Salt Creek Tiger Beetle Reintroduction Plan
for
Nebraska Game and Parks Commission Properties

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for
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Prepared by:

Mike Fritz
Natural Heritage Zoologist
Nebraska Game and Parks Commission

Alicia Hardin
Wildlife Division Administrator

Nebraska Game and Parks Commission
2200 N 33rd St.
P.O. Box 30370
Lincoln, NE 68503

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Executive Summary

The Salt Creek tiger beetle is listed as an endangered species by both the Nebraska Game and Parks Commission (Commission) and the U.S. Fish and Wildlife Service (USFWS). In order to recover the species, the FWS Recovery Plan for the Salt Creek Tiger Beetle states the need to implement large-scale propagation and reintroduction efforts to restore populations of the Salt Creek tiger beetle (SCTB) in order to delist the species. Commission properties in the Little Salt Creek drainage contains both occupied and unoccupied suitable habitat while the Rock Creek drainage contains unoccupied suitable habitat for the SCTB. A large portion of these properties were purchased with funding from Section 6 grants for the recovery and conservation of the Salt Creek tiger beetle. The Recovery Plan states that priority reintroduction sites are to include areas acquired with this funding.

The Commission proposes to release SCTB onto its properties in the Little Salt Creek and Rock Creek drainages in order to advance the recovery and delisting of the SCTB. The Salt Creek Tiger Beetle Reintroduction Plan describes the background of the SCTB, the guiding principles the Commission will use in conducting releases, the steps in conducting releases, and the actions that will be taken to inform and involve private landowners and provide them assurances in order to avoid and minimize any potential impacts.

The Commission will use the following Guiding Principles in conducting releases of the Salt Creek tiger beetle on Commission properties:
1.) The Commission will hold Public meetings (in accordance with State Statute 37-807.4) to present information to the public on the date, location, possible impacts, assurance options, and other details regarding releases of SCTB on Commission property. Landowners with potential suitable habitat in the watershed will be contacted to inform them of the meetings.
2.) The Commission will use the best scientific information available to determine the appropriate dates, locations, and methods to maximize release success and minimize possible impacts of releases.
3.) The Commission will contact and provide information on releases to adjacent landowners and landowners with potential suitable habitat in the watersheds who might be impacted by releases. This will include information on assurances to avoid, reduce and minimize any impacts through the use of programs such as Safe Harbor Agreements, Experimental Population designation, and other options. Commission staff will meet with landowners as requested.
4.) The Commission will continue to work with its partners to improve release practices as well as develop management and restoration practices that contribute to the establishment of self-sustaining populations in order to facilitate the delisting of the species.

The release of SCTB on Commission property are proposed to occur in four phases:
Phase 1.) The first phase is augmentation of existing populations on Commission property within the Little Salt Creek drainage.
Phase 2.) The second phase is reintroduction of SCTB on Commission property within the Little Salt Creek drainage.

Phase 3.) The third phase is reintroduction of SCTB on Commission property within the Rock Creek drainage.
Phase 4.) Restoration activities are planned on Commission properties both in the Little Salt Creek and Rock Creek drainages that could provide additional habitat reintroduction sites.

The Commission will hold public meetings to present information to landowners on the date, location, possible impacts, assurance options, and other details regarding releases of SCTB on Commission property. Landowners adjacent to Commission properties will be contacted to inform them of the meetings. The Commission will contact and provide information on releases to adjacent landowners and landowners with potential suitable habitat in the watersheds who might be impacted by releases on Commission properties. This will include information on assurances to reduce and minimize any impacts through the use of programs such as Safe Harbor Agreements, Experimental Population designation, and other options. Commission staff will meet with landowners as requested.

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1. Introduction

The Salt Creek tiger beetle, *Cicindela nevadica lincolniana,* is one of the rarest insects in North America. It currently occurs in very low numbers exclusively in restricted habitats of remnant salt marshes of Lancaster County, Nebraska. Its historic distribution included saline wetlands in Saunders County. In March of 2001, the Nebraska Game and Parks Commission (Commission) listed the Salt Creek tiger beetle (SCTB) as endangered under the Nebraska Nongame and Endangered Species Conservation Act (NESCA). The U.S. Fish and Wildlife Service (FWS) listed the Salt Creek tiger beetle as a federally endangered subspecies on November 7, 2005 (70 FR 58335, October 6, 2005).

The FWS Recovery Plan for the Salt Creek Tiger Beetle (U.S. Fish and Wildlife Service, 2016) states the need to implement large-scale propagation and reintroduction efforts to restore populations of the Salt Creek tiger beetle at identified occupied and unoccupied recovery areas. Commission properties in the Little Salt Creek and Rock Creek drainages contain habitat designated by the FWS as Critical Habitat and have occupied and unoccupied habitat that can be used in reintroduction efforts to restore populations of the Salt Creek tiger beetle. The Recovery Plan states that priority reintroduction sites are to include areas acquired with funding from Section 6 grants for the recovery and conservation of the Salt Creek tiger beetle. Using funding from USFWS Section 6 Endangered Species Recovery grants, the Commission has purchased much of the remaining suitable SCTB habitat. It has also provided this funding to partners such as the Lower Platte South NRD, City of Lincoln, and Pheasants Forever for their acquisition of SCTB habitat.

Normal insect populations often number in the 100's of thousands to millions of individuals. In 2005 the annual population survey found only 153 Salt Creek tiger beetles in the wild, which at that time was a record low. At this level the species is vulnerable to extinction from a catastrophic event that can be localized in geographic scope. In order to prevent extinction it was necessary to develop a breeding program that can successfully rear SCTB in captivity. These individuals are also needed to augment existing populations and establish new populations that can survive catastrophic events and maintain viable populations in the wild. Because of the highly specific reproductive habitat used by SCTB there is only a very limited number of sites where they can be released. The protection of suitable habitat in conjunction with the reintroduction of captive SCTB, and restoration of reproductive habitat is necessary in order to recover and delist the SCTB.

The Commission proposes to release SCTB onto its properties in the Little Salt Creek and Rock Creek drainages. Releases will be conducted as augmentation of existing populations and reintroduction at sites where SCTB have been extirpated and management activities have restored or created suitable reproductive habitat.

2. Natural History

2.1. Life History

The Salt Creek tiger beetle, *Cicindela nevadica lincolniana*, is a small beetle approx. 0.5 inches in length. It is distinguished from other tiger beetles by its distinctive form and reduced markings and color pattern on its dorsal and ventral surfaces. The head and thorax are a dark brown and the wing covers are metallic brown/olive green with a narrow, light tan band on the wing margins and a reduced band that extends laterally into the middle of the wing cover. The underside of the beetle is a dark metallic green.

Adult SCTB typically begin their emergence in early to mid-June although emergence is based on each year's climatic conditions and in very warm springs adults have been observed as early as mid-May. Once they emerge they begin to feed and mate. Population numbers peak about two-weeks after the first individuals appear. Following mating and egg-laying, adults begin to die in late-July due to senescence. Adult life spans are only 4-5 weeks and adults are present at a location for 5-6 weeks each year.

After mating, the female deposits each egg in a small hole which she has dug. Eggs are laid on barren salt flats of saline wetlands, or along sloping banks of streams where there is exposed salt layers. The female will only deposit eggs at sites with a very narrow range of soil salinity and moisture. It is believed that wild female Salt Creek tiger beetles lay approximately 50 eggs at night in the wild (Farrar 2003). Eggs hatch in approximately two weeks. Upon hatching the young larva uses its head to dig a burrow. This is the burrow that the larvae will use for the next two years of its life. SCTB larvae develop through three instars before pupating. With each instar the larvae increase in size and also increase the diameter and depth of its burrow. In the third and last instar the burrow may be up to 18 inches deep.

In the wild, the Salt Creek tiger beetle has a two-year life cycle, although under captive rearing conditions the larvae can mature and emerge as adults in one year. This indicates that the availability of prey items is the limiting factor in the length of the life cycle. Larvae typically pupate in May of the second year and then emerge as adults. The two-year life cycle means populations of the Salt Creek tiger beetle are naturally cyclical over time and the range of population numbers size may be considerable on a yearly basis due to climatic variation, reproductive success, and environmental factors.

