentially suitable land use/land cover class to a potentially unsuitable class – a change of only 0.4 percent over the decade. While USFWS (2008) points to the "numerous man-made lakes" created in Oklahoma and the ranking of Oklahoma as among the top

producing states for a number of agricultural products, neither these types of land use changes nor conversions to developed land uses have significantly altered the landscape within the current known range of *N. americanus* over the past decade. Therefore, there is no reason to suspect that any large-scale changes to the landscape that would significantly alter the composition of the vertebrate faunal community in ways that affect the abundance of carrion preferred by *N. americanus* have occurred in the recent past or are likely to occur in the future.

Table 4. Changes in potentially suitable land cover for use by *N. americanus* between 2001-2011 within the current range of the species.

LAND COVER CLASS		ACRES
Deciduous Forest		
	No change	10,056,830
	To other potentially suitable cover	292,270
	To potentially unsuitable cover	26,284
Evergreen Forest		
	No change	1,624,987
	To other potentially suitable cover	254,927
	To potentially unsuitable cover	2,305
Mixed Forest		
	No change	634,301
	To other potentially suitable cover	61,430
	To potentially unsuitable cover	1,157
Shrub/Scrub		
	No change	174,557
	To other potentially suitable cover	46,732
	To potentially unsuitable cover	4,210
Grassland/Herbaceous		
	No change	22,694,003
	To other potentially suitable cover	166,333
	To potentially unsuitable cover	124,503
Grassland/Herbaceous		
	No change	8,000,834
	To other potentially suitable cover	31,764
	To potentially unsuitable cover	25,748
Woody Wetlands		
	No change	666,769
	To other potentially suitable cover	26,228
	To potentially unsuitable cover	3,371
Emergent Herbaceous Wetlands		
	No change	508,298

LAND COVER CLASS	ACRES
To other potentially suitable cover	72,614
To potentially unsuitable cover	7,514
ALL POTENTIALLY SUITABLE LAND COVERS	
No change	**44,360,579 (97.5%)**
To other potentially suitable cover	**952,298 (2.1%)**
To potentially unsuitable cover	**195,092 (0.4%)**

As described above, there is no evidence that the current range of *N. americanus* is presently shrinking or that present or threatened destruction or modification of habitat is causing a downward trend in the abundance of *N. americanus*. Instead, the best available data shows that our understanding of the current range is actually expanding with the application of more survey effort using methods that are better at detecting the presence of the species (in fact, the USFWS just updated its recommended presence/absence survey protocols for *N. americanus* in May 2015, suggesting that improvements to increase detectability are still ongoing). The known contemporary range of the species has expanded 100-fold since listing in 1989. Therefore, there is no information to suggest that the habitat supporting *N. americanus* is presently or at risk of significant modification or curtailment in ways that would push the *N. americanus* towards extinction.

In fact, there are thousands of acres of public lands (parks, preserves, forests, grasslands, military reservations, and similar) and other private conservation lands (conservation banks and private nature preserves) within the currently known range of *N. americanus*. These lands are maintained in predominately a natural condition and support the fauna community used by *N. americanus* regardless of the listing status of *N. americanus*. The conservation value of these lands was not adequately considered in the 2008 5-year Status Review.

Amaral et al. (2005) estimated that all of the naturally occurring populations of *N. americanus* are demographically viable, projecting "little risk of single population extinction and no risk of metapopulation extinction over the next 50 years given estimated current conditions." Amaral et al. (2005) included consideration of "projected impacts from catastrophes and habitat loss" in their viability model. There is no evidence to suggest that the "estimated current conditions" and the allowances made for projected impacts modeled by Amaral et al. (2005) have changed since listing or are likely to change in ways that lead to a reduced carrying capacity within the current known range. Therefore, Listing Factor A is does not threaten *N. americanus*.

Listing Factor B (overutilization):

The USFWS has never identified overutilization as a threat to *N. americanus* (USFWS 2008). Even with increased survey effort, most contemporary collections of *N. americanus* follow USFWS-endorsed survey methods for *N. americanus* (USFWS 2010, USFWS 2014b) that call for the temporary capture and release of individuals and require specific protocols that minimize mortality (i.e., traps must be checked by mid-morning to prevent overheating and desiccation, use of trap designs that minimize capture of rainwater and access by scavengers, and shielding from bait that has become liquefied). Therefore, there is no current evidence that overutilization is a threat to the species.

