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NOTES

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Nebraska's Endangered Species Part 1: Introduction and the Insects

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There is now an ongoing, unprecedented loss of species diversity throughout the world as well as a decline in the absolute numbers of organisms from the smallest microorganism to the largest mammal. The current loss of biota has several causes. One is the destruction, conversion, or degradation of entire ecosystems with the consequent loss of entire assemblages of species. Another is the accelerating loss of individual species within communities or ecosystems as a result of habitat disturbance, pollution, and exploitation. Third, and more subtle, is the loss of genetic variability. Selective pressures such as habitat alteration, the presence of chemical toxins, or regional climate changes may eliminate some genetically distinct parts of the population, yet not cause extinction of the entire species.

This is the first of several issues of Museum Notes that will discuss Nebraska's Endangered and Threatened species. Future issues will deal with fish, birds, amphibians, reptiles, mammals, and plants. As a prelude to this series of Museum Notes, we might ask "what does it mean to be Endangered or Threatened?" As defined by the Endangered Species Act of 1973, the term 'endangered species' means any species that is in danger of extinction throughout all or a significant portion of its range. Excluded from this definition would be any insect species determined to constitute a pest whose protection under the provisions of this Act would present an overwhelming and overriding risk to man. A 'threatened species' is any

species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range. Before a plant or animal species can receive protection under the Endangered Species Act, it must first be placed on the Federal list of endangered and threatened wildlife and plants. This listing program follows a strict legal process to determine whether to list a species depending on the degree of threat facing it.

When Congress passed the Endangered Species Act in 1973, it recognized that many of our nation's native plants and animals were in danger of becoming extinct and that our rich natural heritage was of "esthetic, ecological, educational, recreational, and scientific value to our Nation and its people." The purposes of the Act are to protect these endangered and threatened species and to provide a means to conserve their ecosystems. The Act is regarded as one of the most comprehensive wildlife conservation laws in the world.

As of 31 December 2001, 1,812 species are listed, of which 1,260 are U.S. species. The list covers mammals, birds, reptiles, amphibians, fishes, snails, clams/mussels, crustaceans, insects, arachnids, and plants. According to the U.S. Fish and Wildlife Service, there are 517 U.S. species of animals and 743 U.S. species of plants that are endangered and threatened. There are currently 30 U.S. species of animals and seven U.S. species of plants being proposed for listing. There are an additional 117 species of animals and 140 species of plants proposed as candidate species. The law's

ultimate goal is to "recover" species so they no longer need protection under the Endangered Species Act. The law provides for recovery plans that entail the measures needed to restore a species to health. At present, there are 999 species that have approved recovery plans.

There are many websites devoted to endangered species. Among the most comprehensive are those of the U.S. Fish and Wildlife Service (<http://endangered.fws.gov/>), the World Wildlife Fund (<http://www.worldwildlife.org/species/species.cfm>), and the Endangered Species Link (<http://eelink.net/EndSpp/endangeredspecies-mainpage.html>).

In Nebraska, there are (October 2002) six Federally listed endangered species and two threatened species of animals and one endangered species and three threatened species of plants. The state of Nebraska list generated by the Nebraska Game and Parks Commission includes 11 endangered species and seven threatened species of animals and one endangered species and two threatened species of plants. Additional information about these can be found at the website for the Nebraska Game and Parks Commission (<http://www.ngpc.state.ne.us/wildlife/ngthreat.html>).

Why worry about one insect or tiny fish or inconspicuous plant that most of us have never seen? The World Wildlife Fund perhaps said it best: "All that lives beneath Earth's fragile canopy is, in some elemental fashion, related. Is born, moves, feeds, reproduces, dies. Tiger and turtle dove; each tiny flower and homely frog; the running child, father to the man and, in ways as yet unknown, brother to the salamander. If mankind continues to allow whole species to perish, when does their peril also become ours?"

The American Burying Beetle

The American burying beetle, *Nicrophorus americanus* Oliver, is a member of the carrion beetle family Silphidae. Carrion beetles, as their name implies, are an important part of a vast host of scavengers that are responsible for recycling decaying materials back into the ecosystem. They are also referred to as burying beetles or sexton beetles. There are 570 species of silphids found worldwide, and 31 of them occur in North America. There are 18 species in Nebraska.