Adults and larvae are predators of other small insects and arthropods. Salt Creek tiger beetles require an abundant and diverse prey base consisting of flying and non-flying invertebrates from many orders and families (Larochelle 1974, pp. 21-43). Most common prey are adults or immature of beetles, bugs, leaf hoppers, flies, moths, etc. Larvae are ambush hunters lying with their head in the burrow opening and lunging out at distance of ¾ of their body length to capture a prey item. This means that the whole hunting area for a third instar larvae is a circle no more than 1 ½ inch in diameter. The area is smaller for younger instars. Prey items are typically ant size or smaller. The small

hunting area and prey size means there is a limited availability of prey and is results in the two-year life cycle.

Although adults can prey on a greater diversity of available prey than larvae, both adults and larvae are predators of similar-sized insects. Tiger beetles have been observed to eat insects from many orders and families (Larochelle 1974, pp. 21-43). Most common are adult and immature beetles, leaf hoppers, bugs, wasps, flies, moths, etc. Ants (Formicidae) are the most commonly observed prey of adult Salt Creek tiger beetles in the field (Allgeier 2005, p. 5). While adults have a larger hunting area than larvae, they are limited to hunting on open salt flats, and sand bars and bare shorelines of streams. Adults are fast runners and typically run down their prey although they can capture flying insects. (Allgeier 2005, p. 5; Spomer 2005, pers. comm.).

2.2. Habitat Requirements

The Salt Creek tiger beetle is endemic to the saline seeps and salt flats in the Salt Creek and Little Salt Creek drainages of Lancaster county and the Rock Creek drainage of Lancaster/Saunders county. They are found nowhere else in the state or North America. The entire life cycle of SCTB occurs in saline wetlands on exposed saline mud flats or along banks of streams and seeps that contain salt deposits and are sparsely vegetated (Carter 1989; Spomer and Higley 1993; Spomer et al. 2004a).

The Salt Creek tiger beetle has very specific habitat requirements both as adults, larvae, and for reproduction. Adult Salt Creek tiger beetles are confined to moist soil areas within a few meters of seeps, salt flats, wetlands, and stream edges. Adults require open, salt flat areas for foraging; nearby vegetation for escape from predators and heat; and a nearby permanent water source for thermoregulation and drinking; (Spomer and Higley 1993; Higley 2002, pers. comm.; Spomer 2005, pers. comm.).

Salt Creek tiger beetle larvae require continuous moist soils conditions close to seeps or a saline water source to prevent larval desiccation, maintain larval burrows, and for foraging (Spomer and Higley 1993, p. 396). Larval burrows are only found in association with hydrated bare salt flats located along edges of saline streams and saline wetlands (Spomer 2005, pers. comm.).

Living in wetland and stream habitats, larvae of the Salt Creek tiger beetle have adapted to short-term elevated flows, inundation, and anaerobic conditions resulting from flooding and highwater events. Salt Creek tiger beetle larvae plug their burrows and switch from aerobic to anaerobic respiration to avoid short-duration inundation by floods (Spomer 2005, pers. comm.). Although no studies have confirmed these hypotheses for SCTB larvae, Hoback *et al.* (1998, p. 31) found that larvae of *Cicindela togata*, a tiger beetle found in close association with the Salt Creek tiger beetle, were able to survive without oxygen for an average of 6 days.

The SCTB requires a very specific and narrow range of soil salinity and soil moisture for reproduction. The female will only deposit eggs on sites with a salinity range between 2,016.0 mS/m and 2,992.2 mS/m (Allgeier 2005, p. 72). A number of other species of

tiger beetles inhabit saline wetlands and the SCTB utilizes the second highest range of salinity of any species. Field measurements also demonstrate that Salt Creek tiger beetles prefer mean soil moistures of around 47.6 percent (Allgeier 2005, p. 72). The adaptation to a very specific range of salinity and moisture is called habitat or niche partitioning and it enables the Salt Creek tiger beetles to coexist and compete with the other species of tiger beetles that occupy saline habitats. However, these very specific habitat requirements result in a very limited amount of available habitat in which the SCTB can successfully reproduce.

The adult female SCTB will only deposit her eggs in the very narrow and specific range of soil salinity and soil moisture. By selecting for this narrow range of conditions, she reduces the competition for her larvae with larvae from other tiger beetles which do not utilize these habitat conditions. It is this combination of specific requirements that limits the habitat use of the SCTB not only to saline wetland flats but to a very specific portion and type of habitat within the flats. Without these conditions the SCTB will not utilize sites for reproduction.

2.2.1. Historic and Current Available Suitable Habitat

Historically, virtually all SCTB habitat was situated on the surface of the floodplains associated with the Oak Creek, Salt Creek, Little Salt Creek, and Rock Creek drainages. Prior to channelization and down cutting, these stream channels were considerably shallower than they are at present day. Based on historic photographs, the small tributaries that connected the surface saline seeps, saline wetlands, and salt flats to the adjacent streams where very shallow, being only one to several feet deep. These surface seeps meant that large areas of the floodplain around the seeps maintained moist soil due to high groundwater levels. It also means that the highly saline groundwater created large areas of salt flats. As discussed below, channelization and streambed degradation have resulted in the groundwater being intercepted and the subsequent loss and degradation of saline habitat.

At the time of settlement, there were an estimated 65,065 acres of saline wetlands, seeps and salt flats within the floodplain of Salt Creek and its tributaries (Gilbert and Stutheit 1994, p. 5). A more recent assessment identified approximately 15,000 ac of remaining similar saline habitat much of which is highly fragmented and degraded. Within this remaining habitat only a small percentage represents habitat that will support sustainable populations of SCTB. In May of 2014, the U.S. Fish and Wildlife Service (Service) published a revised final rule designating approximately 1,933 acres of critical habitat for the Salt Creek tiger beetle. Critical habitat encompasses occupied habitat, saline seeps needed to maintain habitat, buffer areas, and habitat that acts a movement corridor for the beetle (U.S. Fish and Wildlife Service. 2014).

Of the remaining habitat, most reproductive habitat sites are less than 0.1 acre which are unlikely to provide the necessary habitat needed for the sustainability and recovery of Salt Creek tiger beetle populations. This spatial distribution of

remaining saline wetlands also reduces the connectivity between metapopulations and populations thereby eliminating genetic interchange and the ability to repopulate after catastrophic events (Murphy et al. 1990; Fahrig and Merriam 1994; Ruggerio et al. 1994; Noss 2002). Due to the degradation of habitat, restoration actions will be needed in order to provide the necessary amount of habitat needed for the recovery of the species.

2.2.2. Dispersal Ability

Within the areas of occupied habitat, the majority of SCTB in a population will typically only move short distances. A few individuals have been documented moving longer distances. In two mark-recapture studies, a total of several hundred adult SCTB were marked for tracking. Study results showed that the mean distance traveled by the marked individuals was 138 feet. Based on re-observations only four SCTB were verified moving out of the immediate area where they were marked. The maximum distances moved by the four were between 1070 and 1,509 feet. All moved between a saline stream and saline wetland habitats (Allgeier 2005, pp. 49-50). Salt Creek tiger beetles also have been observed moving among salt flats and seeps along saline stream edges, using barren mid-channel and scoured bank habitats and mid-stream gravel bars as dispersal areas. (Spomer 2005, pers. comm.; Harms 2003, pers. comm.).

Salt Creek tiger beetles can disperse from one mid-channel bar to the next, which enables them to move up and down stream courses in response to habitat changes. These short-range movement corridors are necessary to repopulate areas extirpated due to habitat loss or extreme weather events (Murphy *et al.* 1990).

During periods of high winds, the Salt Creek tiger beetle probably has some long-range dispersal capability, an adaptation that enables it to colonize well-separated habitat. However, in order for SCTB to establish a new population, the site must have the very specific habitat characteristics needed to sustain a population and necessary for reproduction. It is also necessary for a number of both male and female individuals to colonize the same site in order to establish a population.

