Initiation of a Butterfly Monitoring Program at the Tallgrass Prairie Preserve, Osage County, Oklahoma

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A butterfly monitoring program was initiated in 1993 at the Tallgrass Prairie Preserve, Osage County, Oklahoma. This is a long-term study that should allow preserve managers to evaluate the effects of prescribed burning, bison (*Bison bison*) grazing, and possible future environmental threats to the biota of the preserve. It is predicted that within a 5-year period (to account for strays and rare migrants) 130 species of butterflies will be documented at the preserve. Thus far, 74 have been found. Within the butterfly indicator assemblage, certain butterflies [identified as native remnant-dependent or native remnant-associated (r-d/r-a)] are more sensitive to environmental degradation. Thirty-one species of r-d/r-a species have been predicted to occur on the preserve. Thus far, 18 have been found. Informal inventory surveys were conducted approximately bi-monthly from May through October 1993 and resumed in March 1994. Also, starting in March 1994, nine butterfly census routes were walked by trained volunteer butterfly monitors.

INTRODUCTION

The 36,000-acre Tallgrass Prairie Preserve (TGPP), owned and managed by The Nature Conservancy (TNC), is in north-central Osage County, Oklahoma with a center point lying approximately in T27N R8E Section 13 EIM. The TGPP was rested from fire and grazing for two years before reintroducing both prescribed burning and cattle grazing in 1993. In October 1993, a herd of 300 bison (*Bison bison*) was released into a 5,000-acre tract on the preserve, with the goal of eventually having 2,000 bison freely grazing over approximately 30,000 acres of the preserve. This management use of bison grazing and prescribed burning is designed to produce the mosaic of habitats believed to be characteristic of a functioning tallgrass prairie/cross timbers landscape in that area. The TGPP can be considered a large fragment of a once widespread, but now defunct, ecosystem. It is the goal of TNC to restore the TGPP to pre-settlement condition complete with the evolutionary forces that sculpted the tallgrass prairie.

Animals account for 75% of all species on prairie remnants, and 95% of these animals are insects (*1*). Also, there is extensive literature documentation illustrating arthropod dominance of terrestrial ecosystems at the levels of species, individuals, and biomass (*2*). Because of this dominance and the significant and varied roles arthropods play in ecosystems, they should be monitored by land stewards who are actively managing preserves. Their short life spans can give relatively quick assessments of the impacts of prescribed burning and grazing on terrestrial insects (*2*, *3*), especially those that winter above ground and only have a single generation per year (*3*). Also, many arthropod taxa could be used as indicators for systems that no longer support vertebrate indicator species (*2*).

Because of the enormous number of arthropod species and the difficulty in identifying many of them, it is impractical to monitor all terrestrial arthropods. Panzer (unpublished table) has assessed the butterflies as indicators for terrestrial insect groups. While no single taxon can give truly precise information for all other arthropods and tallgrass prairie organisms, butterflies rank as the best indicator group for several reasons. Butterflies are large, relatively easy to identify, ecologically well known, exhibit high population turn-over, and usually occur in small enough numbers to be easily censused. They are attractive and increasingly popular creatures which can draw enthusiastic volunteer monitors (*4*).

Censusing actual butterfly populations is difficult on 2 to 10-acre sites and logistically impossible on 36,000 acres (*3*, Panzer

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pers. comm., 1993). Therefore, a method of assessing relative abundance is necessary. We have instituted the transect method or permanent census route which was originally proposed in 1975 (*5*) and supported by others (*1, 4, 6,*). The data collected by using this method can be manipulated to reveal changes in relative abundance of individual species or arbitrarily designated groups of species. Since butterflies are being used as indicators of overall tallgrass prairie health, we wanted to determine those species most sensitive to ecosystem degradation. Panzer (*1*) calls these species native remnant-dependent/remnant-associated (r-d/r-a) and defines them as those species which are restricted to or closely associated with native prairie remnants.

The management plan of the TGPP poses a methodological problem to designing a feasible monitoring program in that much of the preserve is managed under a semi-random burn policy. Since bison will often preferentially graze in post-burn areas (*7*), both the occurrence of fire and bison grazing cannot be predicted with accuracy.

