Second Atoka Pipeline Project
Habitat Conservation Plan

Appendix A
ABB Species Account

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American Burying Beetle Species Account

Status

The ABB was federally listed as endangered in 1989 (54 FR 29652) by USFWS in accordance with the Endangered Species Act of 1973, as amended (16 USC 1531 et seq.). The ABB Recovery Plan was finalized in 1991 and a 5-year review was completed in 2008. The most recent review found that the ABB remains endangered throughout its current range because of ongoing threats to known populations and the failure to discover or establish viable populations in the remaining Recovery Areas (U.S. Fish and Wildlife Service 2008). Because of its federal listing as endangered, adverse or completely beneficial activities that may affect the ABB are regulated to ensure conservation and persistence of the species.

Species Description

The ABB is the largest carrion beetle (silphid) in North America, reaching 1.0 to 1.8 inches (2.5 to 4.6 centimeters) in length (Backlund and Marrone 1997). ABBs are black with orange-red markings. The most diagnostic feature of the ABB is the large orange-red marking on the raised portion of the pronotum (the upper surface of the first segment of the body that lies between the head and the abdomen), a feature shared with no other members of the genus in North America (U.S. Fish and Wildlife Service 2008). The ABB also has orange-red frons (the upper, anterior part of the head) and a single orange-red marking on the clypeus (the lower face located just above the mandibles). Antennae are large, with notable orange club-shaped tips.

Life History

The ABB is a nocturnal species active in the summer months (active season) when ambient nighttime air temperatures consistently exceed 60 °F (15.5 °C) (U.S. Fish and Wildlife Service 1991). They are most active from 2 to 4 hours after sunset (Walker and Hoback 2007). During the daytime, ABBs are believed to bury themselves in vegetation litter. Some weather conditions, including rain and strong winds, reduce ABB activity (Bedick et al. 1999).

ABBs fly and have been reported moving nightly distances ranging from 0.16 to 30 kilometers (km) (0.10 to 18.6 miles) in various parts of their range (Bedick et al. 1999; Creighton and Schnell 1998; Jurzenski et al. 2011; Schnell et al. 1997–2006). In Oklahoma, ABBs have been recorded to move approximately 10 km (6.2 miles) in 6 nights (Creighton and Schnell 1998). In Nebraska, one ABB was reported to move, wind-aided, approximately 30 km (18.6 miles) in one night (Jurzenski et al. 2011).

Individuals typically live for one year. Adults and larvae are dependent on carrion (flesh of dead animals) for food and reproduction. The ABB competes with other invertebrate species, as well as vertebrate species, for carrion. They are active in the active season and bury themselves in the soil during the winter months (inactive season). Adult ABBs burrow into the soil during the inactive season when ambient nighttime air temperatures consistently fall below 60 °F (15.5 °C) (U.S. Fish and

Wildlife Service 2008). In Oklahoma, this typically occurs for approximately 8 to 9 months from late September until mid-May (U.S. Fish and Wildlife Service 2014). The length of the active and inactive periods, however, fluctuates with temperature. Recent studies indicate that ABBs in Arkansas burrow to depths ranging from 0 to 8 inches (0 to 20.3 centimeters) during the inactive season (Schnell et al. 2007). Others have reported overwintering depths ranging from 0 to 27 inches (0 to 68.6 centimeters) (Hoback 2011).

The ABB begins reproduction soon after emergence from the inactive season, finding and securing a mate and carcass for reproduction. Adults bury a small vertebrate carcass and lay eggs beside it. When selecting carrion for burying in larval brood chambers, birds and mammals weighing from 1.7 to 10.5 ounces (oz.) (48.19 to 297.67 grams) are preferred, with an optimum weight of 3.5 to 7.0 oz. (99.22 to 198.45 grams; U.S. Fish and Wildlife Service 1991). Kozol (1990) found no significant difference in ABB preference for avian versus mammalian carcasses. ABB larvae use the carcass as a food source until they emerge. The entire reproductive process takes approximately 48 to 65 days (Kozol 1990). Following metamorphosis from larva to adult, tenerals (adult ABBs newly emerged from the pupal case) typically emerge from underground in late summer; although timing can vary based on latitude and weather conditions, and some presence/absence surveys in Oklahoma have documented tenerals in early summer (U.S. Fish and Wildlife Service 2016).