3. Status

3.1. Conservation Status

The Salt Creek tiger beetle, *Cicindela nevadica lincolniana*, is one of the rarest insects in North America. It occurs in very low numbers exclusively in restricted habitats of remnant salt marshes of Lancaster and Saunders County, Nebraska. In March of 2000 the Nebraska Game and Parks Commission (Commission) listed the Salt Creek tiger beetle (SCTB) as endangered under the Nebraska Nongame and Endangered Species Conservation Act (NESCA). The U.S. Fish and Wildlife Service (Service) listed the Salt Creek tiger beetle as a federally endangered subspecies on November 7, 2005 (70 FR 58335, October 6, 2005). The Service published a revised final rule (79 FR 26013) on

May 6, 2014, designating approximately 1,933 acres of critical habitat for the Salt Creek tiger beetle in Lancaster and Saunders Counties in Nebraska. The U.S. Fish and Wildlife Service finalized the Recovery Plan for the Salt Creek Tiger Beetle in December of 2016 (U.S. Fish and Wildlife Service, 2016).

3.2. Distribution

The Salt Creek tiger beetle has one of the most restricted distributions of any species in the U.S. It is a species that is endemic to the saline wetlands in northern Lancaster county. From historically collections through present day surveys it has only been found in the Salt Creek and Little Salt Creek drainages of Lancaster county and the Rock Creek drainage of Lancaster/Saunders county. Within these drainages it is only found in limited segments of creek channels with saline seeps and adjacent remnant saline wetlands. The SCTB was first collected in 1888 from what was called the Salt Basin/Lake (now highly modified and called Capitol Beach). Historical collections up through the early 1970's were primarily from the area of the Salt Basin or the adjacent saline wetlands. Surveys in the late 1980's found populations along Little Salt creek near north 27th St. Surveys in the early 1990's through present have documented a number of localized populations of SCTB at multiple sites. Some of these smaller populations are in close enough proximity to interact with each other, these connected populations comprised six metapopulations. Metapopulations are found in the Oak Creek, Lower Little Salt Creek, Upper Little Salt Creek, and Rock Creek drainages. Recent annual surveys have not found SCTB for a number of years at two metapopulations and these are now considered extirpated. These metapopulations are in the Oak Creek and Rock Creek drainages. Currently all four of the extant populations occur in the Little Salt Creek drainage; they include the Arbor Lake, Roper, Lower Little Salt Creek, and Upper Little Salt Creek Metapopulations. Of the four extant metapopulations only portions of two populations occur on private land, all other extant populations occur on public lands. Public entities owning property with extant populations include the Nebraska Game and Parks Commission, the Lower Platte South NRD, and the City of Lincoln. Public entities owning property with extirpated populations include the Nebraska Game and Parks Commission and the Nebraska Dept. of Transportation.

3.3. Population, Abundance and Trends

Annual population surveys were begun by University of Nebraska – Lincoln researchers in 1991. Initial years surveyed known occupied sites and populations were added as new locations were surveyed. Total population numbers fluctuate from year to year. These fluctuations are attributed to the two-year reproductive cycle, and environmental and climatic events. The highest population numbers observed were 777 individuals in 2002. Population numbers in 2003 were 743 and then declined to 558 in 2004. In 2005 total population numbers dropped precipitously to just 153 individuals. This decline was the impetus to initiate captive rearing research to prevent the potential extinct of SCTB in the wild. Since this decline, the population numbers have continued to fluctuate but have never increased to more than 374 in 2012. A new low population number of 143 individuals were observed in 2014 following catastrophic flooding events in 2014. The

annual population survey in 2018 observed 370 SCTB. The numbers of both larvae and adults released on City of Lincoln and Lower Platte South NRD properties have increased since 2014.

Despite having been documented historically in six metapopulations, both the number of metapopulations and number of local populations have been in decline. Surveys of the metapopulations in the Oak Creek and Rock Creek drainages have not found any SCTB since 1998 and both of these are now considered extirpated. In the remaining four metapopulations the number and size of sites occupied by SCTB has decreased by nearly half.

3.4. Threats

Stream Channelization and Incisement

A flood control plan was developed and implemented by the city of Lincoln in the 1950's to reduce the frequency of flooding by Salt Creek. The plan was developed in response to the frequent flooding of areas adjacent to Salt Creek. A main component of the plan was the channelization of Salt Creek from Lincoln to Ashland and the construction of levees and reservoirs (Farrar and Gersib 1991; Murphy 1992). Channelization of Salt Creek has subsequently resulted in the head-cutting of tributaries such as Little Salt, Oak, and Rock Creeks and the continued deepening of channels as their stream beds erode lower to adjust to the bed gradient. The channelization and incision of the streams has drained the majority of saline wetlands that were located on the surface of the floodplain adjacent to these streams. Historically, these saline wetlands and associated saline flats were created and maintained by highly saline ground water seeping to the surface and spreading across the floodplain. The incision of the channels has also allowed the saline ground water to be intercepted by the streams at a lower elevation thus eliminating both the water for the seeps but also the source of salt that maintained the saline wetlands and flats. The on-going long-term effects of these past channelization projects continue to cause the loss and degradation of saline wetlands and salt flats required by the Salt Creek tiger beetle (Harvey et al. 2007).

The head cutting and deepening of channels has created additional major impacts on SCTB and their habitat. The draining and drying of saline wetlands has severely reduced the amount and quality of suitable habitat available to the SCTB. Much of the habitat currently occupied by the largest SCTB populations are saline seeps on the lower portion of banks along Little Salt Creek. These seeps represent the interception of the saline ground water that historically would have created the large complex of seeps and saline flats on the floodplain. On the stream bank these seeps and salt barrens are greatly reduced in size and number, reducing the availability of suitable SCTB habitat. In addition, their location on the stream bank exposes them to severe erosion by high water events. In early May of 2014 an intense rainstorm that produced over 7" of rain in 24 hours and created an extreme high water event on Little Salt Creek and its tributaries. This caused sections of bank to be eroded back up to 18". Since most larvae burrows are between 12"-18" in depth, larvae occurring at these sites were washed away. These high water events have continued with SCTB habitat being subjected to four abnormally high

water events between May 2014 and May 2015 and an average of two per year since then. Due to steepness and erosion, stream banks regularly slough off, burying larvae in their burrows, burying the saline seeps required by adult SCTB for egg laying, and eliminating the bare soil areas that adults need for foraging. It is believed that the steep slopes of the bank reduce the availability of prey items for larvae.

Agricultural Development

Agricultural practices can threaten Salt Creek tiger beetle habitat. Livestock are attracted to exposed salt and can destroy or substantially degrade salt barren habitats for adult and larvae of the Salt Creek tiger beetle through trampling, which can destroy larval burrows and the larvae that inhabit them (Spomer et al. 2001). Cattle grazing also can compact soil and modify soil hydrology, gradually drying out a site and making it unsuitable for adults and larvae (which prefer moist, muddy sites with encrusted salt on soil surfaces). Historically, large herds of bison, pronghorn, and elk were known to regularly use and graze saline wetlands. Grazing has also been associated with saline wetlands since settlement and is undoubtedly an important component of their management. Grazing can be an effective land management tool to control encroachment of aggressive vegetation when done at appropriate stocking rates and times and with use of enclosures to prevent damage to salt barrens and seeps along stream banks. With the very small population numbers of SCTB and very limited habitat at most locations there is a balance between preventing too much impact from grazing and grazing enough to prevent the encroachment of vegetation.

Cultivation can pose a threat to Salt Creek tiger beetle habitats generally through indirect means. Cultivation can increase sediment erosion and result in the introduction of pesticides into adjacent saline wetlands, especially in the absence of a grass buffer. Flooding and over covering by sediment originating from cultivated areas may have caused the extirpation of the Jack Sinn WMA metapopulation of Salt Creek tiger beetles. A series of high water events in the Rock Creek drainage in the 1990's resulted in the deposition of large amounts of silt over the floodplain. The larvae were unable to remove the 3 or more inches of sediment deposited onto their burrows because they extract excess soil material out and away from their burrow, not inward (Spomer et al. 2004a). The flood also changed the vegetation of the area. Before the flood, there were large areas of saline wetlands and salt flats present, after the flood, a thick herbaceous over-story composed of reed canarygrass and cattails infested the area, making it unsuitable for the Salt Creek tiger beetle.