METHODS

The literature was reviewed to predict the butterfly species that were likely to be present at the TGPP as residents, temporary colonists, or strays. This review relied on field guides (*8-10*), butterfly records for Oklahoma (*11*) and data derived from the network of Natural Heritage Programs through the central Biological Conservation Database obtained from the Eastern Regional Office of TNC. From this review, I predict that approximately 130 species could be documented at the TGPP over a five-year period. Nelson (pers. comm., 1994) believes 100 of the 166 documented Oklahoma species would be a more likely estimate. A r-d/r-a species list was compiled, but should be considered preliminary. This list was based on a list for Illinois prairies (*1*). I omitted some butterflies from the list owing to lack of a significant distribution and added some owing to complex life histories or noted close associations with tallgrass prairie. Informal inventory surveys were conducted approximately bi-monthly from May through October 1993 to determine species absence or presence. Informal inventory surveys continued in 1994 coupled with transect (or census route) surveys beginning in March and continuing through October. This time frame was established because most temperate regions appear to have three peaks in butterfly abundance and diversity occurring in spring, summer, and fall (Panzer, pers. comm. 1993). Butterflies can have significant activity in late October at TGPP (Arenz, unpublished data) and early April butterfly emergence is not uncommon for Missouri butterflies (*8*).

Butterfly census route sites were selected to represent a diversity of soil and vegetation types, exposures, and management regimes on the TGPP. Routes were designed to cross ecotones and communities and averaged between 0.75 and 1.0 miles in length. Nine census routes were mapped by compass, topographical map, and a distance-measuring wheel to ensure the year-to-year repeatability of the surveys. More routes will be set up as volunteer support grows.

Volunteer monitors were trained in February, 1994 and were usually accompanied by TNC staff members while walking their routes. Transect survey methods followed that of others (*1, 4, 12*) with monitors walking their route under the following conditions: less than 50% cloud cover, light to moderate winds, censusing approximately between 10 a.m. and 3 p.m., recording only those butterflies seen within a 5-m corridor, and walking at a pace that was consistent for each monitoring visit. Consistency was stressed since individual variation in monitoring style was the only true problem found with this type of program (*4*). Monitors were trained to identify most butterflies expected on the preserve and recorded the species and number of individuals observed within the 5-m corridor. The total number of individuals per unit time of each species seen within each habitat type on a given day could then be compared with the number seen on another day on the same or another route. Physical and vegetational changes along the route were also recorded to correlate both disturbance and vegetation growth/flowering with butterfly abundance, emergence, and/or diversity.

Starting with the 1995 field data, population indices will be calculated. Wildlife

population indices are usually compiled separately for each species (*13*). A population index (*I*) will be calculated for each r-d/r-a species for each butterfly route and should be calculated for other Lepidoptera as well. The calculation follows that of Thomas (*14*):

$$I = 300\ N\ A\ /\ L$$

where *N* represents the number of individuals seen in a given flight area *A* on a given butterfly route with length *L*. Multiplication by 300 standardizes the index for 300 feet. See Thomas (*14*) for justification. The butterfly population indices calculated with 1995 data will be used initially as the reference base for determining changes in the relative abundance of individual species from year to year. Percent change *P* in relative abundance can be calculated by dividing the difference between the base year index *BI* and the current index *CI* by the base year index *BI* (*13*):

$$P = 100\ (CI - BI)\ /\ BI$$

Since TNC is mostly interested in multi-year trends, year-to-year comparisons are not always suitable. Graphing the multi-year index data is the appropriate solution. However, if 1995 is an atypical year for r-d/r-a butterfly abundance, the differences between index numbers will be exaggerated or dampened. Crawford (*13*) found that plotting on a logarithmic scale removed the effects of reference-base bias when comparing index data from one site. When comparing index data from several sites, as on TGPP, reference-base bias still arises. Crawford (*13*) suggests using a mean index number for each site rather than a common reference base year for all sites.

RESULTS AND DISCUSSION

This long-term monitoring project is designed to answer questions concerning bison grazing, prescribed burning, and indicate overall butterfly population trends at TGPP. From the data for 1.5 seasons, only the most general comparisons between 1993 and 1994 can be made. For example, differences were noted in butterfly emergence dates, species were noted in spring 1993 and not in spring 1994, etc., but these observations could and likely do have a variety of causes. Also, insect populations do experience normal fluctuations in population density that 2 years of data cannot resolve.