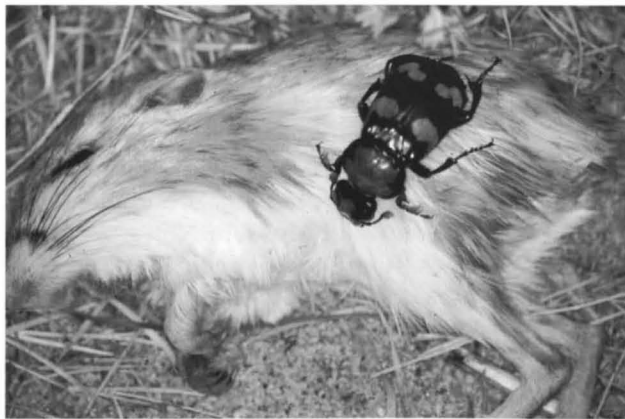
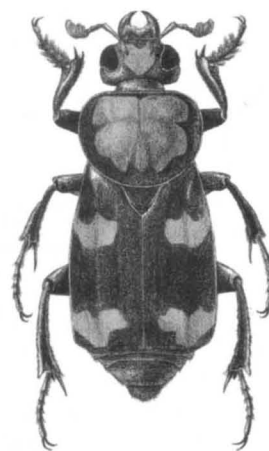
The American burying beetle is the largest carrion-frequenting insect in North America; it may reach a length of 1.5 inches. Like many other carrion beetles in the genus *Nicrophorus*, it is shiny black and distinctively marked with two bright orange bands on each wing cover. While Nebraska has 11 species of *Nicrophorus*, only the American burying beetle has the orange pronotum, and so it can be readily distinguished from the other, more common species.

The American burying beetle has been recorded historically from at least 150 counties in 35 states in the

eastern and central United States, as well as along the southern fringes of Ontario, Quebec and Nova Scotia in Canada. In the last century it has disappeared from over 90% of its historic range. Collecting records indicate that east of the Appalachian Mountains the American burying beetle 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 peripheries of the range. Throughout the 1990s, numerous surveys were conducted in many states to locate remnant populations of the endangered American burying beetle. The beetle now occurs in only six states: Block Island off the southern coast of Rhode Island, Massachusetts (reintroduction) eastern Oklahoma and western Arkansas, central Nebraska, southern South Dakota, and southeastern Kansas. It was proposed as an endangered species in 1988 and was placed on the federal endangered species lists in August 1989.

The earliest record for the American burying beetle in Nebraska is 1921, although it undoubtedly occurred here before that time. They were again collected in 1957 and have now been sporadically recorded since the 1990s. The westernmost North American record for the American burying beetle is near North Platte, Nebraska. The most recent sightings (1992-2001) in Nebraska are from central Nebraska. The available information suggests that this species occurs primarily in undisturbed areas in the central third of Nebraska.



Adult *Nicrophorus americanus* on a dead kangaroo rat in west central Nebraska. A pair of adults will bury the carcass and prepare it for their future brood. Photo by M.L. Jameson.

or not well-known. His search led him to the eastern Nebraska saline marshes near Lincoln and specifically to the Capital Beach area to search for *Cicindela nevadica lincolniana*. Along with Steve Spomer from UNL, Mark searched several of the remnant salt marshes but found very few beetles and concluded that they were now quite scarce and might warrant protection.

In 1991, Spomer began an intensive survey to determine the distribution and abundance of *C. nevadica lincolniana*. With the help of personnel from the Nebraska Game and Parks Commission's Natural



Heritage Program, he located additional sites for the beetle, the largest population being found on Little Salt Creek. Thus, Steve and Leon Higley (Department of Entomology, UNL) coined the term "Salt Creek tiger beetle" for *C. nevadica lincolniana* because the beetle was encountered predominantly in

the Salt Creek watershed. Several methods of population estimates were used, including daytime counts of adult beetles, UV (blacklight) counts at night, and mark-release-recapture of adult beetles. Highest estimates were produced from daytime visual counts.

Several additional, small populations have been located, mostly along Little Salt Creek. Other sites where Salt Creek tiger beetles were *not* found included Salt Creek proper, the Burlington yards in west Lincoln, and Rock Creek near Ceresco. Population estimates have continued yearly, and new sites have been surveyed for presence of Salt Creek tiger beetles. Estimates have ranged from under 200 beetles in 1993 to nearly 800 beetles in 2002.

Adults of *C. nevadica lincolniana* appear as early as the end of May or as late as mid-June and disappear by mid- to late July (*i.e.*, they are active for about 5 or 6 weeks). The Salt Creek tiger beetle is found almost exclusively on the wettest, salt-encrusted soil, usually along creeks and ditches with running water. Apparently once abundant (based on our museum records), destruction of habitat has been detrimental to populations. Populations peak about two weeks after the first individuals appear. Adults mate throughout their life and may mate multiple times. After mating, the male rides atop the female, presumably to prevent her from immediately re-mating and so ensuring his paternity (mate-guarding).