Urban and Rural Development

Commercial, residential, urban, and agricultural developments have been the main threat for the conversion of saline wetlands (Gilbert and Stutheit 1994; Ratcliffe and Spomer 2002). From the 1930s to the 1950s, saline wetlands were destroyed for the development of Lincoln (Farrar and Gersib 1991). In the 1960s, construction of Interstate 80, through the heart of the remaining Salt Creek tiger beetle habitat, resulted in additional filling, dredging, diking, draining, and diversion (Farrar and Gersib 1991). Although the Lincoln Comprehensive Plan greatly limits the development of saline wetlands directly, the development of residential acreages, and development adjacent to

saline wetlands continue to threaten SCTB habitat.

An example of development prompted by growth of the City of Lincoln is the diking of Salt Basin to create Capitol Beach at the turn of the 20th century, which resulted in the subsequent ditching, draining, and filling of the associated saline wetlands. Construction of Interstate 80 northwest of Capitol Beach resulted in the continued filling of saline wetlands in the area. These activities caused the extirpation of the Oak Creek metapopulation, possibly the largest historic metapopulation of Salt Creek tiger beetles and the location of the type locality for the subspecies (Murphy 1992; Rus et al. 2003).

Construction of the North 27th Street interchange along Interstate 80 facilitated the conversion of a large grassland, saline wetland, and stream complex to extensive commercial and residential developments. The Little Salt Creek-Roper metapopulation of Salt Creek tiger beetles in the area of Interstate 80 and the North 27th Street interchange is nearly surrounded by commercial and residential developments.

Historically, the saline seeps produced the highly saline soils of the saline wetlands and salt flats which prevented the establishment and encroachment of dense vegetation. Freshwater runoff from agricultural, commercial and residential developments dilutes the salinity of saline wetlands converting them from saline to freshwater. The dilution by freshwater runoff exacerbates the lack of saline ground seeps that historically would have replenished salt supplies after rainfall events. The continued flushing by freshwater runoff and lack of salt replacement has lowered the salinity of these sites, allowing salt flats to become densely vegetated by non-saline tolerant plants. Species such as cattail, reed canary grass, smooth brome, and broadleaf plants have eliminated or severely degraded habitats used by the SCTB. The encroachment of these plant species converts the open salt flats and barrens to vegetated, shaded habitat, which is unsuitable for SCTB thermoregulation, reproduction, and foraging. The SCTB has a very specific range of high soil salinity and soil moisture which it is adapted to for egg laying. The loss of these highly saline sites due to flushing by freshwater eliminates the habitat required by SCTB for egg deposition.

Artificial Light Pollution

Commercial and residential development in the vicinity of SCTB habitat has resulted in the conversion of a natural dark night sky to a sky that is now lit all night by artificial lighting along Interstate 80, the associated residential and commercial developments adjacent to north 27th Street, and ambient light pollution of Lincoln. Artificial light pollution has been shown by numerous studies to impact and reduce populations of insects that are active at night (Pyle et al. 1981). Allgeier documented that female Salt Creek tiger beetles lay eggs at night (Allgeier et al. 2003), and his studies also showed that they are attracted to artificial light sources (Allgeier 2005). It is very possible that the ambient nighttime light pollution may reduce reproduction by drawing females away from suitable breeding habitat and disrupting egg laying (Allgeier et al. 2004).

Small Population Size and Limited Distribution

Small population numbers and limited distribution present specific types of threats to

which larger well distributed species are not vulnerable. It has been identified that small, close occurring populations are subject to increased extinction rates (Murphy et al. 1990) and (Gilpin 1987). There are several sources of threats for small, closely distributed populations. The reduced habitat areas, close distances between populations, and small population size make them vulnerable to extinction from catastrophic events that can impact all or the majority of populations concurrently. Currently all extant populations of the SCTB occur within the Lower Little Salt Creek, Upper Little Salt Creek. As illustrated by the 2014 high water event it has been shown that extreme rain and high water events can have a major impact on overall SCTB populations. The high water of 2014 and subsequent major rainfall events have, to some extent, been localized within the Little Salt Creek drainage, thus limiting the magnitude of impact to only a portion of populations. If a major rainfall event the magnitude of 2014 occurred throughout drainage, the impact could reduce wild populations to a number from which they could not recover on their own.

In addition to high water events, populations are subject to other catastrophic events. In 2012, a moderately sized pesticide spill occurred on a small tributary in the upper portion of Little Salt Creek drainage. Fortunately, the spill was of a size and high enough in the drainage that is was remediated before it could impact SCTB populations. However, this event, along with the very low population numbers in 2012, illustrated the vulnerability of SCTB populations and served as an impetus to begin the captive breeding program in order to prevent the extinction of the SCTB. Large quantities of pesticides and other toxic chemicals are regularly hauled on roads within the Little Salt Creek drainage and a major spill or other catastrophic event could have a serious impact on SCTB populations and potentially result in extinction.

Small population size also reduces the ability of a local population to sustain itself. Minimum population numbers are needed for successful reproduction. Because SCTB emerge over a period of several weeks, enough male and female individuals need to be present at any one location at the same time in order to be able to mate. Habitat fragmentation can isolate populations and prevent the interaction of individuals needed for successful breeding. This isolation can also cause inbreeding which may affect the survivability of a population. Every species is subject to a certain rate of mortality due to predation, disease, and other environmental factors. This means that a minimum number of individuals are needed in a population in order to ensure a reproduction rate that will surpass this mortality rate and sustain the population. At very low population numbers the impacts to populations from predators and disease become amplified and can contribute to the extirpation of a population.

4. **USFWS Recovery Plan**

The U.S. Fish and Wildlife Service finalized the Recovery Plan for the Salt Creek Tiger Beetle in December of 2016 (U.S. Fish and Wildlife Service, 2016). The plan presents a detailed discussion on; the threats and conservation needs for recovery; the strategy, goals, objectives, and criteria for recovery; and actions needed for recovery. The areas of the Recovery Plan pertinent to this reintroduction plan are summarized as follows:

Land protection (through acquisition or easements), habitat restoration and management for the benefit of the Salt Creek tiger beetle, and reintroduction efforts are anticipated to be necessary to increase metapopulation sizes to within a range of 500-1,000 individuals.

Salt Creek Tiger Beetle Rearing, Propagation, and Reintroduction
Implement large-scale propagation and reintroduction efforts to restore populations of the Salt Creek tiger beetle at identified occupied and unoccupied recovery areas. Reintroductions are to be made at sites with existing and/or restored suitable habitat with priority on sites with permanent protection or long-term conservation agreements where management practices for the Salt Creek tiger beetle are the main objective. Priority reintroduction sites are to include areas acquired with funding from Section 6 grants for the recovery and conservation of the Salt Creek tiger beetle.

4.1. Recovery Plan Goals

Recovery Strategy: The recovery strategy is to establish at least six metapopulations in four recovery areas. Recovery areas are identified based on site inspections, soil surveys (including the presence of saline soils), and restoration feasibility. Accomplishing this strategy requires acquisition of land or conservation easements, focused habitat restoration and management projects, and reintroductions.

Recovery Goals, Objectives, and Criteria: The goal of the Recovery Plan is to recover the Salt Creek tiger beetle such that it no longer meets the Endangered Species Act's (Act) definition of threatened and can be removed from the Federal List of Endangered and Threatened Wildlife.

- Criteria (downlisting) – The criteria for downlisting is: a) establishment of three self-sustaining metapopulations of Salt Creek tiger beetles each numbering between 500 and 1,000 individuals; b) establishment of these three metapopulations in three recovery areas; and c) no net loss of saline wetlands and streams and their associated functions in Rock, Little Salt, Oak, and Haines Branch Creeks and their floodplains.

- Criterion (delisting) – The criteria for delisting is the establishment of six metapopulations of self-sustaining metapopulations (including the three required for downlisting) of Salt Creek tiger beetles each numbering between 500 and 1,000 individuals and sustainability in at least four recovery areas.