Adults locate carcasses using chemoreceptors on their antennae. ABBs are capable of finding carrion at a distance of up to 30 km (18.6 miles; Jurzenski et al. 2011). Success in finding carrion depends upon many factors, including availability of optimal habitats for small vertebrates, density of competing invertebrate and vertebrate scavengers, individual searching ability, reproductive condition, and temperature (Ratcliffe 1996). Once a carcass has been found, inter-specific and intra-specific competition may occur until a dominant male and female remain (Scott and Traniello 1989). Competition between Nicrophorus species can lead to injuries; burying beetles were commonly found with multiple appendages missing. Kozol (1990) reported that the ABB typically out-competes other burying beetles as a result of its larger size.

ABB larvae receive parental care during the entire time they are feeding and growing. This is an extremely rare behavior in insects, a condition normally found only in the social bees, wasps, ants, and termites. Both adults regurgitate food to begging larvae. The larvae grow rapidly and are soon able to feed themselves. The adults continually tend the carcass, removing fungi and covering the carrion ball with an antibacterial secretion. Sometimes the size of the brood is too large to be successfully reared on a small carcass, and both adults will cannibalize small larvae. After about a week, the larvae have consumed all but the bones of the carcass, and the adults fly away. Adults live only one season. The young pupate in the nearby soil and emerge as adults about a month later. Beetles overwinter in the adult stage.

Range

Historically, the ABB range covered over 150 counties in 35 states, including most of temperate eastern North America and the southern portions of three eastern Canadian provinces (U.S. Fish and Wildlife Service 2008). Documentation confirming the species' presence is not uniform throughout this broad historical range. More records exist from the Midwest into Canada and in the northeastern

United States than from the southern Atlantic and Gulf of Mexico region (U.S. Fish and Wildlife Service 2008). Its absence throughout much of its former range became apparent in the 1980s, and by 1989 the ABB was thought to occur only on Block Island, Rhode Island, and at one location in Oklahoma (U.S. Fish and Wildlife Service 2008). The last ABB specimens along the mainland of the Atlantic seaboard were collected in the 1940s (U.S. Fish and Wildlife Service 2008).

Currently, the ABB can be found in less than 10% of its historic range, with localized, extant populations known to occur in six states (U.S. Fish and Wildlife Service 2008). These locations include Block Island off the coast of Rhode Island, eastern Oklahoma, western Arkansas, the Sand Hills and Loess Hills regions in Nebraska, the Chautauqua Hills region of southeastern Kansas, south-central South Dakota, and northeastern Texas. Additionally, a reintroduced population on Nantucket Island off the coast of Massachusetts is thought to be stable and a recent reintroduction attempt in Missouri in 2012 has reported successful brood.

Habitat

The ABB is a habitat generalist and its habitat requirements, particularly for reproduction, may not be fully understood at present. ABBs have been successfully live-trapped in several vegetation types including native grassland, grazed pasture, riparian forest, coniferous forest, mature forest, and oak-hickory forest, as well as on a variety of soil types (Lomolino et al. 1995; U.S. Fish and Wildlife Service 2008). Habitat requirements include soils suitable for the burial of carcasses and carrion (U.S. Fish and Wildlife Service 1991, 2005). Although feeding mainly on a wide variety of carrion, this species may also capture and consume live insects (Scott and Traniello 1989).

Ecosystems supporting ABB populations are diverse and include primary forest, scrub forest, forest edge, grassland prairie, riparian areas, mountain slopes, and maritime scrub communities (U.S. Fish and Wildlife Service 2008). The ABB readily moves between different habitats (Creighton and Schnell 1998; Lomolino et al. 1995). However, it is believed to have more selective breeding habitat (suitable soils and vegetation layer) compared to its feeding habitat. Soil conditions must be conducive to excavation by ABBs (Lomolino and Creighton 1996). Soil moisture is also a factor because ABBs die quickly when desiccated (Bedick et al. 2006). Soils in the vicinity of captures are all well drained and include sandy loam and silt loam, with a clay component noted at most sites. Level topography and a well-formed detritus layer at the ground surface are common (U.S. Fish and Wildlife Service 2008).

Lomolino and Creighton (1996) found that ABB reproductive success was higher in forest versus grassland habitat in part because of the near absence of a leaf litter layer in grassland and the increased difficulty to bury carcasses, as grassland soils tend to be more compact than forest soils. However, of the carcasses buried, habitat characteristics did not significantly influence brood size. Furthermore, 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 (U.S. Fish and Wildlife Service 2008).

Habitat in the Plan Area

The Plan Area is located within the CPA of the ABB range in Oklahoma. The CPA includes areas with recent (within 10 years) documented ABB presence that USFWS believes are likely to contain important elements for ABB conservation and recovery, such as documented presence over multiple years, relatively high density populations, breeding, feeding, and sheltering habitat, and carrion resources.