Eggs are laid along the salty, muddy banks of Little Salt Creek where the soil is sloping. As the egg hatches, the young larva digs a burrow by using its head to scoop out soil. It takes these small "mud clots" to the burrow entrance and flips them outside the hole. They do not leave their burrow under normal circumstances but often wait at the burrow entrance to ambush small arthropods. When a suitable victim is near, the larva attacks with lightning speed. It throws its head (usually backward) to grab the prey with its sickle-shaped jaws. Then, it pulls the prey down into the burrow to devour it. Somewhat like a spider, larvae secrete digestive enzymes to help break down their food before ingestion. Tiger beetle larvae are unique in that they have hooks located on the back of their abdomen to anchor them to the side of the burrow while they subdue large prey. As the larva grows, it molts to a larger stage, or instar, and enlarges and lengthens its burrow. Tiger beetles have three instars. The Salt Creek tiger beetle probably overwinters as a third instar larva.



Larva of the Salt Creek tiger beetle. Photo by S. Spomer.

Before pupation, the larva seals its burrow entrance and digs a side chamber about 2-3 inches below the soil surface. After the adult emerges from the pupa, it remains in the chamber for a length of time while its cuticle hardens. Adult Salt Creek tiger beetles prefer the wetter areas of the salt marsh, like the edge of temporal ponds or seeps along the creek bank, in contrast to the three other species of salt-marsh endemic tiger beetles that prefer the drier "flats". Often subjected to high temperatures on the salt flats during the summer, adults regulate their temperature by altering their behavior. This includes seeking wetter areas, digging burrows, hiding in the shade, or using their long legs to stilt themselves as far above the soil surface as possible. Although tiger beetles are cold blooded (like all invertebrates), these behaviors give tiger beetles some control over their body temperature and help them avoid lethal temperatures on the very hot salt flats during the summer.

The Salt Creek tiger beetle is in direct competition for prey with the Common Shore tiger beetle, *Cicindela repanda*, although populations of the two species peak at different times. They may also use different soil types or strata when choosing sites to lay eggs along the creek banks. Like all tiger beetles, the Salt Creek tiger beetle is a visual predator and must rely on what appears to be a very limited food supply. Adults feed on just about anything they can see and catch, including invertebrates that may be larger than themselves. Tiger beetles eat adult flies, maggots, soft-bodied larvae, and probably worms and nematodes. Tiger beetle larvae are even more directly affected by the food supply because they almost never leave their burrow and must wait until some unsuspecting prey stumbles near their burrow. A limited food supply may prolong their development for a year. Conversely, Salt Creek tiger beetles are eaten by large robber flies (family Asilidae). Other potential or presumed predators include birds, spiders, predatory bugs, and other tiger beetles. Large dragonflies might also catch and eat tiger beetles, and mites are also known to parasitize tiger beetles.



Pupa of the Salt Creek tiger beetle. Photo by S. Spomer.

The largest threat to the Salt Creek tiger beetle (and most endangered insects) is habitat destruction. Lincoln is growing northward, and current tiger beetle populations are quickly being surrounded by housing developments and businesses. Because the Salt Creek tiger beetle is so intimately associated with the eastern Nebraska saline wetlands, any habitat loss will be detrimental to the beetle. Other factors that may affect the Salt Creek tiger beetle are pesticide runoff from increased urbanization, fresh water contamination of the salt basin, and light pollution. Flooding may be detrimental to populations of Salt Creek tiger beetle, especially larvae. Prolonged drought may impact prey populations, which may then lead to high tiger beetle mortality rates.

In 2001, the Salt Creek tiger beetle became the second insect to be included on the Nebraska Endangered Species list. Unfortunately, this status provides minimum protection for the beetle, preventing



A male Salt Creek tiger beetle (on top) mate-guarding a female after mating. In this way, the male guards his reproductive resource from other males. Photo by S. Spomer.

only "take," exportation, and possession of the beetle and mandating that any projects that have state money involved need a state permit, or studies that are conducted by a state agency must be reviewed by the Nebraska Game and Parks Commission to determine their impact on the species. Currently, the Salt Creek tiger beetle is a candidate species for listing under the Federal Endangered Species Act.

As with most endangered species, the Salt Creek tiger beetle's status reflects more than injury to one species. Rather, it reflects the damage and continuing threats to the eastern Nebraska salt marsh habitats. These unique areas are declining almost annually due to human activities. However, future wetland enhancements and restorations may provide the means for increased population growth by the beetle. Introductions of the Salt Creek tiger beetle into restored sites or sites where it does not currently live may also be feasible. By encouraging public awareness, appreciation, and action, and by working with federal, state, and local governments, we can yet preserve one of Nebraska's rarest resources, the eastern Nebraska salt marsh.



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