4.2. Need for Reintroduction of SCTB

4.2.1. Prevention of extinction

Small metapopulations of Salt Creek tiger beetles are not sustainable and tend toward extirpation (For example, see Appendix A, Survey Results for Jack Sinn WMA and Oak Creek Metapopulations). Murphy et al. (1990) and Gilpin (1987) recognized a direct association between increased extinction rates of a species and reduced habitat areas, distances between populations, and small population size. Small populations are not sustainable due to several factors.

- Small numbers of individuals reduce effective reproduction. SCTB adults emerge over a period of several weeks. When populations reach low numbers there are fewer and fewer adults that are present at site at any one time. This means there is less opportunity for adults to find a mate and breed.

- Small populations are effected to a greater extent by small habitat size and loss of habitat as these impacts further reduce the ability of a population to successfully produce the number of SCTB needed to maintain a stable population.

- Small populations have low resilience and are much more susceptible than larger populations to catastrophic events such as inundation and erosion due to high water events, or chemical spills.

- The negative effects of habitat fragmentation and loss of the total number of individuals within a population include the loss of genetic diversity (Lacy 1987). Loss of genetic diversity can lead to a reduction in; fertility, number of eggs produced, and survivability of eggs, larvae, and adults.

The augmentation and reintroduction of captive-reared SCTB provides a means to increase population numbers at sites with low numbers of SCTB thus stabilizing and enhancing their numbers and increasing their resilience and viability.

4.2.2. Recovery and downlisting/delisting

The Recovery Plan identifies propagation and reintroduction as Priority 1 actions: "Priority 1 (a) – An action that must be taken to prevent extinction or to prevent the species from declining irreversibly in the foreseeable future.

1(a) 3.1.1 Experimental Propagation and Reintroduction
1(a) 3.3 Full Scale Propagation and Reintroduction"

Two factors offer the potential to significantly increase numbers of Salt Creek tiger beetles in the wild. These are augmenting small and declining metapopulations and the reintroduction of individuals at extirpated sites once habitat is restored. Appropriate management is then to be implemented to maintain suitable habitat. These actions are necessary to the recovery of the species.

As described previously, the majority of extant SCTB populations are small and most are declining. The release of additional captive-reared SCTB into these populations can maintain and increase population numbers thus preventing their extinction. This will provide the time needed to implement restoration actions that will stabilize and increase habitat which can support increased population numbers and ultimately create stable, self-sustaining populations.

Restoration actions have been undertaken at several sites and are planned for a number of additional locations. Augmentation and reintroduction of captive-reared SCTB is necessary at restoration sites both with and without extant populations. At sites with small, extant populations where restoration activities have restored and increased suitable habitat, the augmentation of SCTB can increase the population to levels that will stabilize it and allow it to increase.

Reintroduction is the only way that new SCTB will become established at sites where SCTB have been extirpated but subsequent restoration activities have restored and increased suitable habitat. Reintroduction will establish reproducing populations and subsequent augmentation will increase population numbers and ultimately create stable, self-sustaining populations.

Both augmentation and reintroduction will facilitate the establishment and growth of populations much faster than non-supplemented populations and are necessary to meet the criteria established for downlisting and delisting.

4.3. Captive Rearing and Reintroduction Program

In 2005 the annual population survey found only 153 Salt Creek tiger beetles in the wild, which at that time was a record low. In order to prevent the potential extinction of the Salt Creek tiger beetle, the Commission, using Sec. 6 funding from the FWS, worked with the University of Nebraska – Lincoln to initiate research into the propagation of SCTB in a captive setting. Based on the results of this research the Commission and the FWS Nebraska Field Office (Service) established a Captive Rearing and Reintroduction Program for the Salt Creek tiger beetle in 2011 with the participation of the University of Nebraska – Lincoln (UN-L) Entomology Dept., the Henry Doorly Zoo (HDZ) in Omaha, NE and the Lincoln Children's Zoo (LCZ) in Lincoln, NE. The Program has two components, the first is the production of individuals in a controlled setting and the second is the reintroduction of individuals into suitable habitat. The production of ample numbers of individuals to effect population numbers is the first step in a reintroduction program. The second step is the successful reintroduction of those individuals into the wild.

Early captive breeding attempts produced fewer than 50 larvae. Following refinements of breeding protocols in 2012, 332 larvae were produced in 2013. Continued refinements of breeding methods and modifications including the use of captive reared adults for breeding have continued to increase the number of larvae produced through captive rearing. Through 2014 captive rearing work had been conducted with 15 pair of adult of SCTB obtained from the wild on an annual basis. Due to the record low numbers of SCTB observed in the wild during the 2014 annual population count, it was decided that no wild individuals would be taken for use in captive breeding for 2015. Instead, captive reared larvae were held back, allowed to pupate and the adults used for captive rearing. In 2015, seventeen pairs of SCTB produced 1351 larvae before breeding was halted.

Current breeding protocols demonstrate that we can consistently produce 800+ larvae per year. While the success in producing larvae and adult SCTB is very positive for the captive rearing portion of the Program, the large number of larvae produced requires a significant commitment of personnel to feed and care for the larvae. An annual production target of 700-800 larvae was established in 2017 based on the working capacity of facility space, available incubators and personnel available to conduct captive breeding and feed and maintain larvae during the rearing phase. The current protocols have the ability to produce significantly greater numbers of larvae annually but would require additional personnel resources and rearing facilities, including incubators.

The current target represents the full capacity of the three facilities at the UN-L Entomology Dept., the Henry Doorly Zoo and the Lincoln Children's Zoo. Maintaining the Program at the current level of capacity requires purchasing breeding and rearing supplies, purchasing and maintaining a supply of prey items for feeding larvae, and maintaining incubators for housing larvae during the rearing process. Most importantly it requires a commitment of significant personnel resources that is required to care for adults and monitor egg laying during the breeding phase and to feed, monitor and maintain the larvae during the captive rearing phase.

4.3.1. Pilot reintroductions and releases

The pilot program for reintroductions began in 2012 with the release of only 11 SCTB larvae. Since that time the increase in production has greatly increase the number of larvae available for reintroduction. Initial reintroductions consisted of the release of only larvae. While the earliest releases were only conducted in the spring, in order to maintain a manageable number of larvae during the captive rearing phase, larvae in excess of the target number are also released during the fall. The release of larvae is straight forward. At the reintroduction site a suitable, moist saline soil location is selected and a small dowel, the approximate diameter of the larva, is used to make a small hole approx. 1 inch deep. The larva is then placed at the opening of the hole which it will immediately enter and begin to dig a burrow.

As part of the pilot reintroduction program it was decided that a test of adult releases would be made. In 2015 and 2016 larvae were retained to allow them to pupate and produce adults for a test of releasing adults into the wild. A total of 23 adults were produced and released in 2015 and 28 in 2016. Releases are made at locations with known extant populations in order to augment wild populations and provide the increased opportunity for breeding and reproduction. In 2017, 140 adults were produced and released as part of a study. Prior to release, all adults were marked with a small spot of paint. During a 10-day period, marked individuals were regularly observed at the release site and were observed interacting with non-marked wild SCTB.

4.3.2. Reintroductions by other entities and their authorization process

The pilot reintroduction program has been conducted on properties owned by the Lower Platte South NRD and the City of Lincoln, which are managed by the

Parks and Recreation Department. Reintroductions are conducted by personnel from the Commission, the USFWS, UN-L Entomology Dept., the Henry Doorly Zoo, the Lincoln Children's Zoo and UN-L Master Naturalist volunteers. Between the initiation of the pilot reintroduction program in 2012 and 2017 a total of 1245 larvae and 191 adults have been reintroduced at 8 locations on 4 different public areas. The Lower Platte South NRD and City of Lincoln are contacted on an annual basis to obtain permission for the reintroduction of SCTB. Permission is requested either by letter or email. Notification of authorization is also either by email or letter. The Natural Resources and Greenways Manger for the City of Lincoln and the General Manager for the Lower Platte South NRD provide the authorization for their respective agencies. Representatives from the Lower Platte South NRD and the City of Lincoln, Parks and Recreation Department have been present at and participated in all of the reintroductions. There have been no concerns expressed by the public or issues concerning private lands with any of the releases made through July 2018.