Listing Factor C (disease or predation):

The USFWS acknowledges that there is no evidence of disease being a threat to *N. americanus* and, despite documentation that a number of different species have predated *N. americanus* (Jurzenski and Hoback 2011), "direct predation is not believed to be an important mortality factor" for the species

(USFWS 2008). Therefore, there is no information to indicate that Listing Factor C threatens the status of *N. americanus*.

Listing Factor D (inadequacy of existing regulatory mechanisms):

The USFWS acknowledged in the 2008 5-year Status Review that "in many situations it is difficult to apply the protective provisions under sections 7 and 9 of the ESA, because the use of baited pitfall traps may successfully capture beetles in locations where it is simply transient or present only opportunistically due to the carrion provided in the in the trap." With this statement, the USFWS admited that the conservation status of the *N. americanus* has not been substantially improved with the protections afforded by its endangered status under the ESA – again, pointing to the conclusion that the original listing was in error. Conversely, removal of those protections should not substantially decrease the conservation status of the species and suggests that the existing regulatory mechanisms that generally influence human uses of the landscape are sufficient to prevent this listing factor from threatening the continued existence of the species.

Nonetheless, there are a variety of conservation efforts currently in place that benefit the species. A total of approximately 5,144 acres are permanently protected for the explicit benefit of *N. americanus* in two conservation banks in Oklahoma, as well as a permittee-responsible mitigation reserve in Oklahoma (Common Ground 2015, Business Wire 2014).This includes the Muddy Boggy Conservation Bank, Common Ground Capital ABB Conservation Bank, and the Keystone McAlester Conservation Area. Additionally, there are many captive breeding and reintroduction efforts for *N. americanus* that released wild caught or captive raised beetles at seven sites across Missouri, Ohio, and Massachusetts in attempts to re-establish population in the wild (USFWS 2008). *Nicrophorus americanus* are reared at the St. Louis Zoo in St. Louis, Missouri; Roger Williams Park Zoo in Providence, Rhode Island; The Wilds in Ohio; and the Cincinnati Zoo in Cincinnati, Ohio (77 Fed. Reg. 16712). *Nicrophorus americanus* also benefit from the existence of public lands in Oklahoma, Arkansas, Rhode Island, Nebraska, and Texas. These lands and most likely others offer thousands of acres that are largely protected from disturbances that would render broad areas unsuitable for use by *N. americanus* and are generally maintained in a natural state

Listing Factor E (other natural or manmade factors):

USFWS (2008) addresses competition for carrion by scavengers as an "other natural or manmade factor," instead of as a form of habitat loss, and states that "competition for carrion can be a limiting factor" contributing to the decline of the species. However, while *N. americanus* are known to compete with vertebrate scavengers, invertebrate scavengers, and other carrion beetles, there is no indication that such competition is any more or less intense today than at the time of listing or that *N. americanus* populations are currently suffering declines as a result of such competition. No studies have been performed that demonstrate adverse population-level effects on *N. americanus* arising from competition for carrion, only that competitive interactions are part of the ecology of the species and that *N. americanus* individuals do not always outcompete other carrion users. However, these observations are not sufficient to establish that competition is a threat to the status of the species as a whole.

Furthermore, *N. americanus* has been successfully reared at several universities and zoos (USFWS 2008). Currently, captive ABB populations are maintained at the Roger Williams Park Zoo in Providence, Rhode Island; St. Louis Zoo in St. Louis, Missouri; The Wilds in Ohio; and the Cincinnati Zoo in Cincinnati, Ohio (USFWS 2012). Captive-reared and direct-translocated ABBs have been released at seven sites in attempts to re-establish populations in the wild. ABB reintroductions have been attempted in Missouri, Ohio, and Massachusetts (USFWS 2008). Not all reintroduction efforts have been successful, but researchers recently published a study that demonstrated that the most common (and, until recently, USFWS-advocated) method of marking individual beetles (i.e., by clipping or notching of the wing

coverings called "elyctra") significantly reduces the reproductive success of marked individuals by 90 percent (Hall et al. 2015). The wing coverings are important for sound production by individual beetles and are used in communication related to breeding, carcass defense, and brood rearing. Modifying wing coverings adversely affects *N. americanus* communication and may also alter the beetle's ability to move. Hall et al. (2015) note that most lab-raised *N. americanus* individuals used in reintroduction efforts have been so marked, which may be contributing factor in why some reintroductions have not been successful.

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