Because the ABB is a habitat generalist, it can potentially occur in any non-urbanized portion of the Plan Area. USFWS has designated specific habitat conditions that are considered unfavorable, as listed below (U.S. Fish and Wildlife Service 2016).

- Land that is tilled on a regular basis, is planted in monoculture, and does not contain native vegetation.
- Pasture or grassland that has been maintained through frequent mowing, grazing, or herbicide application at a height of 20 centimeters (8 inches) or less.
- Land that has already been developed and no longer exhibits surficial topsoil, leaf litter, or vegetation.
- Urban areas with maintained lawns, paved surfaces, or roadways.
- Stockpiled soil without vegetation.
- Wetlands with standing water or saturated soils (defined as sites exhibiting hydric soils and vegetation typical of saturated soils, and/or wetland hydrology).

Land cover types in the Plan Area were mapped based on aerial imagery and field surveys, and areas unsuitable to ABB were identified based on the criteria in *American Burying Beetle Impact Assessment for Project Reviews* (U.S. Fish and Wildlife Service 2016).

Threats

Populations of the ABB have been extirpated from more than 90% of its original range. In the 1980s, entomologists documented the decreasing abundance of the ABB across its range. East of the Appalachian Mountains, the ABB declined in a generally north to south direction, and the decline was well underway, if not complete, by 1923. West of the Appalachians, the decline occurred later. In the Midwest, the decline appears to have proceeded generally from the center of the range outward, with all collections since 1960 occurring at the western and eastern peripheries of the range (U.S. Fish and Wildlife Service 2008).

While the cause for the decline of this species is not clearly understood, it could be a result of habitat fragmentation, habitat loss, carcass limitation (i.e. reduced availability of optimally sized carrion), pesticides, disease, light pollution, interspecific competition for carcasses, or a combination of these factors. The ABB Recovery Plan (U.S. Fish and Wildlife Service 1991) and the 5-year Species Status Review (U.S. Fish and Wildlife Service 2008) identify potential threats to the ABB, including disease/pathogens, pesticides, direct habitat loss and alteration, interspecific competition, loss of genetic diversity in isolated populations, increase in competition for prey, increase in edge habitat,

decrease in abundance of prey, agricultural and grazing practices, and invasive species. The primary cause, however, has been habitat loss and fragmentation (U.S. Fish and Wildlife Service 1991).

Land use changes that fragmented native forest and grasslands and created edge habitats (such as the edge between forest and grassland, or grassland and cropland), in addition to the removal of top-level carnivores such as grey wolf (*Canis lupus*) and eastern cougar (*Puma concolor*), during the westward expansion of settlement in North America caused a decrease of indigenous species and an increase in meso-carnivores that thrive in areas disturbed by humans. These species include American crow (*Corvus brachyrhynchos*), raccoon (*Procyon lotor*), red fox (*Vulpes fulva*), Virginia opossum (*Didelphis virginiana*), striped skunk (*Mephitis mephitis*), coyote (*Canis latrans*), feral cats (*Felis domesticus*), and other opportunistic predators (Wilcove et al. 1986). A number of these species, especially the raccoon and striped skunk, have undergone dramatic population increases over the last century (Garrott et al. 1993), and the coyote and Virginia opossum have expanded their ranges. These generalist predators have increased in abundance where edge habitats allow increased foraging opportunities (Ray 2000). Therefore, as habitat for species in the favored weight range for ABB reproduction decreased, populations of its predators (ABB competitors) increased, potentially further limiting ABB reproductive potential.

ABBs are attracted to artificial lighting (Kozol 1990), which can lead to disruptions of the species' normal behavior patterns. The species has been shown to respond differently to varying light sources, and ultraviolet or mercury vapor lights elicit stronger responses while sodium vapor lights are the least attractive to ABBs (Anshutz et al. 2007).

The red imported fire ant (*Solenopsis invicta*) has become a formidable competitor for carrion and a potential source of mortality for burying beetles when they co-occur at a food source (Warriner 2004). Scott et al. (1987) studied *Nicrophorus carolinus*, a burying beetle closely related to the ABB, in Florida and concluded that the inability of this species to successfully bury carrion was due to red imported fire ant interference. Collins and Scheffrahn (2005) noted that red imported fire ants may reduce ground-nesting populations of rodents and birds. Of the states containing populations of the ABB, red imported fire ants now occur in Arkansas, Oklahoma, and Texas, mainly in the Arkansas River valley and southward (U.S. Department of Agriculture 2003).

Fire may cause direct mortality of individuals during the ABB's active season (approximately May through July) (Howard et al. 2012), and can affect ABB habitat during the active or inactive seasons through loss of habitat and loss of food sources.

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