5. Role of WMAs in Meeting Recovery Goals

In its final Revision of Critical Habitat for the Salt Creek tiger beetle, all of the Commission properties in the Little Salt Creek and Rock Creek drainages contain habitat designated by the FWS as Critical Habitat. (U.S. Fish and Wildlife Service. 2014). Critical habitat is defined as habitat that is "essential to the conservation of the species and includes habitat for food, water, …cover…and sites for breeding, reproduction, or development of offspring". The Commission properties in these drainages all contain habitat that meet these requirements of the SCTB. The FWS Recovery Plan for the Salt Creek Tiger Beetle (U.S. Fish and Wildlife Service, 2016) states the need to implement large-scale propagation and reintroduction efforts to restore populations of the Salt Creek tiger beetle at identified occupied and unoccupied recovery areas. The Commission properties fulfill both of these roles.

Funding obtained by the Commission from U.S. Fish and Wildlife Section 6 Recovery Lands grants was used in the acquisition of all Commission lands in the Little Salt Creek drainage. This funding is specifically designated for the acquisition of lands for the recovery of federal listed species. The Recovery Plan states that priority reintroduction sites are to include areas acquired with funding from Section 6 grants for the recovery and conservation of the Salt Creek tiger beetle.

Although no Section 6 funding has been used in the acquisition of Commission properties in the Rock Creek drainage the properties have designated critical habitat which is identified in the Recovery Plan for recovery actions including reintroduction. Future acquisitions in the drainage may include funding from Section 6 grants.

6. Reintroduction on Commission Properties

6.1. Evaluation of Suitable Habitat on WMAs

Commission properties in the Little Salt Creek and Rock Creek drainages have undergone several levels of evaluation to identify potential suitable habitat for SCTB releases. Evaluations included using soil maps to identify the location of saline soils on Commission properties and aerial imagery to identify salt flats which represent potential suitable habitat sites. Ground surveys were then conducted by SCTB habitat experts to verify habitat suitability and identify sites which meet SCTB life cycle requirements. Experts conducting on ground verification included representatives from the Commission, the Lower Platte South NRD, the City of Lincoln, the UN-L Entomology Dept., and the USFWS.

6.2. Need for Multiple Sites/Watersheds

Multiple sites in multiple watersheds are required for SCTB for several reasons. As referenced above, the FWS Recovery Plan's requirement for delisting is six self-sustaining metapopulations each numbering between 500 and 1,000 individuals and sustainability in at least four recovery areas. The identified areas include Commission properties in the Little Salt Creek and Rock Creek drainages. Six metapopulations are based on the historical distribution of the species. Suitable habitat for the SCTB occurs at small, discrete sites, in combination these small sites comprise metapopulations. Due to this small size, any one site has a limited carrying capacity for SCTB and therefore multiple small sites are required to meet the goal of six metapopulations. Multiple locations in multiple watersheds are also needed to prevent extinction due to large scale catastrophic events and to mediate local climatic and environmental fluctuations on a year to year basis in order to maintain the goal of self-sustaining populations of 500-1000 individuals.

6.3. Guiding Principles for Releases

The Commission will conform to the following Guiding Principles in conducting releases of the Salt Creek tiger beetle on Commission properties:

1.) The Commission will hold Public meetings (in accordance with State Statute 37-807.4) to present information to the public on the timing, location, possible impacts, assurance options, and other details regarding releases of SCTB on Commission property. Landowners with potential suitable habitat in the watershed will be contacted to inform them of the meetings.

2.) The Commission will use the best scientific information available to determine the appropriate dates, locations, and methods to maximize release success and minimize possible effects of releases.

3.) The Commission will contact and provide information on releases to adjacent landowners and landowners with potential suitable habitat in the watersheds who might be impacted by releases. This will include information on assurances to reduce and minimize any impacts through the use of programs such as Safe Harbor Agreements, Experimental Population designation, and other options. Commission staff will meet with landowners as requested.

4.) The Commission will continue to work with its partners to improve release practices as well as develop management and restoration practices that contribute to the establishment of self-sustaining populations in order to facilitate the delisting of the species. Partners include the Lower Platte South NRD, the City of Lincoln, Pheasants Forever, the USFWS, UN-L Entomology Dept., the Henry Doorly Zoo, and the Lincoln Children's Zoo.

6.4. Augmentation and Reintroduction

6.4.1. Augmentation vs. Reintroduction

Two terms are used to describe the release of SCTB for recovery purposes, augmentation and reintroduction. For purposes of this plan, augmentation is defined as the release of larvae and/or adult Salt Creek tiger beetle at a location already occupied by an extant population of wild Salt Creek tiger beetle or where a population has previously been established through reintroduction. Releases at these sites will be done for the purpose of supplementing existing populations in order to increase population size and long-term sustainability.

For purposes of this plan reintroduction, is defined as the release of larvae and/or adult Salt Creek tiger beetle at a location where a wild population of Salt Creek tiger beetle is considered to be extirpated (not observed for more than 15 years) or at a location where restoration activities have created suitable but previously unoccupied habitat. Releases at these sites will be done in order to establish self-sustaining populations at new sites in order to meet Recovery Plan goals.

6.4.2. Commission properties identified for the release of SCTB

Within the Little Salt Creek drainage, several recent evaluations have determined that, along with habitat currently occupied by extant populations of SCTB, unoccupied habitat capable of supporting SCTB also exists on properties owned by the Commission. The evaluations also determined that no habitat capable of supporting SCTB exists on private lands adjacent to properties owned or managed by the Commission. The Lower Platte South NRD owns Little Salt Springs Recreation and Little Salt Fork Marsh Preserve Recreation Areas which are adjacent to Commission property and have extant SCTB populations and suitable SCTB habitat. With their permission, releases have taken place on NRD property since 2014.

Within the Rock Creek drainage, the Commission owns property with habitat capable of supporting SCTB. The use of soil maps, aerial imagery, and ground

surveys have determined that there are a number of locations within the property that has habitat suitable for SCTB. The use of soil maps and aerial imagery has also identified several sites on private lands adjacent to the WMA that may be capable of supporting SCTB. Ground surveys have not yet been conducted to determine if suitable habitat does in fact exist at these sites. A number of these sites are enrolled in the NRCS Wetland Reserve Program which specifies the management of the site for saline wetlands and the recovery of listed species. The previously known occurrence of SCTB from the Rock Creek drainage is considered extirpated. There are currently no known extant populations of SCTB on Commission property in the Rock Creek drainage.

6.4.3. Releases Phases of SCTB on Commission property

The release of SCTB on Commission property are proposed to occur in four phases.

Phase 1.) The first phase is augmentation of existing populations on Commission property within the Little Salt Creek drainage.

Phase 2.) The second phase is reintroduction of SCTB on Commission property within the Little Salt Creek drainage.

Phase 3.) The third phase is reintroduction of SCTB on Commission property within the Rock Creek drainage.

Phase 4.) Restoration activities are planned on Commission properties both in the Little Salt Creek and Rock Creek drainages. After these restorations are complete, a reassessment of the properties will be completed and these sites may be opened as reintroduction sites.

6.5. Potential for Dispersal and Establishment of SCTB on Private Property

Only adult SCTB can disperse and they only live up to 6 weeks. Thus the potential timeframe for them to disperse is only during summer when adults are active. While SCTB are strong fliers their flights primarily cover short-distances of a few dozen yards when in pursuit of prey or seeking cover or water. There are only two recorded instances of SCTB moving longer distances. In both cases the distance moved by adult SCTB were less than ¼ mile. It is possible that adult SCTB may move distances greater than ¼ mile.