The general inventory work of 1993 and 1994 (through June 30, 1994) resulted in the documentation of 74 species of butterflies occurring on the TGPP (Table 1). Eighteen of these species are members of the 31 species believed to be r-d/r-a butterflies at the TGPP and are so indicated. The locations of the r-d/r-a species were annotated on topographical maps for future reference.

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15. Collated List of English Names for North American Butterflies. *American Butterflies*. May (1994) pp. 28-35.

TABLE 1. Butterflies and Skippers Seen at The Tallgrass Prairie Preserve, Osage Co., Oklahoma

Species[a]	Common Name
Superfamily **Papilionidea**	
Anaea andria	goatweed leafwing
Anthocharis midea	falcate orangetip
Asterocampa celtis	hackberry emperor
Battus philenor[b]	pipevine swallowtail
Calycopis cecrops	red-banded hairstreak
Celastrina ladon	spring azure
Cercyonis pegala[b]	common wood nymph
Chlosyne gorgone[b]	gorgone checkerspot
Chlosyne nycteis[b]	silvery checkerspot
Colias cesonia	southern dogface
Colias eurytheme	orange sulphur
Colias philodice	clouded sulphur
Cyllopsis gemma	gemmed satyr
Danaus plexippus	monarch
Enodia anthedon	northern pearly eye
Euptoieta claudia	variegated fritillary
Eurema lisa	little yellow
Eurema nicippe	sleepy orange
Eurytides marcellus	zebra swallowtail
Everes comyntas	eastern tailed-blue
Feniseca tarquinius	harvester
Hemiargus isola	Reakirt's blue
Junonia coenia	common buckeye
Leptotes marina	marine blue
Libytheana carinenta	American snout
Limenitis archippus	viceroy
L. arthemis astyanax	red-spotted purple
Lycaena xanthoides[b]	great copper
Megisto cymela	little wood satyr
Nathalis iole	dainty sulphur
Nymphalis antiopa	mourning cloak
Papilio cresphontes[b]	giant swallowtail
Papilio glaucus	E.[c] tiger swallowtail
Papilio joanae	Ozark swallowtail
Papilio polyxenes	black swallowtail
Papilio troilus	spicebush swallowtail
Parrhasius m-album	white m-hairstreak
Phoebis sennae	cloudless sulphur
Phyciodes tharos	pearl crescent
Polygonia interrogationis	question mark
Satyrium calanus	banded hairstreak
Satyrium edwardsii[b]	Edward's hairstreak
S. favonius ontario	northern hairstreak
Satyrium liparops[b]	striped hairstreak
Speyeria idalia[b]	regal fritillary
Strymon melinus	gray hairstreak
Vanessa atalanta	red admiral
Vanessa cardui	painted lady
Vanessa virginiensis	American lady
Superfamily **Hesperioidea**	
Achalarus lyciades	hoary edge
Amblyscirtes nysa	nysa roadside-skipper
Amblyscirtes vialis[b]	cmn[c] roadside skipper
Ancyloxypha numitor	least skipper
Atalopedes campestris	sachem
Atrytone arogos[b]	arogos skipper
Atrytone logan	delaware skipper
Atrytonopsis hianna[b]	dusted skipper
Epargyreus clarus	silver-spotted skipper
Erynnis juvenalis[b]	Juvenal's duskywing
Erynnis horatius[b]	Horace's duskywing
Euphyes vestris	dun skipper
Hylephila phyleus	fiery skipper
Pholisora catullus	common sootywing
Poanes hobomok[b]	hobomok skipper
Poanes zabulon	zabulon skipper
Polites origenes[b]	cross-line skipper
Polites themistocles	tawny-edged skipper
Pompeius verna	little glassywing
Pyrgus communis	cmn[c] checkered skipper
Staphylus hayhurstii	Hayhurst's scallopwing
Thorybes bathyllus[b]	southern cloudywing
Thorybes pylades[b]	northern cloudywing
Thorybes confusis	confused cloudywing
Wallengrenia egeremet	northern broken dash

a The nomenclature used in this table for both common and scientific names is taken from the North American Butterfly Association's Standing Committee on English names [see (15)].

b Species identified to be native tallgrass prairie remnant-dependent or remnant-associated.

c E.=eastern; cmn=common.