6.6. Potential Landowner Impacts

Private landowners would only be impacted by the release of SCTB if there were suitable SCTB reproductive habitat on their property and SCTBs were to establish reproductive populations on their property. Suitable SCTB habitat includes salt flat habitat that supports both adult foraging and reproduction activities such as egg laying and larval development. If an area does not have suitable habitat the area is not

considered supportive to the reproduction of the individual or species. If SCTB disperse to a site without suitable habitat, they will not establish a population and the dispersing individuals will soon leave or die. Thus if an adult SCTB temporarily lands on non-suitable habitat on private land there is no potential for impact to the private landowner.

Depending on the land use and land management activity there may or may not be an impact to a private landowner with a reproducing population of SCTB on their land. Normally, established activities are not considered to have an impact while new activities or projects may be more likely to have impacts.

6.6.1. Activities that do not impact private landowners with a population of SCTB on their property

Current land use activities related to ag production such as crop production, grazing, haying, etc. will not be impacted by the presence of potential suitable habitat or SCTB on private property.

Recreational activities such as hunting, fishing, etc. will not be impacted by the presence of potential suitable habitat or SCTB on private property.

Within the Rock Creek drainage, a number of sites with potential suitable habitat are currently enrolled in the NRCS Wetland Reserve Program. As part of the conservation agreement, these sites are managed for saline wetland habitat and the recovery of listed species and therefore there would be no impact to the landowner.

Activities undertaken by private landowners that do not require federal or state permits or do not receive state or federal funding are not impacted by the presence of potential suitable habitat.

6.6.2. Activities that may impact private landowners with a population of SCTB on their property

State and federal laws regarding endangered and threatened species have two main components related to impact of a listed species: prohibition on "take" and the requirement for consultation

- Take - SCTB are protected from intentional take.
  - Intentional "take" is prohibited (Take is defined as harass, harm. pursue, hunt, shoot, wound, kill, trap, capture, collect).
  - Actions that unintentionally kill or harm a listed species on private property are typically not prosecuted (for example, normal agricultural practices).
- Coordination - Activities or projects that are funded by or require a state or federal agency permit may require consultation.
  - Coordination with NGPC and/or USFWS to determine the potential impact to listed species of projects on private lands is required only if the project is funded by or authorized by (permit) a state or federal agency.

- Coordination may determine that the project will have no negative impact and can proceed as planned (it is important that coordination be started early in the development planning process).
- If the coordination determines that negative impacts may occur, modifications to the project may be required in order to avoid or minimize impacts.
- In nearly all cases, the project should be able to be modified so that it meets the landowner's objectives and does not harm the listed species. In cases where the project can't be suitably modified, mitigation measures may be used to offset the damage and allow the project to proceed.
- If a landowner wants to alter a saline wetland, a Corps 404 permit will likely be required and that will trigger consultation. The Corps is unlikely to grant a permit for a project that significantly degrades a saline wetland – even without any SCTB present at the site. When a site is identified as a wetland, the presence of wetland habitat would require permitting regardless if the site has potential suitable habitat for SCTB.

6.7. Options for Landowners

If a landowner has potential suitable habitat or currently has SCTB on their property there are potential options that will allow them to proceed with proposed projects.

6.7.1. Safe Harbor Agreement (SHA)

On a project by project basis the landowner can work with NGPC and/or USFWS to modify the project or provide mitigation. Again, this is only needed in cases where state/federal funds or permits are used.

- Safe Harbor Agreement
  - This is an Agreement between landowner and USFWS that allows an activity to proceed under agreed upon conditions. An SHA usually take 6-9 months to develop.
  - Under the Agreement, actions are undertaken by the landowner that will provide a net conservation benefit that contributes to the recovery of the species.
  - Surveys are completed to document the baseline status of the listed species on the landowner's property.
  - Under the agreement the landowner can continue the agreed upon management activities for the duration of the SHA.
  - Landowner has assurances that they will not need to change the agreed upon activities, even if the population size of the listed species increases on their property.
  - Landowner can return the property to the baseline condition at the end of the Agreement, if they so choose.

6.7.2. Designation of released SCTB as an experimental population

Experimental population is a designation that may be made by the USFWS for species that are released under certain criteria.

- Reintroduced populations of a listed species can be designated as experimental if the reintroduction is outside of the species current range but within its historic range.
    - USFWS determines if the experimental population is "essential" or "non-essential" to the continued existence of the species
    - Regulatory restrictions are considerably reduced for a "non-essential" experimental population (NEP). Restrictions remain the same for an "essential" population.
    - NEPs are treated as threatened, regardless of the original status of the species. This allows for more flexibility in the management of the released individuals.
    - A 4(D) rule can be developed for a threatened species that allows for a number of activities that may have otherwise been prohibited.
    - Regulations issued under a 4(D) rule are generally compatible with routine human activities in the reintroduction area.
    - The USFWS would need to determine which, if any, of the potential reintroduction sites are outside of the species current range (if none, then the experimental population designation is not applicable).
    - The USFWS would need to determine if the reintroduction outside the current range would qualify as a "non-essential" population.

6.8. Outreach to Landowners

The Commission will hold public meetings to present information to landowners on the date, location, possible impacts, assurance options, and other details regarding releases of SCTB on Commission property. Landowners adjacent to Commission properties will be contacted to inform them of the meetings. The Commission will contact and provide information on releases to adjacent landowners and landowners with potential suitable habitat in the watersheds who might be impacted by releases on Commission properties. This will include information on assurances to reduce and minimize any impacts through the use of programs such as Safe Harbor Agreements, Experimental Population designation, and other options. Commission staff will meet with landowners as requested.

7. Habitat Restoration and Management for SCTB on Commission Property

The presence of SCTB, or the releases of SCTB, on Commission properties will not restrict the multiuse purposes of the properties. Recreational uses such as hunting, fishing, trapping, bird watching, hiking, etc. will not be restricted.

Numerous habitat restoration and management projects have been implemented in the past on Commission owned properties in order to restore and improve saline wetland habitat for the variety of services they provide including habitat for wildlife. Overall saline wetland habitat restoration and management activities are likely to continue. However, in order to meet the Recovery goal of sustainable populations, restoration projects will need to be undertaken to provide habitat in sufficient amount for sustainable populations. Meeting these goals means

that restoration and management projects need to focus on providing specific SCTB reproductive habitat not just saline wetland habitat. Once the habitat is restored, it and existing habitat will need to be managed to maintain SCTB populations.

7.1. Habitat Restoration

A key to the recovery of the SCTB is the availability of sufficient suitable habitat to meet the requirements of the Recovery Plan. Due to the loss and degradation of habitat it is necessary to undertake restoration activities to increase the availability of suitable habitat. The goal of habitat restoration for the SCTB is to restore reproductive habitat. This is done through restoring saline ground water hydrologic function to create saline seeps and exposed salt flats as parts of saline wetlands. Along with the Lower Platte South NRD, the City of Lincoln, and Pheasants Forever, the Commission is part of the Saline Wetland Partnership. The Partnership works to protect, restore, and manage saline wetland habitat.

7.1.1. Restoration projects

In the past several years, restoration projects have been undertaken on properties owned by the City of Lincoln, the Lower Platte South NRD, and Pheasants Forever. It is anticipated that restoration projects will be designed and implemented on Commission properties in the future. Project designs have included the creation of "pull backs" along Little Salt Creek to create suitable habitat by exposing saline soils and seeps, and creating terraces along stream channels to create habitat by removing silt deposits that have buried saline soils. Water control structures to block drains and sediment removal are other restoration techniques that if done properly can provide habitat for the SCTB. The most recent project on NRD property is designed to create saline flats by pumping highly saline ground water and spreading it on the surface of saline soils. Future projects may include the use of weirs to increase ground water levels in the floodplain along stream channels to maintain and restore surface saline seeps.

7.1.2. Project design and development

Restoration projects use the most current and best available information along with expert knowledge to design and develop a project tailored to the specific conditions of a site. Saline wetland specialists, SCTB habitat experts, saline hydrologist, landscape designers, and habitat managers are all included in the design and development of a restoration project. Project design participants include representatives from the Lower Platte South NRD, the City of Lincoln, the UN-L Entomology Dept., UN-L hydrologists, private design consultants, and the USFWS. Commission representatives include SCTB experts, wetland biologists, and area managers. Current projects utilize knowledge gained from previous projects to refine design aspects of previous projects and incorporate new approaches.

7.1.3. Planning and implementation

Once a site is selected, the project goes through several design steps. A core team of Partnership representatives, area managers, and experts decide on a restoration approach specific to the site and restoration goals. A consulting firm is then hired to develop initial design plans, which are then reviewed plans by the core team and the next step of design is developed. Depending on the site and ownership, a public meeting may be held to receive comments and all adjacent landowners are given the opportunity to review draft plans and provide their input. Experts are solicited to review and submit input and a draft final design is developed based on review comments. The final design is reviewed and approved and required permits are obtained. A firm is then contracted to build the on-ground project, and a contractor is hired to build the project.

7.2. Management

The key to sustainable populations is maintaining suitable habitat which is dependent on management. Managing existing and restored habitat for the SCTB can be challenging. The modification of hydrologic regimes have led to the loss of ground water systems that historically maintained larger and more resilient habitat tracts. These systems supported numerous seeps of highly saline ground water which maintained complexes of salt flats. These large tracts also experienced grazing by herds of bison, elk, deer, and pronghorn which helped to reduce vegetation and maintain the open salt flats. Today's ground water modifications have drastically reduced saline seeps and the available area of saline flats. Changes to land use and invasive vegetation threatens an ever greater percentage of saline habitat.

7.2.1. Grazing

Grazing is a valuable tool in managing vegetation, however, due to the very small size of current salt flats the use of grazing at sites with small, extant SCTB populations can be problematic. Grazing can be an effective tool to control encroachment of aggressive vegetation when done at appropriate stocking rates and times and with the use of enclosures to prevent damage to larval habitat of salt barrens and seeps along stream banks. The salt flat habitat used by SCTB larva for their burrows is moist, soft soil. Grazers moving though this habitat can compress the surface soil to the extent that larvae may not be able to dig new openings or the grazer can sink in to the point where the larva may be crushed. Historically larger salt flats provide a level of resilience not present at most sites currently occupied by SCTB. While some larvae would have been killed by the impact of grazers, there were large enough numbers of SCTB to recolonize the site the following year. The overall effect of grazing was to create and maintain a sufficient amount of habitat to support sustainable SCTB populations.

The very small size of current SCTB larval habitat means that these sites have lost that resilience. Even a small amount of trampling can impact enough habitat that a large percentage of larvae can be killed. If this happens it means that there are would not be enough SCTB produced to recolonize the impacted habitat and the

population declines and can be extirpated. To reduce the impact of grazing, fencing can and has been used to prevent impact by grazers at sites with limited habitat. While this is useful to prevent the immediate impacts of grazing, the long-term management needs are to use additional management tools and restoration in combination to create larger habitat areas that can be managed under regimes that will restore resilience to the site.

Additional information is needed to understand the full impacts of grazing on SCTB and for use in developing management regimes that benefit SCTB habitat while not causing long-term detrimental impacts to populations. In the interim, grazing should continue to be used as a tool to manage vegetation. Fencing, stocking rates, and other management practices should be used to exclude or direct animals away from areas identified as most vulnerable to trampling impacts.

7.2.2. Herbicide use

For small sites or sites where grazing cannot be implemented, such as steep creek banks, the use of herbicide may be an alternative. Test use of herbicides applied by hand spraying has shown success in killing encroaching vegetation. In order for spraying to be successful it must be done in at least three consecutive years. Spraying the first year will kill the majority of vegetation. Spraying is then required for two more consecutive years to maintain open habitat during the two-year larval development period. Spraying is done in the fall after the first frost when the larvae are less active and in closed burrows and to avoid impact to the State listed, endangered saltwort. Hand spraying is very labor intensive but herbicide can be applied by larger capacity sprayer from a tractor or ATV. In the fall of 2017 the City of Lincoln tested herbicide application by helicopter. Initial results have indicated the method has good potential. This application is cost effective and can be applied with relative accuracy.

Herbicides used for SCTB habitat management must be approved for use in and around wetlands. The Commission has developed a list of herbicides and surfactants that are approved for use on saline wetland habitat and around SCTB. This includes timing recommendations to avoid impact to the listed saltwort.

7.2.3. Other methods

Prescribed burning has limited but still useful application in management for SCTB. Traditional use of prescribed burning is for periodic fire to remove litter and recycle nutrients. In the situation of salt flats, the vegetation is normally too thin to carry fire. Prescribed burning can be used after herbicide application to remove dense, dead vegetation that has encroached on salt flats and thus open up the substrate for use by SCTB.

Tilling also can be used to control vegetation and open up substrate on areas that are not occupied by larvae burrows and adult SCTB. Tilling should be conducted when the site is dry enough to prevent ruts from being created and preferably in

the fall in order to provide time for the loosened soil to re-settle into a uniform surface usable by adults for egg laying and larval burrow building.

7.3. Management Implementation

The implementation of management practices for SCTB should be done following an assessment of a site. The assessment should determine the use of the site by SCTB and identify the management issues needed to restore, create, and maintain habitat. Management practices should be coordinated with those on adjacent sites in order to maintain overall area resilience and ensure SCTB population stability. In many cases management practices may need to be implemented in sequence over the course of several years in order to achieve the desired objectives. Grazing regimes should be planned over a multi-year period to consider the interval needed to create and maintain open substrate and identify sites that require fencing on a year to year basis to prevent trampling. Management practices such spraying by helicopter can be coordinated with other management entities such as the LPS NRD and City of Lincoln to minimize costs. It is important to ensure that once management objectives are reached the habitat must be maintained for a minimum of two years to match the SCTB larvae development cycle and be useful as reproductive habitat for SCTB.

8. Monitoring

Monitoring provides information on the fate of individuals released into the wild and the success of reintroduction methods. It provides valuable data on conditions contributing to the success or failure of releases. Monitoring will also be used to determine when the population of a site has stabilized over time indicating the site has reached its carrying capacity.

8.1. Monitoring Release Success

Determining the fate of released adults is very challenging. A pilot study was conducted in 2017 to test and identify issues in using marked adults to determine release success. In the study, captive reared adults were marked using different paint colors prior to release. Surveys were then conducted over time to record the number of observed marked animals. This data could then be used to determine survival. Design issues were identified from the study and recommendations developed. In order for a full study to be successful, it needs to be conducted at a large enough location, preferably with no existing adult SCTB population, so the marked individuals are easily observed and can be counted, even in the event the marking paint comes off. Due to the difficulty in observing adult SCTB, the site needs to have large, open salt flats so adults can be more easily observed and not have quick access to dense vegetation in which to hide. Larger numbers of adults need to be released at one time in order to obtain adequate sample size for statistically significant results. Counts of marked individuals need to be at a minimum of two day intervals and by a minimum of two individuals to obtain accurate data. There are several habitat sites on Commission property with the size and unoccupied condition that would be highly suitable for conducting this type of study.

8.2. Annual Population Monitoring

An annual survey for the SCTB was begun in 1991by the University of Nebraska-Lincoln and has been conducted every year since. The annual survey is crucial to determining the current population status and trends over time. The population numbers of the Salt Creek tiger beetle in the wild are very low, with extant populations at only a few active sites. The status of the sites and the number of individuals in a population can change significantly in the course of a year. Understanding the current population status and distribution of Salt Creek tiger beetle is essential for determining threats to the populations and changes in habitat condition. This information can identify when conditions may require immediate action to ensure the survival of the species. Monitoring in previous years has detected the significant decline in both the number of populations and individuals. This in turn identified the need to initiate captive rearing of beetles in order to prevent potential extinction and provide individuals for reintroduction. Comparing the baseline, pre-release population numbers, to post-release population numbers can also be used to assess release success. Therefore, conducting annual surveys of Salt Creek tiger beetle populations is crucial to determining the current status of populations and changes in distribution of the SCTB. Monitoring can also be used to evaluate the effectiveness of restoration and management activities. The annual census is conducted at all locations with extant populations and at sites known to have been occupied in the past. Counts of individuals at any one site are conducted several times during the period when adults are active with the highest number of adults observed representing the count for the year.

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